FOODS
PROCURED,
NUTRITIONAL
STATUS &
DIETARY
INTAKE

OF PEOPLE LIVING IN SOUTH AFRICA

DESKTOP REVIEW

health
Department:
Health
REPUBLIC OF SOUTH AFRICA

RESPICE PROSPICE
UNIVERSITY *of the* WESTERN CAPE

2030 NDP

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25(OH)D	25-hydroxyl vitamin D
AGP	Alpha-1-acid glycoprotein
AI	Adequate intake
A/I	Asian Indians
A-NU	African non-urban
AMDR	Acceptable macronutrient distribution range
A-U	African urban
B	Black Africans
BIA	Bioelectrical impedance analysis
BFAP	Bureau for Food and Agricultural Policy
BMD	Bone mineral density
BMI	Body mass index
Bto20	Birth-to-20 cohort
C	Coloured (mixed race)
CCHIP	Community Childhood Hunger Identification Project
CDC	Center of Disease Control
CFIAS	Children Food Insecurity Access Scale
DDS	Dietary diversity score
DES	Dietary energy supply
dL	decilitres
DOH	Department of Health
DRIs	Dietary reference intakes
EA	Enumeration area
EAR	Estimated average requirement
EER	Estimated energy requirements
EP	Eastern Province
F	Females
FAO	Food and Agriculture Organization (United Nations)
FBS	Food balance sheets
FCT	Food composition tables
FFM	Fat-free mass
FFQ	Food frequency questionnaire
FM	Fat mass
FS	Free State
g	Grams

GHI	Global Hunger Index
GHS	General Household Survey
GP	Gauteng
HAZ	Height-for-age z-score
Hb	Haemoglobin
HbA1c	Glycated haemoglobin
HC	Hip circumference
HDL	High-density lipoprotein
HFIAS	Household Food Insecurity Access Scale
HH	Households
HPL	Health Promotion Levy
hsCRP	Highly sensitive C-reactive protein
HSFSA	Heart and Stroke Foundation of South Africa
IES	Income and Expenditure Survey
IFFQ	Indicator food frequency questionnaire (non-quantified)
IOTF	International Obesity Task Force
IS	Informal settlement
kcal	Kilocalories
kg	Kilograms
kJ	Kilojoules
KZN	KwaZulu-Natal
L	Litre
LCS	Living Conditions Survey
LDL	Low-density lipoprotein
LP	Limpopo province (Northern Province)
LSM	Living Standards Measure
M	Males
m^2	Square metres
mg	milligrams
mL	millilitres
MP	Mpumalanga
MRC	Medical Research Council
MU	Middle-class urban
MUAC	Mid-upper-arm circumference
N/A	Not available
NC	Northern Cape
n/d	not defined

NCD	Non-communicable disease
NDoH	National Department of Health
NFCS	National Food Consumption Survey
NFCS-FB	National Food Consumption Survey-Fortification Baseline
NFFP	National Food Fortification Programme
NID-CRAM	National Income Dynamics Study—Coronavirus Rapid Mobile (Survey)
NIDS	National Income Dynamics Study
NU	Non-urban
NWP	North West province
NYRBS	National Youth Risk and Behaviour Study
PA	Physical activity
PDIS	Provincial Dietary Intake Study
PMBEJDG	Pietermaritzburg economic justice, equity and dignity group
PRISMAP	Preferred Reporting Items for Systematic Reviews and Meta-analysis Protocols
PSU	Primary sampling unit
PTH	Parathyroid hormone
PU	Peri-urban
QFFQ	Quantified food frequency questionnaire
R	Rural
RAE	Retinol activity equivalents
RDA	Recommended dietary allowance
RE	Retinol equivalents
RF	Rural formal
RI	Rural informal
RTD	Ready to drink
RTE	Ready to eat
SA	South Africa
SADHS	South African Demographic and Health Survey
SAFBDG	South African Food-Based Dietary Guidelines
SAMRC	South African Medical Research Council
SANHANES	South African National Health and Nutrition Examination Survey
SASAS	South African Social Attributes Survey
SDGs	Sustainable Development Goals
SES	Socio-economic status
SSB	Sugar-sweetened beverage
StatsSA	Statistics South Africa

T	Tribal
TE	Total energy
TF	Transferrin
TfR	Transferrin receptor
TFS	Transferrin saturation
TIBC	Total iron binding capacity
TP	Total protein
U	Urban
UF	Urban formal
UFS	University of the Free State
UI	Urban informal
UIC	Urinary iodine concentration
UKZN	University of KwaZulu-Natal
UNDP	United Nations Development Programme
UP	University of Pretoria
US	University of Stellenbosch
USDA	United States Department of Agriculture
UU	Upper-class urban
UWC	University of the Western Cape
W	White (Caucasian)
WC	Waist circumference/Western Cape province
WHO	World Health Organization
WHR	Waist–hip ratio
WHZ	Weight-for-height z-score
WITS	University of the Witwatersrand
WQ1	Wealth quintile lowest
WQ2	Wealth quintile second
WQ3	Wealth quintile third
WQ4	Wealth quintile fourth
WQ5	Wealth quintile highest
WtHR	Waist-to-height ratio
Yrs	Years
%	Percentage

ACKNOWLEDGEMENTS

South Africa is experiencing an increase in the prevalence of obesity, both among adults and children. Various factors contribute to the increase in obesity, including cultural and social factors, socio-economic status, and the increasing supply of energy dense foods.

The last National dietary intake study (National Food Consumption Survey) was conducted in 1999 (more than 20 years ago) and was limited to children 1-9 years old. There has never been a national dietary study undertaken on children 0-1 year, adolescents, adults and the aged. The available fragmented localized studies cannot be used to provide a national picture/view.

I am pleased to present the results of a desktop review on the Foods procured, Nutritional status and Dietary intake of people living in South Africa. The desktop review is the first deliverable of the NDOH 45/2018 – 2019 contract awarded to the DSI-NRF Center of Excellence in Food Security of the University of the Western Cape for a study to determine foods and drinks consumed by various living standards measures (LSM) groups in South Africans and to understand factors influencing their intake.

The desktop review report consolidates independent reviews of published and selected grey literature on foods consumed by people living in South Africa (from a production perspective, food retail perspective and individual or household consumption perspective) as well as the nutritional status and dietary intake of children aged 0–17 years and adults 18 years and older from 1997 - 2019. The desktop review report therefore forms a comprehensive basis for the findings of the National Dietary Intake Survey that will become available at the end of 2022/23 financial year.

I would like to acknowledge efforts of all members of the desktop review team, in particular representatives from the University of the Western Cape, the University of the Free State, the North West University and the South African Medical Research Council for the technical assistance to the project. I would also like to thank staff at the National Department of Health: Dr Dr Tshimi Lynn Moeng-Mahlangu: Chief Director: Health Promotion, Nutrition and Oral Health, Ms Rebone Ntsie: Director Nutrition, Dr Tshilidzi Muthivhi, Director: Health Research, and Ms Maude de Hoop: Nutrition Directorate for their support and guidance.

DR SSS BUTHELEZI
DIRECTOR-GENERAL: HEALTH

CHAPTER 1

EXECUTIVE SUMMARY

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1.1 BACKGROUND

The estimated population of 58.8 million South Africans[1] live in a country that is regarded as nationally food secure, but the divide in terms of access to resources and high unemployment continues to render a significant proportion of citizens food insecure[2] and at nutritional risk. In addition, urbanisation is contributing to changed livelihoods and diets in both rural and urban areas. Food acquisition is primarily dependent on cash in food systems that are being transformed through the penetration of formal retail, international trade and globalisation.[3,4,5]

In most parts of South Africa, subsistence agriculture has been eroded as a result of apartheid land policies and overcrowding.[6,7] Inadequate agricultural extension services have resulted in even remote rural households increasingly relying on processed food from the formal food and retail system.[8] Over the last 20 years, South Africa has experienced a significant nutrition transition, with the changing food systems fueling the rate of transition. The prevalence of obesity has increased drastically and currently co-exists with stagnant, high levels of stunting.

The nutrition transition has resulted in an increased intake of nutrients of concern like sugar, salt and saturated fats globally[9,10,11,12] and it is assumed this picture is mirrored in South Africa. In the absence of national dietary intake data, Mchiza *et al.*[13] concluded that energy and macronutrient intakes range from low in certain studies and adequate to high in urban areas. Consequently, the prevalence of hypertension, overweight, obesity and other non-communicable diseases are on the increase in adults.[11,14] The formulation of strategies to arrest the obesity trend and the monitoring of progress with respect to existing interventions are dependent on up-to-date and comprehensive dietary intake information.

1.1.1 Scope of this report

On 10 February 2020, an award was made to the University of the Western Cape by the National Department of Health for the scope of work as per bid specifications NDOH45/2018–2019. The award was accepted on 28 February 2020. The project involves delivering a study to determine foods and drinks consumed by various Living Standards Measure (LSM) groups in South Africa and to understand factors influencing their intake. The service level agreement specified the period of delivery as 1 October 2020–31 March 2022 (18 months).

The work would be conducted by a core team from the University of the Western Cape, led by Professor Rina Swart (Department of Dietetics and Nutrition), under the auspices of the DSI/NRF Centre of Excellence in Food Security and supported by an informal consortium of universities in South Africa teaching dietetics and nutrition (see Table 1.1).

Table 1.1 Members of the research consortium

Collaborating researchers from the core team*		Collaborating researchers from the consortium*	
Institution	**Name**	**Institution**	**Name**
University of the Western Cape (UWC) UWC support	Rina Swart	Durban University of Technology	Ashika Naicker Heleen Grobbelaar
	Julian May	North-West University	Tertia Van Zyl
	Ernie Kunneke	University of the Free State	Corinna Walsh Louise Van den Berg
	Zandile Mchiza	University of South Africa	Elize Symington
		University of Limpopo	Ditope Rabodiba Makoma Bopape
		Stellenbosch University	Xikombi Mbhenyane Renee Blaauw Lisanne du Plessis Ali Dhansay (SAMRC)
		Sefako Makgato University	Annette Van Onselen
		University of Pretoria	Heather Sedibe Friede Wenhold Claire Martin
		University of Venda	Lindelani Mushaphi
		Universtriy of Zululand	Unathi Kolanisi Corrie du Preez
		Nelson Mandela University	Annelie Gresse

*Additional researchers and postgraduate students involved as part of the capacity development strategy

The purpose of this report is to present the first deliverable under project NDOH45/2018–2019, a desktop review of foods procured by people living in South Africa using industry data, Living Conditions surveys and other relevant surveys.

This report consolidates independent reviews conducted by different teams within the consortium and expands the initial purpose to include the nutritional status and dietary intake of children aged 0–18 years and adults. This report roughly covers a 20–25-year period (1994/7–2019/20) as it builds on earlier reports, namely the report by Vorster *et al.*[15] titled 'The nutritional status of South Africans: A review of the literature from 1975–1996' as well as the peer-reviewed paper by Ronquest-Ross *et al.*[16] titled 'Food consumption changes in South Africa since 1994–2012'.

This report is organised into five chapters, namely:

Chapter 1: Executive summary

Chapter 2: Foods procured by people living in South Africa, using industry data. This chapter analyses proprietary information collated by Euromonitor International from industry retail figures for fresh and packaged foods in South Africa.

Chapter 3: A review of food consumption trends in South Africa, as informed by other surveys such as the Income and Expenditure Survey and the General Household Survey in South Africa.

Chapter 4: The dietary intake and nutritional status of children (0–18 years) in South Africa: A review of the literature from 1997–2019.

Chapter 5: The nutritional status of South African adults: A review of the literature from 1997–2019.

Delimitation of the report

Procurement is defined in the Oxford Dictionary as "the action of obtaining something" (https://www.lexico.com/definition/Procurement). Procurement is one component of the broader concept of sourcing and acquisition and is typically viewed as the process of physically buying a product or service. Within the field of food and nutrition, and specifically how it applies to the foods being consumed by individuals, terminology is not always clearly differentiated and is thus used interchangeably. The food system in a country exists within other systems, such as the economic, environmental, political, health and social systems[17] (see Figure 1.1). All the different systems interact and affect the food that is available to a person (i.e., the source of food) to choose from, the food that is acceptable to a person given personal circumstances and social norms, and the food that the person will eventually be able to access (given the available means to obtain the food as well as the capabilities or agency of the person to exercise such choice).

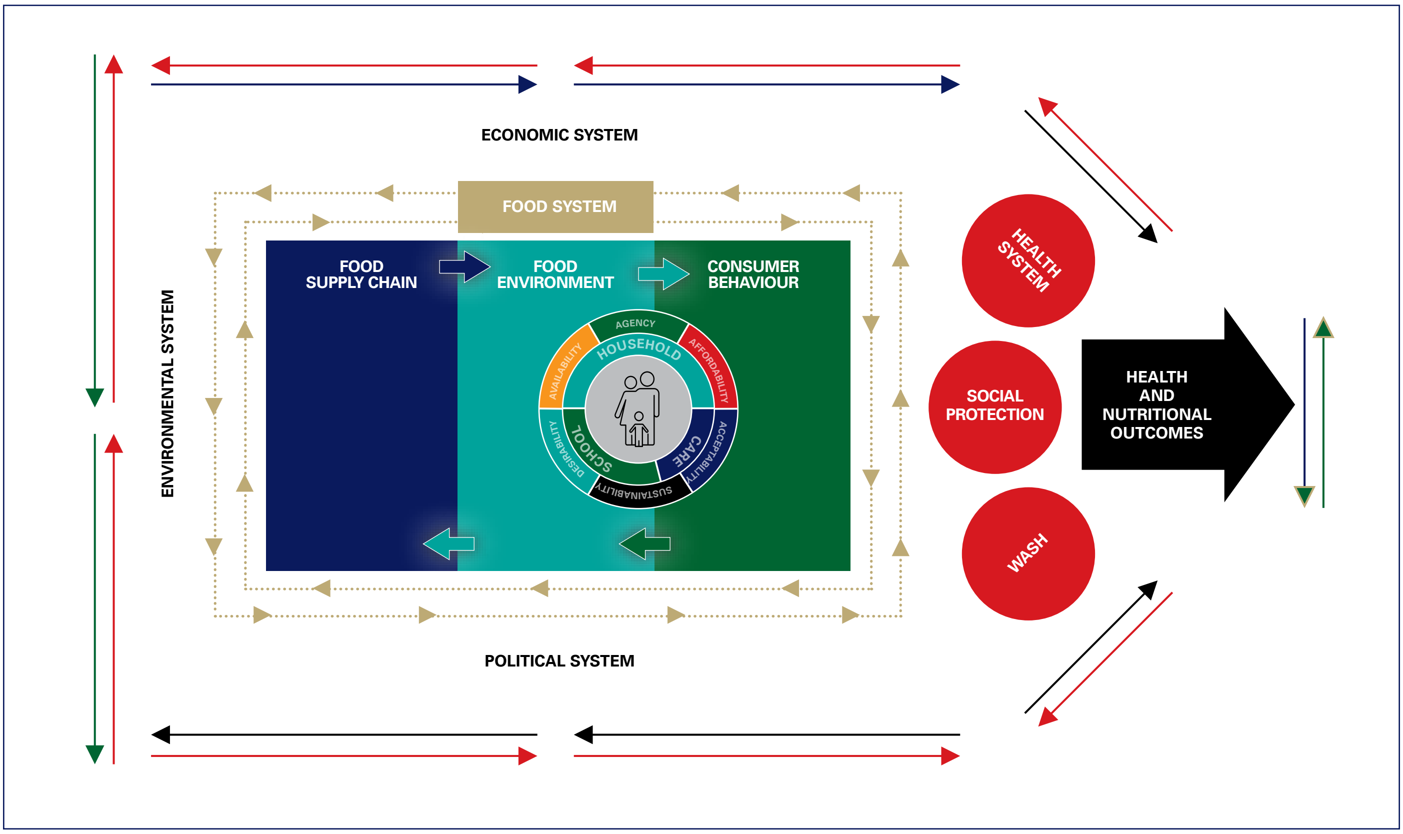

Figure 1.1: Diagrammatic illustration of systems and forces affecting the diet quality and quantity of people
Source: Swart *et al.*[17]

For the purpose of this review, the focus will be on individuals (as opposed to institutional food procurement) and information will be reported as food consumption by source of food (Chapters 2 and 3). See Figure 1.2 for the conceptual framework of procurement and levels of reporting. Individual food consumption, which is the outcome when foods procured are consumed by individuals, will be reported for children aged 0–18 years (Chapter 4) and for adults (Chapter 5).

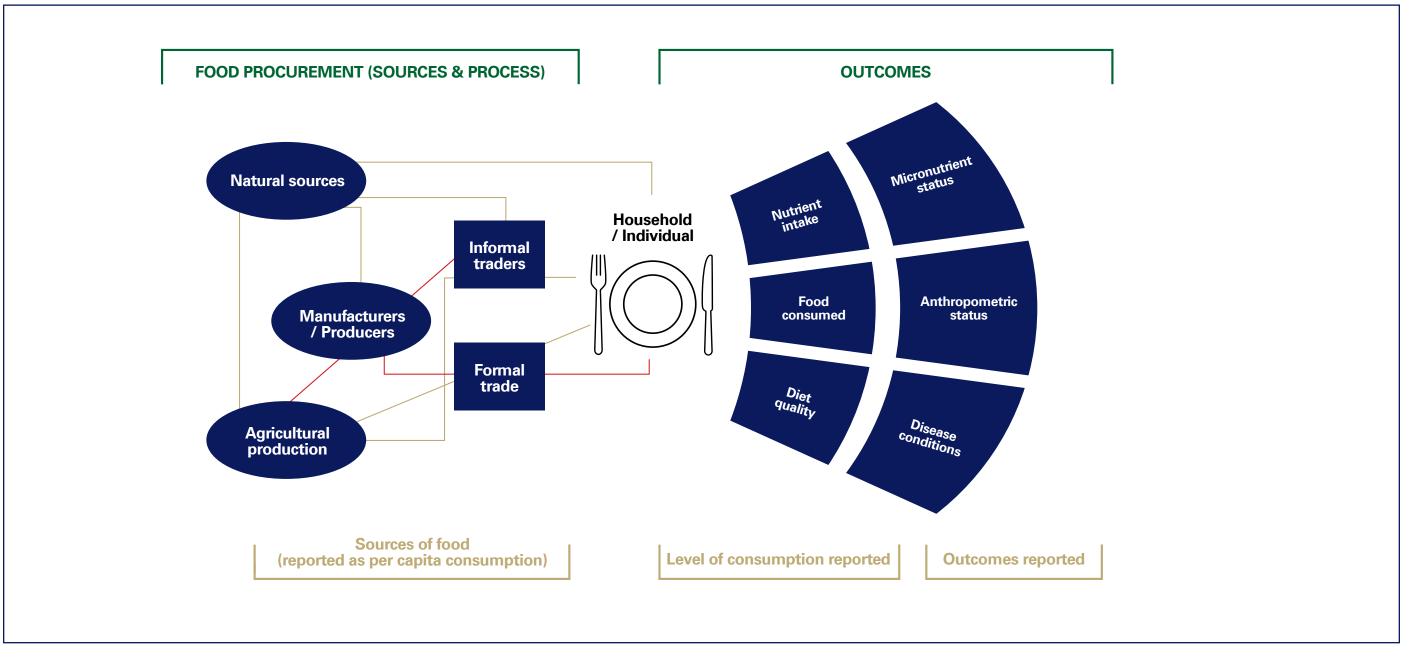

Figure 1.2: Conceptual framework of food procurement and how information is reported
Source: Author

1.2 FOODS PROCURED BY PEOPLE LIVING IN SOUTH AFRICA, USING INDUSTRY DATA

The South African food system has become increasingly commercialised, and the number and diversity of processed food options have grown dramatically over the last 20 years. Labadarios[18] recorded in 1999 that 94% of the population procure all their food, i.e., do not produce any food for own consumption. Ronquest-Ross *et al.*[16] documented an increase in food produced through agriculture as well as food sold in retail for most of the food groups over the period 1994–2012. This report extends the period under investigation with a focus on 2005–2018 and reports on food consumption based on agricultural production as well as food consumption based on food retail during the same period. In general, the annual per capita energy supply as well as the share of each of the food groups within that energy supply remained relatively constant and fluctuated between 2089kJ and 3022kJ per capita. (See Figure 2.1 in Chapter 2.) Firstly, it should be noted that the food supply in South Africa (based on FAO production) exceeds the threshold of per capita energy supply of 2500kcal per day, thus confirming the continued self-sufficiency of the country.[19]

Per capita onsumption has increased along almost all product items (fresh food and packaged food) within the foods sold between 2005 and 2018, as recorded in Euromonitor data. This could be a reflection of an increase in consumption overall (i.e., purchasing more food and eating more food), although some of the changes could also be the result of a decrease in consumption from any home-based production, marginal as it is.

The most significant changes in processed food retail have been observed in carbonated drinks. The consumption of soft drinks has increased over time, with the most notable changes being evident in the consumption of carbonated drinks (sweetened non-alcoholic drinks that contain carbon dioxide). Soft drinks sold increased from approximately 60.4 litres per capita per annum in 2006 to 91.2 litres per capita per annum in 2019 (63% increase). Bottled water has also seen a significant increase from 5.2 litres per capita per annum in 2006 to 11.2 litres per capita per annum in 2019, representing a 115% increase in consumption over this period. The volume of concentrates that is consumed also poses a challenge. Although the sugar content of concentrates differs significantly, a 100mL per capita per day volume of concentrate will contribute significant amounts of sugar to the diet of South Africans. It is likely that the average sweetened beverages sold per capita per day, alone, exceed the WHO[20] recommendations for total sugar consumption.

Consumption of dairy products was much lower than that of carbonated drinks. For example, the total consumption of all drinking milks was 26 litres per capita in 2005 and grew to 33 litres per capita in 2019—only about one-third of the volume of carbonated drinks consumed per capita. Although overall, the retail consumption of dairy products increased over time, the primary change was in shelf-stable cow's milk as well as yoghurt. Consumption of yoghurt almost doubled between 2005 and 2019, from 3.6kg to 6.7kg per capita. The growth in shelf-stable life milk may suggest a desire to consume milk but accessibility to fresh milk or storage capacity for fresh milk may be lacking. Despite these changes, the overall dairy consumption is low, and it is unlikely that the average South African consumer will achieve 15% of the daily adequate intake for calcium.

All fresh foods have shown increased consumption (kilograms per capita per annum) over time, except for pulses which recorded a slight decline between 2005 and 2019. The most notable change in fresh foods has been the steady increase in meat consumption, which increased from 44.7kg per capita in 2005 to 53.9kg per capita in 2019, representing a 21% increase over the period. The increase was driven mainly by increased consumption of beef and veal, and poultry, which increased by 31% and 23% between 2005 and 2019, respectively.

Consumption of cereals increased although shifts took place within the cereal range, with rice consumption decreasing from 11.2kg per capita to 9.1kg per capita, and pasta/instant noodles replacing rice. Bread consumption increased, with the most notable changes being in packaged bread. Although confectionery consumption (including sugar confectionery, chocolate and ice cream) remained relatively stable at levels of around 1kg per capita per annum each, the consumption of all breakfast cereals increased by at least 50%, while the consumption of both sweet biscuits and salty snacks increased by more than 100% to 1.7kg and 2.4kg per capita, respectively. Consumption of ready meals doubled, although still ended up at a relatively low level of 0.3kg per capita per annum.

The information available from Euromonitor cannot be disaggregated by income decile or by province, but it supports the observed rising levels of overweight and obesity in the country—especially when the information is considered within the context of shifts reported towards more sedentary lifestyles and reduced physical activity levels.[21,22]

The understanding of the context within South Africa, as illustrated in poverty and unemployment figures,[1] the differential consumption based on regional and income deciles reported in Chapter 3, as well as our knowledge of food prices in the country, as reflected monthly in the affordability index of the Pietermaritzburg economic justice, equity and dignity group (PMBEJDG),[23] leave no room for a conclusion other than extreme variations in intake, with low income being a driver of food choices towards cheap, energy-dense foods. A lack of resources such as refrigeration facilities also drives retail changes, with changes in shelf-stable meat/meat replacements and shelf-stable milk being a case in point. However, it is notable that Odenutan-Wayas *et al.*[24] concluded that food-secure shoppers spent more on food, but food items purchased frequently did not differ from the food-insecure shoppers and included greater expenditure on sugar-sweetened beverages and snacks than on fruit and vegetables.

The proportionate changes in ultra-processed foods, particularly sugar sweetened beverage consumption, should most certainly be explored as a potential contributor to overweight and obesity.

1.3 A REVIEW OF FOOD CONSUMPTION TRENDS IN SOUTH AFRICA AS INFORMED BY OTHER SURVEYS

Statistics South Africa (StatsSA), the country's official statistical agency, regularly conducts nationally representative surveys that collect data on food security and food consumption—albeit unquantified and not translatable into nutrient intake. Three such surveys provide information on "consumption". These surveys are:

i) the General Household Survey (GHS) conducted annually. Since 2013 it has included an unquantified 24-hour recall method to allow the calculation of a dietary diversity score as well as the proportion of households reporting consumption of a particular food group.
ii) the Income and Expenditure Survey (IES) conducted every five years between 2000/01 and 2010/11 on a sample of just over 25 000 households.
iii) the Living Conditions Survey which has been conducted twice, i.e., in 2008/09 and in 2014/15. They collected similar consumption information to the IES.

Consumption-level information from two other national surveys, i.e., the South African National Health and Nutrition Examination Survey (SANHANES) and the South African Demographic and Health Survey (SADHS), are also briefly summarised in Chapter 3. Detailed findings from these two surveys are also included in the review of studies on nutritional status and dietary intake of children (Chapter 4) and adults (Chapter 5).

The GHS analysis included in this report covers the 2002–2018 period and illustrates that the proportion of households that reported hunger gradually declined from 23% in 2002 to 10% in 2018. In 2018, for example, 21% of households in the poorest income quintile reported hunger, compared to 3% of households in the richest income quintile (Chapter 3, Figure 3.3). Across geographical locations, the prevalence of hunger was lowest in provinces where a larger number of households reportedly participated in agricultural activities (for example, in Limpopo) (see Chapter 3). The 2020 COVID-19 pandemic and control measures such as lockdowns have triggered job losses and subsequent food insecurity. In the NIDS-CRAM (National Income Dynamics Study—Coronavirus Rapid Mobile) Survey, 40% of households reported a loss of income[25,26] and it is estimated that hunger and food insecurity levels have reverted to levels recorded in 2002 and earlier.

Since 2013, the GHS has been collecting data on food consumption among individuals based on a 24-hour recall methodology used for 10 broad groups. It should be noted that the GHS is not a food consumption survey and thus the results presented have several limitations, most notably that the findings do not necessarily represent consumption at the household level. However, they provide insights into food consumption trends and dynamics. The analysis illustrates that cereals remained the most commonly consumed food group among respondents, and that the least commonly consumed foods across the six-year period were pulses, spinach and wild greens, and fruits. A dietary diversity score created from this data, similar to the methodology used in the 2012 SANHANES survey, shows significant provincial and income decile variations. In 2018, over 75% of households in the Western Cape reported access to medium or highly diversified diets, compared to 43% in the Free State. The findings also show that household dietary diversity levels increased with income deciles, with over 70% of those in the richest decile reporting medium or high dietary diversity compared to 41% in the poorest income decile.

The Income and Expenditure Survey (IES) includes information on household income and expenditure on foods for consumption. This information is used to update the basket of goods and services included in the consumer price index (CPI) computation. This survey is also used to produce poverty estimates for the country. To reduce respondent fatigue, the latest IES required only a two-week diary on household expenditure compared to the initial four-week diary.

The list of top 10 household food expenditure items does not include any fruits and vegetables in all income decile households. When expenditure on the top 35 food items is considered, only tomatoes, onions, cabbages, apples and bananas appear on this list. A comparison of findings between the 2005/06 IES and the 2014/15 Living Conditions Survey suggests a small change in the number of food items acquired by households over time—specifically an increase in expenditure on brown bread, relative to other food groups. This increase is larger among the poorest households, compared to those in the richest deciles (Chapter 3). Across all households and in both years under consideration (2005/6 and 2014/15), the food item with the highest expenditure was poultry, absorbing approximately 12% of total household food expenditure. However, the expenditure share of poultry was highest in the poorest 40% of households. The expenditure share of potatoes in the poorest and middle deciles declined significally between the two surveys, but no changes were observed in the richest deciles (Chapter 3, Table 3.3). The results also show that there was an increase in spending on carbonated cold drinks between 2005/06 and 2014/15. Although the richest households remained the highest proportionate spenders on carbonated drinks, the average national increase was mainly driven by increases in the poorest and middle-income deciles (Chapter 3).

The Living Conditions Survey (LCS) aims to provide data for the purpose of analysing living conditions and poverty trends in South Africa. Like the IES, the LCS surveys a large number of households (27,527) over a one-year period. The LCS is a more comprehensive survey than the IES, and therefore collects more detailed data on poverty dynamics and household consumption in the form of expenditure. As with the IES, the LCS reported significant differences in spending across provinces and expenditure deciles. Based on the 2014/15 LCS, the highest levels of spending on fruits and vegetables were in the Western Cape and Gauteng provinces, while the lowest was in the Eastern Cape. The average fruit expenditure by households in the Western Cape was 3.5 times that of households in the Eastern Cape. Similarly, spending by households on vegetables in the Western Cape was 50% above the national average and twice that of households in the Eastern Cape. The meat food group recorded the second-highest average expenditure but, like other food groups, there were significant differences across provinces and expenditure deciles. A comparison of expenditure on meat across deciles shows that expenditure in households in the richest deciles was at least five times that of households in the poorest decile. The widest disparities were in fruit consumption where the spending in the richest households was 19.5 times that in the poorest households (Chapter 3).

Most of the national studies identified relate to household spending patterns and therefore do not provide individual-level information on procurement or consumption (other than the amount of money spent on it). The differences in household food consumption measured in terms of food expenditure illustrate the stark differences between income deciles. In general, the lowest five deciles spend similarly small proportions of money on the different food groups. Thereafter, each decile increases expenditure on food groups, with decile 10 spending 19 times more on fruit, six times more on meat and four times more on vegetables. Furthermore, consumption of meat types differed, with lamb and pork featuring more in higher-income deciles, while poultry meat was the primary meat expenditure item in deciles 1–4. Increased meat consumption as income rises seems to be an international phenomenon.[27] The findings from a local study by Odunitan-Wayas reported in section 1.2 confirms that although the amounts spent are very different within different socio-economic groups, the proportionate spending on unhealthy food items is similar.

The food groups consumed by individuals in the SANHANES 2012 survey revealed interesting provincial differences—most of which were, in all likelihood, a function of income. First, more expensive food items such as eggs, fruit, meat and fish were reported to be consumed by larger proportions of participants in Gauteng and the Western Cape. The dry, arid provinces of the Northern Cape and North West reported the lowest consumption of vitamin A-rich fruit and vegetables as well as nuts and legumes, while KwaZulu-Natal, Limpopo, Mpumalanga and North West reported a relatively low consumption of dairy products (ranging from 34-39%). Limpopo reported the highest consumption of different types of vegetables and protein—probably as a result of agricultural production for household use reported in Limpopo.[1]

Dietary diversity was low for most South Africans, with only 21% of decile 10 respondents consuming a high diversity diet. In deciles 1–4, almost 60% of respondents consumed less than four of the food diversity groups.

Expenditure on ultra-processed foods, such as beverages, snack foods and processed meats increased in most income deciles between 2005 and 2015, which is in line with findings from Euromonitor data reported in Chapter 2. Consumption of soft drinks increased proportionately more in low-income groups and was almost equal to high-income groups at a 3.5–5% level of expenditure. Expenditure on processed meat and salty snacks increased by approximately the same amount in each income decile (i.e., 0.5 percentage points). The same pattern was evident for chocolates at 0.3 percentage points, except for the two highest deciles where chocolate consumption made up 1.5% of expenditure. Processed bread intake increased more significantly in lower-income deciles, while decile 10 demonstrated the lowest increase and the lowest absolute level of expenditure at around 7%. The lower-income deciles spent around 18% on processed bread.

As far as urban-rural differences are concerned, expenditure on soft drinks and on ham and polony was similar—which means that rural expenditure has changed dramatically. The increase in expenditure on processed bread, salty snacks and chocolate was very similar among rural and urban respondents. Rural expenditure on soup powders was still higher than in urban areas, while expenditure on chocolate was lower than in urban areas.

The frequency of consumption of specific foods was indicated as one to three times per week by 40–50% of respondents, except for fish NOT being eaten by 60% of the respondents. It is noteworthy that vegetables were consumed by about 50–60% of respondents, with 40% consuming them one to three times per week. The same frequency of consumption of less healthy foods, such as fast food, sweetened fruit juice, crisps, chocolates, sweet biscuits, deep-fried foods, pastry and processed meats, was reported by 40–50% of respondents. The consumption of fruit one to three times per week was reported by only 49% of respondents.

The consumption trend of sugar-sweetened beverages (SSBs) by age group is a cause for concern. The relatively low level of consumption of SSBs by those >65 years (19%) is unlikely to be the result of the elderly not liking SSBs, but rather the unfamiliarity of their generation with SSBs. Would this then imply that more than 42% of the next generation (currently aged 5–14 years) who reported having consumed SSBs the previous day are at risk of obesity by the time they reach adulthood? Concerns about the quality of eating habits of future generations appear to be real as only 23% of children aged 6–23 months met the minimum acceptable dietary requirements. The quality of young children's diets in South Africa makes no distinction between genders and is only slightly better in the higher-wealth quintiles.

1.4 DIETARY INTAKE AND NUTRITIONAL STATUS OF CHILDREN (0–18 YEARS) IN SOUTH AFRICA (1997–2019)

A comprehensive systematic review of the available literature was conducted on the dietary intakes and nutritional status of South African infants and children (0–18 years old) to determine the extent of nutritional status research, the representation of age groups and geographical areas, and the methods and cut-points used, and also to report on trends relating to the improvement or deterioration in intakes and nutritional status over the period 1997–2019.

Online databases (Pubmed, CINAHL, EbscoHost and SAePublications) were used to identify papers published from 1997–2019, including 117 publications that described the prevalence of malnutrition in terms of anthropometric variables, the dietary intakes or the biochemical nutritional status of South African infants and children (0–18 years old).

Most publications reported cross-sectional studies, while a small number of prospective cohort studies were included, of which data collected during one wave per indicator included over the period 1997–2019 were used. Baseline data from a small number of randomised controlled trials were also included. All studies collected measured data and only quantitative data were included. A total of eight nationally representative studies and 109 regional studies were included. Overall, 46% of the publications on regional studies examined the nutritional status of infants and preschool children, 39% of primary school-age children and 15% of adolescents. The most commonly used reference to define anthropometric nutritional status was the National Center for Health Statistics (NCHS) cut-off points up to the year 2010.

The International Obesity Task Force (IOTF) cut-points to define overweight and obesity have been commonly used since 2005, while most recent studies have applied the WHO 2006 definitions on malnutrition among children of 0–5 years and the WHO 2007 definitions for children of 5–18 years. In addition, the CDC cut-points and the recent IOTF cut-points for thinness were used. The highest prevalence of stunting among infants was reported in KwaZulu-Natal, the Eastern Cape and Limpopo, while in the total under-5-years group the highest prevalence of stunting, underweight and wasting was found in the Northern Cape. In nationally representative studies, the prevalence of underweight and wasting generally decreased from 1999 to 2016, while stunting prevalence did not change. More infants younger than nine months than older infants and young children were generally overweight, with a consistent decrease in weight-for-height z-score (WHZ) from infancy up to the age of 59 months. The prevalence of overweight and obesity increased from 2002 to 2016 among adolescents.

Most studies used the WHO cut-off points and guidelines for biochemical indicators, but specifics varied and made it difficult to assess trends over time and across different areas. Vitamin A status improved remarkably, and the prevalence of iron deficiency among South African children was generally lower in more recent studies in both rural and urban areas. Infants up to the age of one year are more severely affected and urban primary school children are least affected by anaemia. The prevalence of zinc deficiency is varied and there are no recent data for iodine status after 1999.

Variability in dietary assessment methods and metrics used across the studies limited comparisons between study groups and the ability to observe trends over time. In terms of macronutrient distribution, dietary intake in Limpopo and, to a lesser extent, KwaZulu-Natal is low in fat and high in carbohydrates, and intake of plant protein is two to three times higher than that of animal protein. South African children and adolescents consume a diet deficient in calcium. Vegetable, fruit and milk intake is low, while unhealthy foods are frequently consumed.

The double burden of malnutrition, with underweight among primary school-age boys and obesity among infants and adolescent girls, is evident from the results of this review. The growing incidence of overweight and obesity among infants, preschool children and adolescents is of concern. Although household food security has apparently improved over the past few years, the risk of increased food insecurity and all forms of malnutrition will increase due to the economic consequences of the COVID-19 lockdown measures.

A recent, comprehensive study with repeated measurements throughout childhood showed that high BMI at the age of two to three years tends to stay high, and that normal BMI occasionally rises to high BMI, but the reverse is rarely true.[28] Early childhood and post-puberty may be important periods for interventions to prevent obesity, particularly among girls. Inadequate intake of vegetables and fruit increases the risk of micronutrient deficiencies, while the frequent consumption of unhealthy snacks and sugar-sweetened beverages are of concern. The improvement noted in vitamin A status could be attributed to the National Food Fortification Programme and vitamin A supplementation programmes. In general, iron status appears to have improved, but limited data indicate that the prevalence of zinc deficiency is still high in South African children from low-income communities.
Limited success has been achieved in carrying out interventions targeting the double burden of malnutrition in children. Appropriate interventions designed to curb rising obesity among children include restricting advertising of unhealthy foods to children, improving the nutritional quality of school meals, imposing taxes on unhealthy foods and providing subsidies for healthy foods, and providing supply chain participants with incentives to produce more healthy foods.[29] Greater focus is needed on improving calcium intake across all age groups. Also, appropriate interventions are needed to improve dietary diversity and increase the intake of vegetables and fruit, and milk.

1.5 NUTRITIONAL STATUS OF SOUTH AFRICAN ADULTS (1997–2019)

There is no national data on the dietary intake of adults in South Africa, and a decline in local studies about food intake was recorded from 1979–2010. Local studies are not representative of the situation in the country as a whole and often provide a fragmented picture of current circumstances. However, secondary data analyses and meta-analyses have provided useful insights into the nutritional status of South African adults.

This review includes a comprehensive, systematic review of the available literature on the dietary intakes and nutritional status of South African adults and includes 195 publications. Where publications reported variables using different units, conversion software was used to convert findings to the SI unit in order to make comparisons possible.

At the beginning of the new millennium, a review on diet, physical activity and obesity within the Black population of South Africa conducted by Bourne *et al.*[30] confirmed the findings of Vorster *et al.*,[15] describing a nutrition transition characterised by shifts in dietary intake from the traditional diet to a more Western diet and an increased prevalence of overweight and obesity—especially among Black women.[30] The results of the current review confirm these earlier findings and note that since the time that they were published, the prevalence of overweight and obesity has increased even further, and the diets of South Africans have deteriorated even more. Poor diets, sedentary lifestyles as well as misperceptions about health consequences of obesity[31] necessitate ugent interventions. Maize and bread were identified as the most commonly consumed staple foods. Although higher socio-economic groups reported intakes of more milk and meat, most dietary studies found an intake of small amounts of dairy products, fruit and vegetables. Low intakes of calcium and potassium were reported across all strata. Overall, the proportion of foods high in fat has increased and similarly the intake of sugar and sugar-sweetened beverages has increased across all socio-economic groups.

Biochemical variables are not frequently included in studies on adults. Where it is included, the focus is usually on vitamin A and iron. Vitamin A status appears to have improved although some population groups have been excluded from assessment since 2003. Iodine status and folate status were last reported on for 2005 when they were deemed adequate, although pockets of iodine deficiency did exist. Anemia still affects one in three women of reproductive age and one in five men.

1.6 CONCLUSION

There is a need for synchronisation and alignment of studies (local and nationally representative) to ensure comparability of results and to systematically provide updated information to assist in monitoring both undernutrition and overweight/obesity in children and adults, as well as the associated shifts in food consumption patterns. The current NDOH45/2018–2019 will serve as a comprehensive baseline and an effort should be made to ensure that different instruments used by different organisations in future studies are comparable and provide immediate monitoring value.

Overall, it is recommended that methodologies used in regular surveys by Statistics South Africa be harmonised with dietary methodology studies. Key modules should be developed which will guide researchers in including selected, standardised information whenever data are collected. This will allow for meta-analyses and the use of big data analyses strategies to provide information on dietary changes within the population. National surveys conducted by central statistics offices in other countries, such as Brazil,[32] the United Kingdom[33] and Bangladesh,[34] include information that is sufficiently detailed to allow for the calculation of nutrient intake. This option has been explored in the South African Income and Expenditure Survey, but as no quantities have been recorded, it has not been possible.

Owing to the major impact of nutrition on health, nutritional surveys can make a meaningful contribution to determining the prevalence of malnutrition and the impact of interventions at the population level. In order to obtain useful information, assessments of anthropometry, biochemistry and dietary intake need to be performed using valid and reliable techniques. Furthermore, evaluation and interpretation of the obtained results should be done using relevant and applicable references and standards.

Conclusions from the four components of this desktop review confirm the following about the dietary intake of South Africans:

- The majority of the population procure most of their food from commercial enterprises (small, medium and large enterprises).
- The gains in reduction of hunger since 2002 have in all likelihood been erased by the socio-economic effect of the COVID-19 pandemic control measures.
- Dietary diversity is low and heavily reliant on energy-dense foods that are not necessarily nutrient dense.
- Intakes of fruit and vegetables are particularly low.
- Intakes of food sources of calcium are very low.
- The intake of commercially manufactured, ultra-processed foods that are high in added sugar, salt and saturated fat are growing exponentially across all income groups.
- The high intake of ultra-processed foods, such as sugar-sweetened beverages and salty snacks, among young adults who were born into an obesogenic food environment suggests the need for far-reaching and impactful strategies to improve the healthiness of their diets.

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CHAPTER 2

FOODS PROCURED BY PEOPLE LIVING IN SOUTH AFRICA, USING INDUSTRY DATA

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2.1 INTRODUCTION

The food supply within a country and globally is often referred to as "consumption" data. Consumption can, however, have different meanings, depending on the source of information (see Figure 1.2). The most widely used and comprehensive data on food supply and consumption are published annually by the UN Food and Agriculture Organization (FAO). This data date back to 1961 and are presented as the average daily supply of food energy (measured in kilocalories/kcal per person per day) and food protein/fat (measured in grams/g per person per day). These food supply/consumption data do not include consumption-level waste, i.e., wasted at retail, restaurant and household levels,[1] and therefore represent food available for consumption at the retail level, rather than actual food intake.[2] Food balance sheets are useful for providing policy-level information to ensure food security, such as the extent to which a country depends on imports to feed itself (import dependency ratio) and the amount of food crops used for feeding livestock in relation to total crop production. However, they do not give any indication of the different diets consumed by different population groups, e.g., people belonging to different socio-economic groups, ecological zones or geographical areas within a country; nor do they provide information on seasonal variations in the total food supply.[1] The latter is best obtained from food consumption surveys.

Global market research and data analytics companies also report on food consumption data. In essence, these market reports are based on foods purchased, although different companies use different sources of information to obtain such purchase data. Three well-known companies are NielsenIQ, Kantar Europanel and Euromonitor International. Both NielsenIQ[3] and Kantar Europanel[4] use a cohort (also called a panel) of households. Through regular data collection from these households, consumer behaviour is studied with the primary purpose of informing industry about market share and emerging trends or providing feedback on specific marketing strategies. The panel members are required to record all items purchased on all household members' shopping trips, including each item's barcode, using scanners provided to them along with a barcode booklet for products without barcodes, e.g., cut-to-order meat, and unpackaged fruits and vegetables. Panel members are also instructed to provide information on where they shopped and date of shopping episode, and to submit photos of their receipts via the data-collection system.

The sample of households comprises urban and rural households. However, in view of the possible lack of electricity, which is necessary for recording purchases, the sample excludes extremely poor households (Living Standards Measure, LSM 1–3), which represent approximately 5–10% of the South African population. Households are recruited via telephone, text and online, with poor reporters (i.e., those who fail to report more than five different categories of items purchased and/or make less than one shopping trip per week) being dropped on a rolling basis, with immediate targeted replenishment based on sociodemographic attributes.

As of the beginning of 2019, Kantar Europanel terminated their data-collection activities in South Africa. NielsenIQ did not do any data collection in South Africa during 2020 due to COVID-19. Data from Neilsen and Kantar were not purchased for this report as, "technically speaking", they do not represent industry data, although they are collated by commercial entities for profit. However, a scoping review was done to identify papers that report on either Nielsen or Kantar. Only one paper on South Africa could be identified, which will be discussed at the end of this chapter.

Industry data, i.e., food retail data from commercial enterprises, have been recorded annually by Euromonitor International[5] (hereafter referred to as Euromonitor) since 1998. Data for the period 2000–2020 were purchased from Euromonitor and analysed for the purpose of this report. Euromonitor has a syndicated market research database which pools data from industry (traders) with data from national statistics offices and other secondary sources.[6] The company publishes the total and per capita trade volumes for various fresh and packaged foods. The nutrition information on food products can be converted to calories or kJ per capita per annum as an indication of food security based on total energy required per capita per annum.

It should be noted that Euromonitor data have the same limitation as food balance sheets, i.e., they can estimate a per capita "consumption" based on food retail data, but they cannot provide disaggregated information by province or by sub-category of consumers, such as particular age groups. The data that Euromonitor collects on consumers report primarily on social behaviour preferences and choices (not specific food product choices) and are not included in this report.

2.2 METHODOLOGY

The statistics presented in this chapter are based on data from two sources namely, the Food and Agriculture Organization (FAO) food balance sheets (FBS) and the Euromonitor International Database on Packaged Food and Food Services. This data has been supplemented by published literature that reported on food retail data.

The FAO's FBS provide data on food consumption from a supply perspective and therefore examine a country's food supply patterns. The net food supply considers the food produced, changes in stock, imports and exports. Because the FAO data relate to food supply based on production estimates, it does not provide food consumption estimates for households or individuals. Nevertheless, the food balance sheets are useful because they show trends in food supply at country, regional and global levels, thus allowing for comparability of estimates. They are also useful for examining changes that occur over time and can provide insights on dietary patterns by assessing the extent to which a country's food supply is adequate for the nutritional requirements of the population. The FAO uses the food supply data to calculate the number and percentage of a country's population that is undernourished—an indicator recorded as part of the Sustainable Development Goals (SDGs) reporting system. The 2005–2013 FAO estimates were derived using an old FBS methodology, which has since been discontinued, while the 2014–2018 estimates were based on a new FBS methodology.[*1] The analyses presented here is for the period 2005-2018.

[*1] The key differences between the two FBS methodologies is that in the new methodology, the imputations for FBS components that are not provided by countries (e.g., stocks and industrial utilisation) are generated by dedicated modules and a balancing mechanism is used to proportionally apply imbalances across the components. In the old FBS methodology, only one component would take on the outstanding unbalanced amounts and, subsequently, carry all the statistical errors. Another difference between the two sets of data is that 2015–2013 series were based on the 2015 version of UNDP population data, while the latter series uses the 2019 UNDP population data. More information on the differences between the old and new FBS methodologies can be found on the FAO's website: http://fenixservices.fao.org/faostat/statisc/documents/FBS/New%20FBS%20methodology.pdf

The Euromonitor International Database on Packaged Food and Food Services data has been extracted by Euromonitor from the international database for the purpose of this survey. This extraction was done with the agreement that data would be used only for reporting as part of the National Dietary Intake Survey and would not be reported at a product brand level. The analysis builds on research conducted by Ronquest-Ross *et al*[6] who used similar data to examine shifts in food consumption in South Africa between 1999 and 2012. The analysis presented here is for the period 2005–2019. The main variables of interest are the per capita food consumption based on sales from retail and food service outlets and population estimates at the corresponding timepoints.

Euromonitor provides data on the total and per capita trade volumes of various fresh and packaged foods and therefore allows examination of the patterns in a country's food supply from a retail perspective. Given that most households in South Africa (>94%) procure all their food[7] from a range of retailers, the statistics on foods purchased represent a reasonable estimate of food consumption at a national level, although they cannot provide estimated food consumption according to households' or individuals' intake. Using the nutrition information on food products, this information is converted to calories, or kJ per capita per annum, as an indication of food security based on total energy required per capita per annum. However, it should be kept in mind that it is not based on actual individual dietary intake. Statistics South Africa confirmed that the number of households involved in agricultural activities has been on the decline, with 13% reporting such activities in 2016.[8] In these households, the majority (78%) engage in agricultural activity to supplement their food supply, with only 7.8% relying on it as the main source of food.[8] Chakona and Shackleton[9] documented that procurement and consumption of wild foods are highly dependent on proximity to natural resources and are used as a coping strategy only by the poorest/most food insecure in these settings.

Published literature was reviewed to identify papers that report on food retail volumes in South Africa. A systematic review conducted in March 2018 on this topic did not report any studies for South Africa,[10] thus a scoping review[11] of the period 2018-2020 was conducted. The search strategy for the scoping review included food retail, food sales, food purchases, food procurement and food acquisition, as well as the three sources of commercially available procurement data, i.e., Kantar, Nielsen and Euromonitor and South Africa. The search included Google Scholar, PubMed, Web of Science, Psych Info via Ovid, Scopus and Business Source Complete. Out of the 923 papers identified on the basis of the search criteria, no papers on volume of sales were uncovered. Subsequently, a general literature search was done and papers included in this report were purposefully selected to provide a sense of the inferences that could be drawn from such data. This information is reported in section 2.3.5 below.

2.3 RESULTS

The Bureau for Food and Agricultural Policy regularly provides updated summaries and related visual representations of information from the food balance sheets. The paper published by Ronquest-Ross *et al.*[6] was the first and, to date, the only paper reporting on both food supply and retail sales using FAO balance sheets and Euromonitor data. As the nature of the two data sources differs, information is not directly comparable, but within broad categories it can provide an indication of trends. Ronquest-Ross *et al.*[6] concluded that in the period 1994–2012 the food consumption changes observed in South Africa caused a shift towards diets of sugar-sweetened beverages, increased processed and packaged food (including animal source foods) and foods with added caloric sweeteners and decreased vegetable consumption. The current review of FAO balance sheets and Euromonitor data started to overlap with and extend the Ronquest-Ross *et al.*[6] review in 2005.

2.3.1 Trends in food supply and retail sales

Figure 2.1 shows average kilocalories (kcal) per capita per day based on food supply for the 2005–2018 period, and the contribution (%) of various food groups to the average total kilocalories. Over the years, cereals have remained the largest and most important source of dietary energy, contributing more than 50% to average total kcal per capita per day. Meat, sugars and sweeteners, and vegetable oils are ranked together in second place (Figure 2.1). In 2018, these three food groups each contributed 11% to the average total kcal per capita per day. The contribution of vegetables and fruits remains low, with each comprising approximately 1% of average total kilocalories. The inadequate fruit and vegetable supply is confimed by the per capita per annum amount, which translates into a total of 170g compared to the WHO recommendation of 400g per capita per day.

Alcoholic beverages make up at least 4% of the national energy supply per capita per day (about 110ml per person per day). (Table 2.1). It should be noted that wine is one of the top 10 food items exported by South Africa[13] (Figure 2.2). Retail data from Euromonitor suggest a lower volume procured by South Africans, with two-thirds of alcohol purchased from off-trade such as supermarkets and grocery stores (Table 2.1).

Table 2.1: Location and volume of alcohol retail sales (Euromonitor) in liters per person of legal drinking age, 2005–2018

ALCOHOL	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2012–2118
Off-trade	46,7	45,9	48,9	48,5	46,9	47,3	46,7	47,2	46,7	46,6	46,5	46,8	47,2	47,8	**1,27**
On-trade	29,1	29,3	28,2	25,9	26,6	26,9	26,7	27,1	27,1	26,9	27,3	27,4	27,3	27,3	**0,74**
TOTAL	75,8	75,2	77,1	74,4	73,5	74,2	73,4	74,3	73,8	73,5	73,8	74,2	74,5	75,1	**1,08**

Per capita alcohol retail sales increased between 2012 and 2018 by 1%.

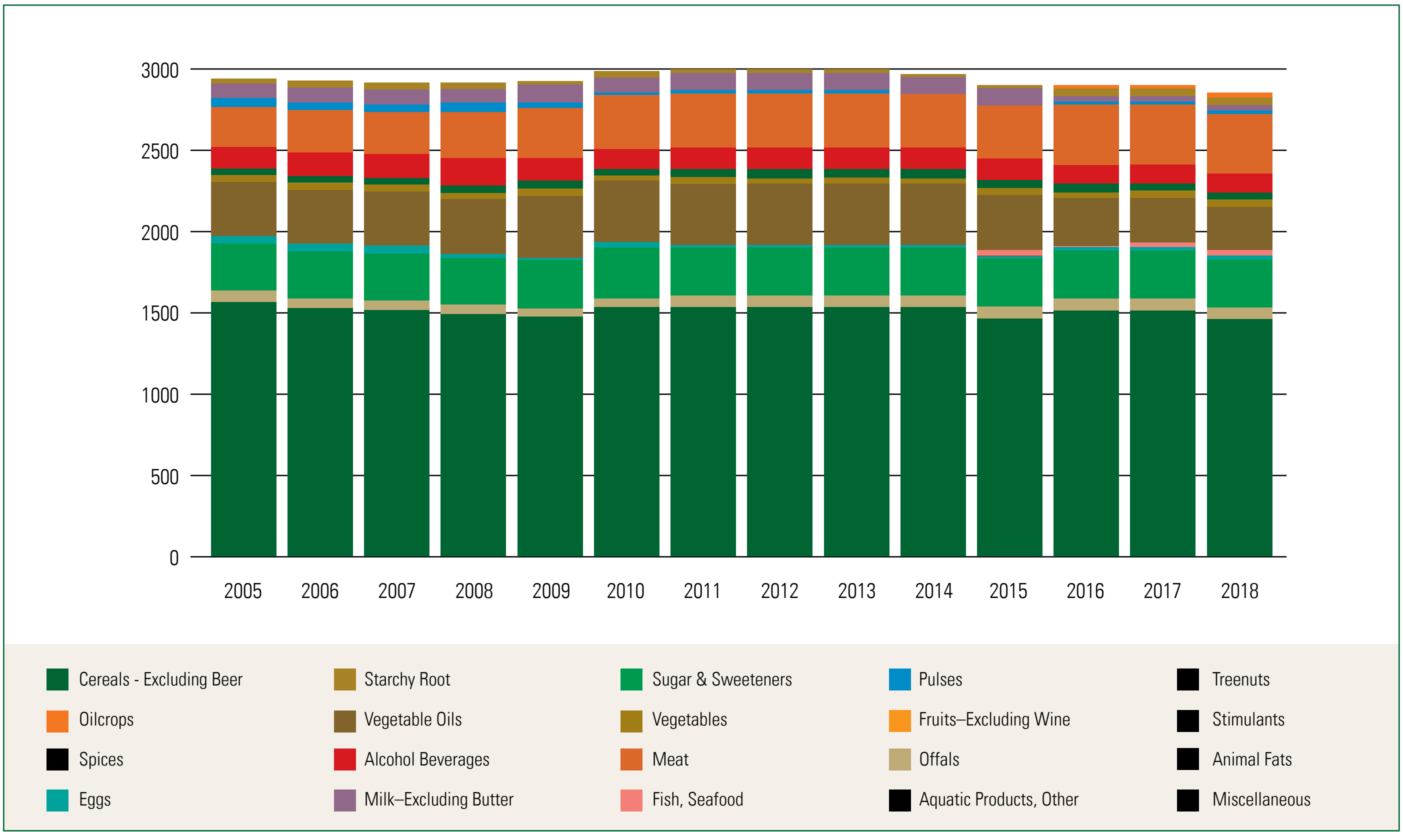

Figure 2.1: Food groups' contribution (%) to total kilocalories per capita per day (2005–2018) based on FAO food balance sheets

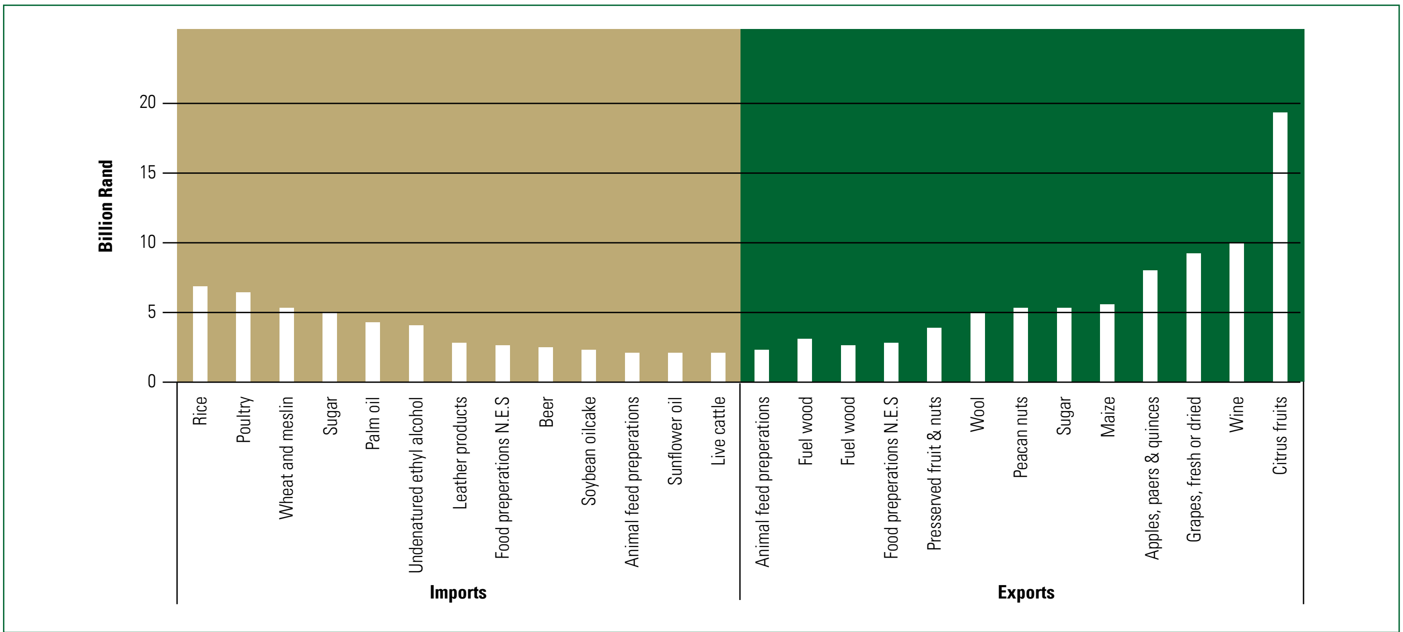

Figure 2.2: South Africa's major agricultural and food product imports and exports, 2019

Source: BFAP[13]

In 2018, approximately 181kg per capita per annum of cereals were available for consumption. More than 50% of this apparent consumption consisted of maize and related products. This was followed by wheat and related products (33% in 2018) and rice (13% in 2018). Traditional cereals such as millet and sorghum had relatively low demand, with each comprising less than 1% of total cereals supply throughout the period under consideration. While rice demand appears to have grown over time, as shown by increased availability (Table 2.2), retail sales of rice appear to be declining (Figure 2.3).

Table 2.2: FAO cereals supply (kilograms per capita per annum), 2005–2018

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Total cereals — excluding beer	186.1	180.1	179.1	174.8	173.2	179.3	180.4	178.4	180.0	186.9	178.0	183.6	184.6	180.5
Wheat and products	59.4	60.4	60.3	60.1	59.5	58.7	60.5	60.0	60.1	57.5	46.8	56.7	52.0	59.2
Rice and products	15.6	15.7	15.7	15.6	16.6	16.5	16.7	16.5	17.4	25.1	25.0	24.9	22.9	23.1
Barley and products	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Maize and products	108.0	101.2	100.1	96.7	94.2	101.2	100.4	99.4	100.1	102.0	103.2	99.6	106.9	95.1
Rye and products	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Oats	1.0	1.0	1.1	0.7	1.1	1.1	1.1	1.6	0.8	0.6	1.2	0.9	1.6	1.5
Millet and products	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Sorghum and products	1.7	1.5	1.5	1.3	1.5	1.4	1.4	0.7	1.4	0.8	0.7	0.6	0.3	0.7
Other cereals	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.8	0.8	0.7	0.7	0.7

The cereal supply between 2012 and 2018 increased in the case of wheat, rice and maize by -0.5%, 39.2% and 1%, respectively. The rice trajectory continued from 1994, with Ronquest-Ross *et al.*[6] reporting a 48% increase, while the negative supply of maize previously reported did not continue. Sorghum and millet continued to decline in production over this period at -58% and -50%, respectively.

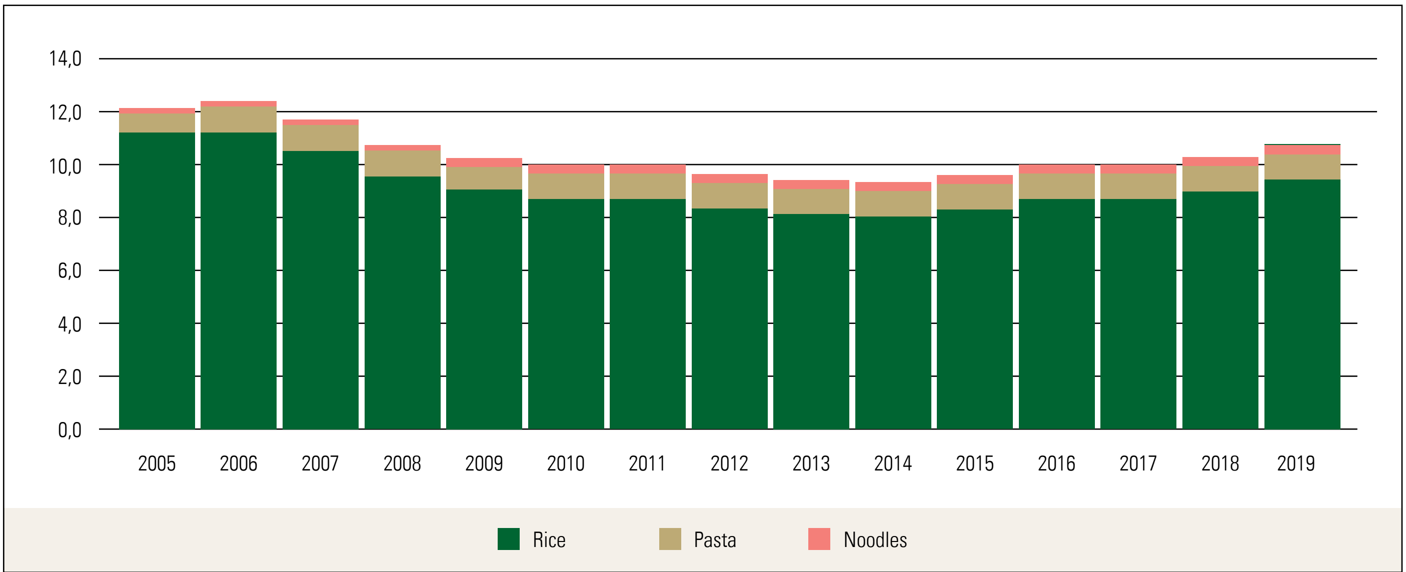

Figure 2.3: Euromonitor consumption of pasta, rice and noodles (kilograms per capita per annum), 2005–2019

The supply of fresh produce was primarily negative according to FAO balance sheets,[1] with fruits, vegetables, nuts and pulses changing by -21%, -7.69%, -66.67%, and -54.29%, respectively (Table 2.3). Starchy root supply experienced a positive growth rate of 8.72% over the period 2012–2018. Euromonitor data showed a marginal change in these products in terms of retail over the same period (5%, 4%, 7.69%, -4.17% and -4.98%, respectively) (Table 2.4). This continued the trajectory documented by Ronquest-Ross *et al.*[6] for the period 1994–2012.

Table 2.3: FAO fresh produce supply (kilograms per capita per annum), 2005–2018

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Fruits	36.5	37.6	34.0	36.2	32.9	33.6	38.6	32.7	38.0	31.2	29.4	21.2	19.9	22.7
Vegetables	41.9	40.0	42.1	44.8	42.9	45.6	45.1	46.8	43.0	41.3	44.2	40.8	42.2	39.6
Nuts	0.3	0.4	0.4	0.4	0.3	0.3	0.4	0.4	0.3	0.1	0.1	0.1	0.1	0.1
Pulses	2.8	3.3	3.0	2.9	3.5	3.0	2.8	2.8	2.3	2.5	2.3	1.6	1.6	1.6
Starchy roots	29.9	31.0	32.4	33.2	29.8	33.5	34.0	34.1	31.8	32.6	32.3	32.2	32.3	32.4
Sugar and sweeteners	30.7	31.3	30.7	30.0	30.4	35.2	35.0	36.0	36.9	44.6	45.6	43.3	41.7	41.3

The most noticeable change in fresh food*[2] supply and consumption (Table 2.3 and Table 2.4) was in meat consumption. Euromonitor data show that this increased from 44.7kg per capita in 2005 to 53.9kg per capita in 2019 (Table 2.5), representing a 21% increase over the period.

Table 2.4: Euromonitor consumption of fresh produce (kilograms per capita per annum), 2005–2019

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Fruits	22.0	22.3	22.5	22.6	22.7	23.3	23.1	23.7	23.8	23.9	24.0	23.9	23.9	24.0	24.0
Vegetables	35.6	35.9	35.9	35.9	35.9	36.1	36.2	36.1	36.1	36.4	36.7	36.7	36.9	37.1	37.6
Nuts	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.4
Pulses	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.3	2.3	2.3	2.3	2.3	2.3
Starchy roots	26.9	26.8	27.6	27.7	27.9	27.9	27.7	27.8	27.6	27.4	27.3	26.8	26.6	26.9	27.2
Sugar & sweeteners	26.5	26.9	26.8	26.7	26.5	26.5	26.4	26.1	26.0	25.8	25.7	25.5	25.3	25.1	24.9

A similar trend was observed when FAO data were examined. Kilograms-per-capita supply increased from 45.9 in 2005 to 64.1 in 2018 (Table 2.6). The increase in meat consumption was driven mainly by higher consumption of beef and veal, as well as poultry which, based on Euromonitor data, increased by 31% and 23% between 2005 and 2019, respectively.

*[2] In Euromonitor, fresh food refers to refresh, uncooked and unprocessed foods (packaged and unpackaged). It includes the following products: packaged dried fruits, packaged raw sugar products and natural sweenteners, e.g., brown sugar, table sugar and honey.

Table 2.5: Euromonitor consumption of animal meats and products (kilograms per capita per annum), 2005–2019

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Fish and seafood	5.5	5.5	5.5	5.5	5.5	5.5	5.6	5.6	5.6	5.6	5.7	5.7	5.8	5.8	5.9
Total meat	44.7	45.4	46	46.6	47.3	47.7	48.4	48.6	49.2	50.1	51.1	52.1	52.7	53.2	53.9
Beef and veal	14.6	15	15.8	16.2	16.5	16.9	17.3	17.4	17.6	17.9	18.2	18.5	18.7	18.9	19.1
Lamb, mutton and goat	2.9	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.9	2.9	2.9	2.9	2.9	2.9	.03
Pork	4.3	4.3	4.3	4.3	4.2	4.2	4.2	4.1	4.1	4.1	4.1	4.2	4.2	4.0	3.9
Poultry	22.2	22.5	22.4	22.6	22.9	23	23.4	23.4	23.9	24.4	25.2	25.8	26.3	26.7	27.3
Other meat	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.7
Eggs	7.2	7.3	7.6	7.7	7.7	7.9	8.1	8.2	8.5	8.5	8.6	8.6	8.0	8.1	8.2

Table 2.6: FAO meats and meat products supply (kilograms per capita per annum), 2005–2018

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Fish and seafood	8.5	7.9	7.8	6.9	5.1	5.9	5.7	7.5	6.3	7.1	6.5	6.2	6.4	6.4
Total meat	45.9	49.5	52.8	56.6	57.5	58.2	59.3	60.4	64.9	63.6	63.3	64.8	62.5	64.1
Bovine meat	14.7	16.5	16.2	15.3	15.1	16.3	15.8	15.9	18.0	17.8	18.7	18.6	17.1	16.7
Mutton and goat meat	3.6	3.8	3.3	3.9	3.8	3.6	3.3	3.5	4.3	3.4	3.2	3.2	3.2	3.2
Pig meat	3.6	3.5	5.0	6.2	6.6	4.4	4.5	4.6	4.2	4.4	4.5	4.4	4.3	4.8
Poultry meat	23.6	25.3	27.8	30.5	31.3	33.2	34.8	35.5	37.6	37.2	36.1	37.8	37.1	38.6
Meat, other	0.4	0.4	0.5	0.7	0.7	0.8	0.9	0.9	0.9	0.8	0.9	0.8	0.8	0.8
Total offal	4.2	4.3	4.6	4.6	4.7	4.8	4.9	4.9	4.8	7.0	7.1	7.5	5.1	5.3
Eggs	5.9	6.6	6.9	7.2	6.5	6.7	7.3	7.6	7.2	6.1	6.9	6.2	5.8	5.9

2.3.2 Trends in retail sales of packaged foods

This section focuses on trends in sales of packaged foods, which include retail sales and those from food service outlets. Table 2.7 shows sales of processed meats, fruit and vegetables (expressed as per capita consumption). Compared to fresh foods, processed meats and vegetables have shown slight increases in sales, with the most notable change occurring in sales of frozen processed potatoes and frozen processed vegetables, which recorded a 21% and 38% increase in consumption between 2005 and 2019, respectively. Sales of processed meat remained fairly stable, except for a decline in 2019 which was driven mainly by decreased sales of chilled processed meat.

Table 2.8 shows trends in dairy consumption, based on retail and food service sales. In line with evidence from various studies showing increased consumption of dairy products, the data show that demand for packaged dairy products has increased over time. Fresh and shelf-stable cow's milk shows the most notable rise, increasing by 21% between 2005 and 2019. In addition, the consumption of flavoured milk drinks has seen a steady rise, increasing by 74% between 2005 and 2019. Other products that have shown significant increases are yoghurts. Between 2005 and 2019, consumption of drinking yoghurt and flavoured yoghurt increased by 150% and 94%, respectively.

Table 2.7: Euromonitor consumption of processed meat, fruit and vegetables (kilograms per capita per annum), 2005–2019

PROCESSED MEAT AND SEAFOOD	2005	2007	2009	2011	2013	2015	2017	2019
Total processed meat and seafood (total)	3.8	3.6	3.5	3.5	3.6	3.6	3.6	3.1
Total processed meat	1.7	1.7	1.7	1.8	1.7	1.7	1.7	1.2
Shelf-stable processed red meat	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2
Chilled processed meat	1.4	1.4	1.4	1.4	1.4	1.4	1.4	0.9
Chilled processed red meat	1.3	1.3	1.3	1.3	1.3	1.3	1.3	0.8
Chilled processed poultry	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Frozen processed meat	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Frozen processed red meat	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0
Frozen processed poultry	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Processed seafood	2.0	1.7	1.6	1.6	1.7	1.7	1.7	1.7
Chilled processed seafood	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Frozen processed seafood	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2
Meat substitutes	0.2	0.2	0.1	0.1	0.2	0.2	0.2	0.2
Shelf-stable meat substitutes	0.2	0.2	0.1	0.1	0.1	0.2	0.2	0.2
PROCESSED FRUITS AND VEGETABLES								
Total processed fruit and vegetables (total)	6.2	6.9	6.3	6.6	6.5	6.6	6.6	6.8
Shelf-stable fruit and vegetables	2.8	3.0	2.6	2.6	2.7	2.7	2.7	2.7
Shelf-stable beans	1.2	1.3	0.9	0.9	1.0	1.1	1.1	1.1
Shelf-stable fruit	0.4	0.4	0.4	0.4	0.4	0.4	0.3	0.3
Shelf-stable tomatoes	0.2	0.2	0.2	0.3	0.2	0.2	0.2	0.2
Shelf-stable vegetables	1.0	1.0	1.0	1.0	1.1	1.1	1.0	1.0
Frozen processed fruit and vegetables	3.4	3.9	3.7	4.0	3.9	3.9	3.9	4.1
Frozen fruit	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Frozen processed potatoes	2.4	2.8	2.6	2.8	2.7	2.7	2.7	2.9
Frozen processed vegetables	0.8	0.9	0.9	1.0	1.0	1.0	1.1	1.1

Table 2.8: Euromonitor consumption of dairy products (kilograms/litres per capita per annum), 2005–2019

DAIRY	2005	2007	2009	2011	2013	2015	2017	2019
Total butter and spreads:	3.2	3.2	3.2	3.3	3.3	3.3	3.1	3.1
Butter	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3
Cooking fats	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Margarine and spreads	2.9	2.9	2.9	3.0	3.1	2.9	2.9	2.8
Total cheese:	2.4	2.4	2.5	2.6	2.7	2.9	3.1	3.2
Processed cheese	0.5	0.5	0.5	0.5	0.6	0.7	0.7	0.7

Table 2.8 continued

DAIRY	2005	2007	2009	2011	2013	2015	2017	2019
Unprocessed cheese	1.9	2.0	2.0	2.0	2.1	2.3	2.4	2.4
Hard cheese	1.3	1.3	1.4	1.4	1.5	1.6	1.7	1.8
Soft cheese	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Total drinking milk products:	26.5	27.7	26.0	27.6	29.4	31.3	32.7	33.0
Flavoured milk drinks	2.3	2.7	2.3	2.5	3.0	3.5	3.9	4.0
Dairy only flavoured milk drinks	0.3	0.3	0.3	0.4	0.5	0.5	0.5	0.5
Flavoured milk drinks with fruit juice	2.0	2.4	2.0	2.1	2.5	3.0	3.4	3.5
Cow's milk	23.6	24.5	23.1	24.6	25.9	27.3	28.2	28.5
Total fresh milk:	15.1	14.6	13.9	13.9	14.0	13.8	13.3	12.4
Fat-free fresh milk	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1
Semi-skimmed fresh milk	1.6	1.6	1.6	1.5	1.6	1.6	1.5	1.4
Full fat fresh milk	13.3	12.9	12.2	12.2	12.3	12.1	11.6	10.9
Shelf-stable milk:	8.6	9.8	9.2	10.6	11.8	13.5	15.0	16.1
Fat-free shelf-stable milk	1.1	1.1	1.3	1.5	1.6	1.9	2.1	2.2
Semi skimmed shelf-stable milk	1.4	1.5	1.7	2.0	2.2	2.5	2.8	3.0
Full fat shelf-stable milk	6.1	7.2	6.2	7.2	8.0	9.1	10.1	10.9
Powder milk	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4
Milk alternatives — soy drinks	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.2
Total yoghurt and sour milk products:	3.6	4.0	4.4	5.0	5.5	6.2	6.6	6.7
Sour milk products	1.6	1.6	1.7	1.8	2.0	2.5	2.6	2.8
Yoghurt	2.0	2.4	2.8	3.2	3.5	3.8	3.9	3.9
Drinking yoghurt	0.2	0.3	0.4	0.4	0.4	0.5	0.5	0.5
Flavoured yoghurt	1.6	1.8	2.2	2.6	2.9	3.1	3.2	3.1
Plain yoghurt	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Total other dairy products:	1.9	1.9	2.0	2.1	2.2	2.3	2.5	2.5
Chilled and shelf-stable desserts	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6
Coffee whiteners	0.8	0.8	0.8	0.9	1.0	1.1	1.2	1.3
Condensed milk	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Cream	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Fromage frais and quark	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Between 2005 and 2019, sales (expressed as consumption) of packaged bread increased by 29%, from 9.2kg per capita per annum to 11.9kg per capita per annum. This equates to at least one slice of bread per capita per day. Packaged bread includes all types of flat and leavened bread that are produced industrially and sold in a pre-packaged state, including chapati, pita, naan, tortilla, rolls, and white and brown leavened breads. In contrast, sales (expressed as consumption) of unpackaged breads, which mainly consist of flat bread and leavened bread made according to artesian methods, showed only a slight increase between 2005 and 2015, after which there was a sustained decline until 2019. Sales of other baked goods, such as cakes, dessert mixes, and packaged and unpackaged pastries, have remained fairly stable over the years, but sales of frozen baked goods appear to have shown a steady decline in demand (Table 2.9).

Table 2.9: Euromonitor consumption of bread and baked goods (kilograms per capita per annum), 2005–2019

	2005	2007	2009	2011	2013	2015	2017	2019
Packaged bread	9.2	9.5	10.2	10.9	11.3	11.3	11.6	11.9
Unpackaged bread	11.3	11.6	11.9	12.2	12.1	12.0	11.9	11.7
Cakes	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Dessert mixes	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Frozen baked goods	0.6	0.6	0.5	0.5	0.5	0.5	0.4	0.4
Packaged pastries	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Unpackaged pastries	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7

Processed breakfast cereals have become increasingly popular over the years. The most notable change, as shown in Figure 2.4, is the 67% increase in the consumption of hot cereals[*2] between 2005 and 2019. Ready-to-eat (RTE) cereals increased by 50% between 2005 and 2019. This increase was mainly driven by the rise in consumption of family breakfast cereals, which increased by 67% between the two periods. Consumption of children's breakfast[*3] cereals remained fairly stable.

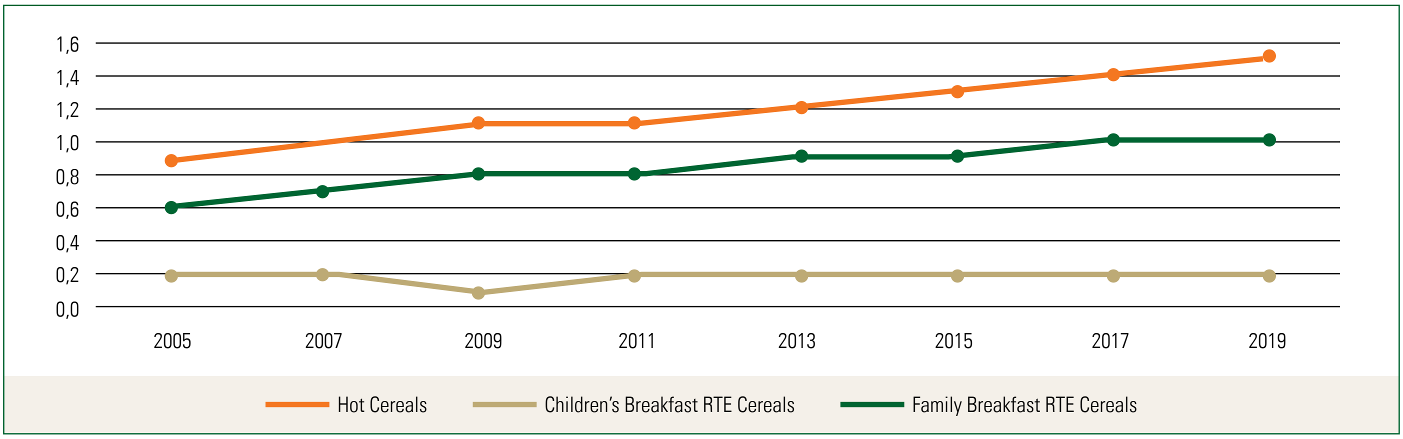

Figure 2.4: Euromonitor consumption of breakfast cereals sales (kilograms per capita per annum), 2005–2019

[*2] Hot cereals includes porridge and instant hot cereals e.g. oat, wheat, rice, etc. Instant hot cereals are defined by the fact that they can be made in a dish with added water or milk and can be microwaved.

[*3] Children's breakfast cereals includes breakfast cereals of all type which are explicitly marketed at children and/or adolescents. Packaging and advertising is specifically developed to target children. Many products are sweet or chocolate-based variants of family products.

Other processed foods that showed a rise in demand include chilled ready meals. Between 2005 and 2019, there was a 50% increase in sales (expressed as consumption) of these packaged foods. Sweet and savoury snacks also showed increased consumption. Sales (expressed as consumption) of plain biscuits increased by 250% between 2005 and 2019, while potato chips and puffed snacks increased by 133% and 40%, respectively (Table 2.10). Plain biscuits and potato chips appear to have been the most prominent snacks, with both recording kg per capita sales of 1.4 in 2019—up from 0.4 and 0.6 in 2005, respectively.

Table 2.10: Euromonitor consumption of ready meals, and sweet and savoury snacks (kilograms per capita per annum), 2005–2019

	2005	2007	2009	2011	2013	2015	2017	2019	% change 2005–2019
Chilled pizza	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Chilled ready meals	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	50%
Frozen pizza	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	
Frozen ready meals	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.1	
Fruit snacks (dried fruit)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Total snack bars	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Chocolate coated biscuits	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Cookies	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Filled biscuits	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Plain biscuits	0.4	0.5	0.6	0.7	0.9	1.1	1.3	1.4	250%
Nuts, seeds and trail mixes	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Potato chips	0.6	0.7	0.8	0.9	0.9	1.1	1.2	1.4	133%
Tortilla chips	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	50%
Puffed snacks	0.5	0.6	0.6	0.6	0.7	0.7	0.7	0.7	40%
Savoury biscuits	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	33%
Popcorn	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Other savoury snacks	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Frozen desserts	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	-50%
Ice cream	1.0	1.0	1.1	1.0	1.0	1.0	1.0	1.0	
Chocolate confectionery	0.8	0.9	1.0	1.0	0.9	0.9	0.9	0.9	12.5%
Gum	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Sugar confectionery	1.0	1.1	1.1	1.0	1.0	1.1	1.1	1.1	10%

2.3.3 Trends in sales of soft drinks

Consumption of soft drinks has increased over time, based on sales data from Euromonitor (Figure 2.5). The most notable changes are evident in carbonated drinks (sweetened, non-alcoholic drinks that contain carbon dioxide) which recorded increased sales of 51%, from approximately 60.4 litres per capita per annum in 2007 to 91.2 litres per capita per annum in 2019 (Table 2.11). This translates into an increase in daily consumption of carbonates of 165mL to 250mL per capita per day.

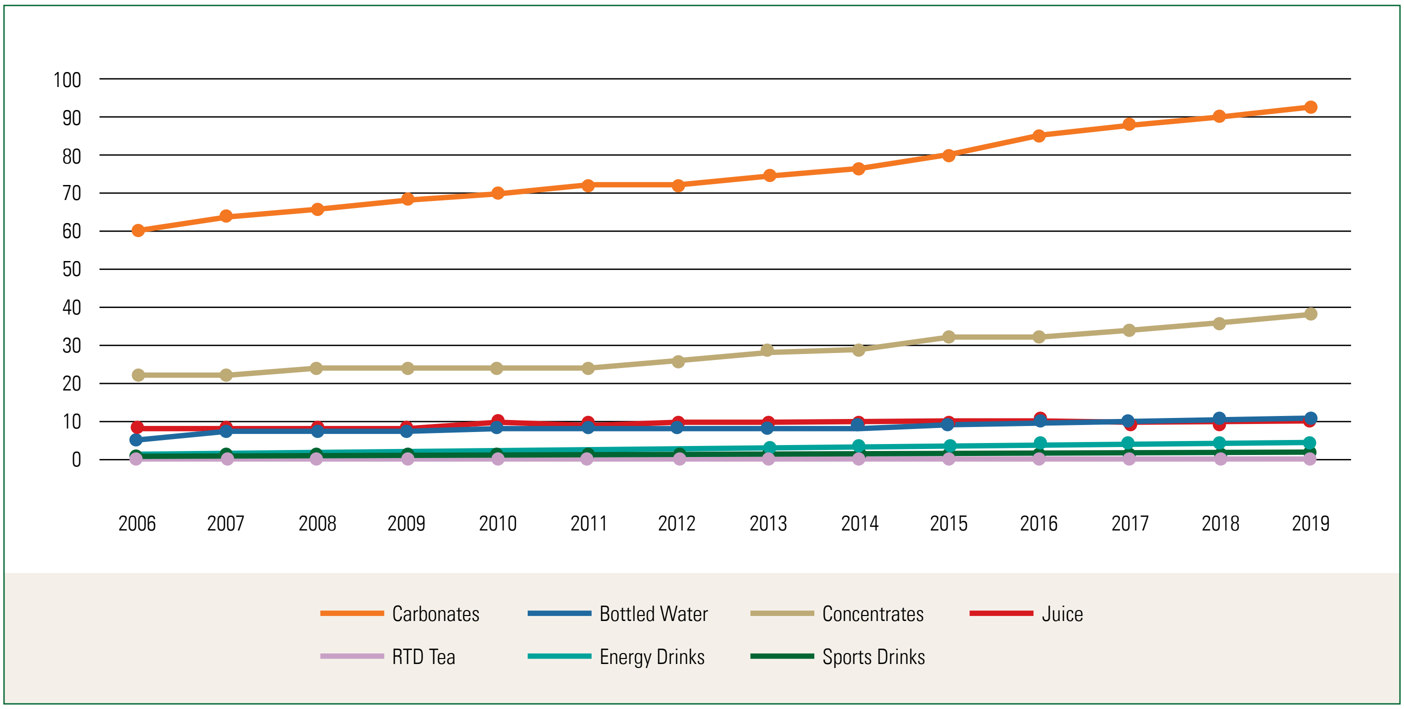

Figure 2.5: Euromonitor consumption of non-alcoholic beverages (litres per capita per annum), 2006–2019

The increase in consumption of carbonates was mainly driven by increased consumption of non-cola carbonates, such as lemonade/ lime, ginger ale, tonic water, orange carbonates and other non-cola carbonates. Consumption of these soft drinks increased by 82%, compared to a 27% increase recorded in cola carbonates with the total volume of cola and non-cola carbonates now being similar (Table 2.11). Cola carbonates are sweetened, non-alcoholic drinks that combine caffeine, caramel colour and sweetener. In contrast, non-cola carbonates comprise all other carbonated drinks that are not cola carbonates, but exclude carbonated waters, ready-to-drink (RTD) teas and coffees, and energy and sports drinks.

Table 2.11: Euromonitor consumption of non-alcoholic beverages (litres per capita per annum), 2007–2019

	2007	2009	2011	2013	2015	2017	2019
Bottled water	6.3	7.1	7.7	8.3	9.1	9.9	11.2
Carbonated bottled water	1.4	1.7	1.9	2.0	2.1	2.2	2.3
Flavoured bottled water	1.2	1.3	1.4	1.5	1.6	1.7	1.8
Functional bottled water		0.0	0.1	0.1	0.1	0.2	0.2
Still bottled water	3.7	4.1	4.3	4.7	5.2	5.8	6.9
Carbonates	64.1	67.5	70.7	73.5	79.9	86.6	91.2
Cola carbonates	35.1	35.6	35.1	35.2	37.1	39.9	42.8
Low-calorie cola carbonates	3.6	3.8	3.5	3.6	3.8	4.8	6.1
Regular cola carbonates	31.5	31.8	31.6	31.6	33.3	35.1	36.6
Non-cola carbonates	29.0	31.8	35.5	38.3	42.8	46.7	48.4

Table 2.11 continued

	2007	2009	2011	2013	2015	2017	2019
Lemonade/Lime	9.0	9.4	9.6	9.7	10.3	10.8	11.7
Ginger ale	0.2	0.2	0.2	0.2	0.3	0.3	0.3
Tonic water/other bitters	0.4	0.4	0.5	0.6	0.7	0.7	0.8
Orange carbonates	4.2	4.2	5.2	5.3	5.6	6.3	6.4
Other non-cola carbonates	15.2	17.7	19.9	22.4	25.9	28.6	29.2
Concentrates	22.7	24.1	25.2	27.1	31.1	33.8	36.5
Liquid concentrates	21.9	23.3	24.3	26.3	30.3	33.0	35.6
Powder concentrates	0.8	0.8	0.8	0.8	0.8	0.8	0.9
Juice	7.4	7.8	8.4	8.9	9.5	9.3	8.8
100% juice	5.4	5.8	6.5	7.0	7.5	7.3	6.9
Not from concentrate 100% juice	3.4	3.5	3.8	4.1	4.4	4.2	4.0
Reconstituted 100% juice	2.1	2.3	2.6	2.9	3.1	3.0	2.9
Juice drinks (up to 24% juice)	0.2	0.3	0.2	0.2	0.2	0.2	0.2
Nectars	1.7	1.7	1.7	1.7	1.7	1.8	1.7
RTD tea	0.6	0.7	0.8	0.9	1.0	1.1	1.0
Energy drinks	0.9	1.2	1.6	2.0	2.6	3.0	3.4
Sports drinks	0.8	0.9	1.0	1.1	1.2	1.4	1.4

Besides carbonates, soft drinks that are classified as concentrates have also recorded a steady increase in consumption over time. A comparison of 2007 and 2019 sales shows that consumption of these items increased by 61% in that period. While concentrates come in both liquid and powder form, it is the consumption of the former that has increased significantly, by approximately 63% when comparing sales in 2007 and 2019. Besides concentrates and carbonates, bottled water has also seen increased demand, from 6.3 litres per capita per annum in 2007 to 11.2 litres per capita per annum in 2019, representing a 78% increase in consumption in that period (Table 2.13).

The rates of change in sales (i.e., procurement) of packaged food products in the periods 2007–2013 and 2013–2019 were in general greater in the period 2013–2019. Particularly noteworthy was the negative growth rate in packaged total processed meat over the period 2013–2019, which included the removal of selected ready-to-eat processed meats from supermarket shelves due to the Listeriosis outbreak in 2018.[14] The positive growth in flavoured milk drinks was primarily the result of the growth in dairy-only flavoured milk drinks in 2007–2013 and flavoured milk and fruit juice drinks in 2013–2019. Fresh milk consumption saw no growth in the period 2007–2013 and negative growth in the period 2013–2019 (Table 2.12). This negative growth was absorbed by positive growth in shelf-stable milk over both periods, with the total current consumption of shelf-stable milk (46mL per capita per day) exceeding that of fresh milk (34ml per capita per day). The growth in sour milk product consumption was greater during the 2013–2019 period, while the growth in yoghurt consumption continued—albeit at a lower rate when compared to 2007–2013 (Table 2.12). The daily consumption of sour milk and yoghurt added another 8mL and 11mL per capita per day to bring the consumption of liquid dairy products to 108mL per capita per day.

Plain biscuit sales were overall of a low volume (4g per capita per day) but demonstrated growth of 80% and 55% over the two time periods (Table 2.12). Crisp (including chips, tortillas and puff snacks) sales translated into 7g per capita per day and in this group potato chips grew exponentially (28% and 55%) over the two time periods.

A small negative growth rate was recorded for fruit juice sales during the 2013–2019 period (Table 2.13). In contrast, the consumption of other sweetened beverages increased exponentially during both 2007–2013 and 2013–2019. This was true for cola carbonates (0.3% and 21.6%, respectively) which represent almost 47% of all carbonated beverages, non-cola carbonates (32.1% and 26.4%), concentrates (19.4% and 34.7%) as well as sweetened beverages with low volume sales like ready-to-drink tea (50% and 11.1%), energy drinks (122.2% and 70%) and sports drinks (37.5% and 27.3%) (Table 2.13). The total volume of concentrates sold in retail in 2019 was 100mL per capita per day and energy drinks was 9mL per capita per day, in addition to the 250mL per capita per day of carbonated drinks sold. It should be noted that although a 69% increase in volume of low-calorie beverages sold was recorded during 2013–2019, the total volume remained relatively low. The volume of low-calorie cola carbonated beverages sold was 18% of the volume of sweetened cola carbonated beverages in 2019.

Table 2.12: Rates of change in packaged food retail sales (kilograms per capita per annum), 2007–2013 and 2013–2019 (Euromonitor) (Processed meat and seafood; Dairy products; Baked products)

PROCESSED MEAT & SEAFOOD	2007	2013	2019	% CHANGE	
				2007–2013	2013–2019
Total processed meat and seafood (total)	3.6	3.6	3.1	0.0	-13.9
Total processed meat	1.7	1.7	1.2	0.0	-29.4
Shelf-stable meat substitutes	0.2	0.1	0.2	-50.0	100.0
DAIRY PRODUCTS	**2007**	**2013**	**2019**	**% CHANGE**	
				2007–2013	**2013–2019**
Total cheese:	2.4	2.7	3.2	12.5	18.5
Processed cheese	0.5	0.6	0.7	20.0	16.7
Unprocessed cheese	2.0	2.1	2.4	5.0	14.3
Hard cheese	1.3	1.5	1.8	15.4	20.0
Total drinking milk products:	27.7	29.4	33.0	6.1	12.2
Flavoured milk drinks	2.7	3.0	4.0	11.1	33.3
Dairy-only flavoured milk drinks	0.3	0.5	0.5	66.7	0.0
Flavoured milk drinks with fruit juice	2.4	2.5	3.5	4.2	40.0
Cow's milk	24.5	25.9	28.5	5.7	10.0
Total fresh milk:	14.6	14.0	12.4	-4.1	-11.4
Fat-free fresh milk	0.2	0.2	0.1	0.0	-50.0
Semi-skimmed fresh milk	1.6	1.6	1.4	0.0	-12.5
Full-fat fresh milk	12.9	12.3	10.9	-4.7	-11.4
Shelf-stable milk:	9.8	11.8	16.1	20.4	36.4
Fat-free shelf-stable milk	1.1	1.6	2.2	45.5	37.5
Semi-skimmed shelf-stable milk	1.5	2.2	3.0	46.7	36.4
Full-fat shelf-stable milk	7.2	8.0	10.9	11.1	36.3

Table 2.12 continued

DAIRY PRODUCTS	2007	2013	2019	% CHANGE	
				2007–2013	2013–2019
Powder milk	0.5	0.4	0.4	-20.0	0.0
Milk alternatives — soy drinks	0.1	0.1	0.2	0.0	100.0
Total yoghurt and sour milk products:	4.0	5.5	6.7	37.5	21.8
Sour milk products	1.6	2.0	2.8	25.0	40.0
Yoghurt	2.4	3.5	3.9	45.8	11.4
Drinking yoghurt	0.3	0.4	0.5	33.3	25.0
Flavoured yoghurt	1.8	2.9	3.1	61.1	6.9
Plain yoghurt	0.2	0.2	0.2	0.0	0.0
BAKED PRODUCTS	**2007**	**2013**	**2019**	**% CHANGE**	
				2007–2013	**2013–2019**
Packaged bread	9.5	11.3	11.9	18.9	5.3
Unpackaged bread	11.6	12.1	11.7	4.3	-3.3
Plain biscuits	0.5	0.9	1.4	80.0	55.6
Nuts, seeds and trail mixes	0.2	0.2	0.2	0.0	0.0
Potato chips	0.7	0.9	1.4	28.6	55.6
Tortilla chips	0.2	0.2	0.3	0.0	50.0
Puffed snacks	0.6	0.7	0.7	16.7	0.0
Savoury biscuits	0.3	0.3	0.4	0.0	33.3
Sugar confectionery	1.1	1.0	1.1	-9.1	10.0

Table 2.13: Rates of change in packaged food retail sales (litres per capita per annum), 2007–2013 and 2013–2019 (Euromonitor) (non-alcoholic beverages)

NON-ALCOHOLIC BEVERAGES	2007	2013	2019	% CHANGE	
				2007–2013	2013–2019
Bottled water	6.3	8.3	11.2	31.7	34.9
Carbonated bottled water	1.4	2.0	2.3	42.9	15.0
Flavoured bottled water	1.2	1.5	1.8	25.0	20.0
Functional bottled water		0.1	0.2		100.0
Still bottled water	3.7	4.7	6.9	27.0	46.8
Carbonates	64.1	73.5	91.2	14.7	24.1
Cola carbonates	35.1	35.2	42.8	0.3	21.6
Low-calorie cola carbonates	3.6	3.6	6.1	0.0	69.4
Regular cola carbonates	31.5	31.6	36.6	0.3	15.8
Non-cola carbonates	29.0	38.3	48.4	32.1	26.4

Table 2.13 continued

NON-ALCOHOLIC BEVERAGES	2007	2013	2019	% CHANGE	
				2007–2013	2013–2019
Lemonade/Lime	9.0	9.7	11.7	7.8	20.6
Ginger ale	0.2	0.2	0.3	0.0	50.0
Tonic water/other bitters	0.4	0.6	0.8	50.0	33.3
Orange carbonates	4.2	5.3	6.4	26.2	20.8
Other non-cola carbonates	15.2	22.4	29.2	47.4	30.4
Concentrates	22.7	27.1	36.5	19.4	34.7
Liquid concentrates	21.9	26.3	35.6	20.1	35.4
Powder concentrates	0.8	0.8	0.9	0.0	12.5
Juice	7.4	8.9	8.8	20.3	-1.1
100% juice	5.4	7.0	6.9	29.6	-1.4
Not from concentrate 100% juice	3.4	4.1	4.0	20.6	-2.4
Reconstituted 100% juice	2.1	2.9	2.9	38.1	0.0
Juice drinks (up to 24% juice)	0.2	0.2	0.2	0.0	0.0
Nectars	1.7	1.7	1.7	0.0	0.0
RTD tea	0.6	0.9	1.0	50.0	11.1
Energy drinks	0.9	2.0	3.4	122.2	70.0
Sports drinks	0.8	1.1	1.4	37.5	27.3

2.3.4 Range and sources of packaged food products for sale in South Africa

A survey in the six major supermarket chains in South Africa in 2018 yielded at least 5290 different packaged products and 1457 different beverages which carried a nutrition information panel at the back.[15] The majority of these packaged food products were processed (see Table 2.14) and were mostly ultra-processed when the NOVA classification[16] is applied. This list excluded unique packaged products that are found for sale in some spaza shops.

Table 2.14: Processed packaged foods in the South African market

Packaged food and beverages in South Africa (2018) classified as processed/ultra-processed. according to the NOVA classification system			
FOOD CATEGORY	TOTAL NUMBER OF PRODUCTS	NUMBER OF PRODUCTS CLASSIFIED AS PROCESSED	% OF PROCESSED FOODS (ACCORDING TO NOVA CLASSIFICATION)
Breakfast cereals	110	98	89.09
Cereals and cereal products	254	226	88.98
Confectionery and desserts	1119	1094	97.77
Dairy	791	682	86.22
Fruits	196	124	63.27

Table 2.14 continued

FOOD CATEGORY	TOTAL NUMBER OF PRODUCTS	NUMBER OF PRODUCTS CLASSIFIED AS PROCESSED	% OF PROCESSED FOODS (ACCORDING TO NOVA CLASSIFICATION)
Vegetables	510	369	72.35
Legumes	100	98	98.00
Mixed dishes	299	298	99.67
Protein	602	571	94.85
Snack foods	699	587	83.98
Soups and sauces	610	571	93.61
TOTAL FOOD	5290	4718	89.19
Dairy drinks	306	179	58.60
Other beverages	478	416	87.03
Sodas	288	287	99.65
100% fruit juice	385	10	2.60
TOTAL BEVERAGES	1457	892	61.22

Source: Analyses by Tamryn Frank (unpublished data)

2.3.5 Studies that reported on commercial food retail data and trends in the food retail environment

In conducting a scoping review for the period 2018–2020, the author found no papers with information on the food retail environment, using commercially available retail data in South Africa. Subsequently, a general literature search was conducted and papers purposefully included to provide a sense of the inferences that could be drawn from such data. The papers identified reported on the physical food environment, focusing on aspects such as the presence of supermarkets and fast-food outlets, and sales of sugar-sweetened beverages.

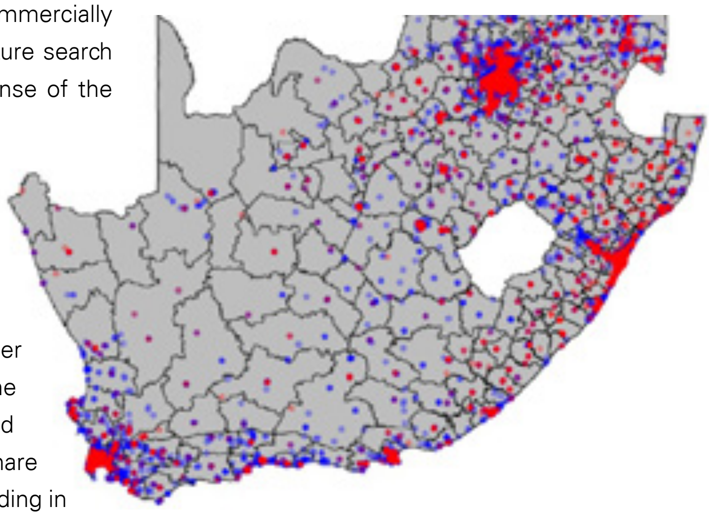

Figure 2.6: Spatial distribution of fast-food outlets and supermarkets in South Africa
Source: Otterbach *et al.*[17]
Note: Red dots represent supermarkets and blue dots represent fast-food outlets

Otterbach *et al.*[17] documented the location of fast-food outlets as well as supermarkets in South Africa in 2017 (see Figure 2.6). Their paper provides useful information on the formal food retail landscape in the country, comprising a total of 2862 supermarkets and 4450 fast-food outlets. The Shoprite/Checkers/OK conglomerate has the largest share of supermarket outlets (40%), with SPAR (30%) and KFC (21%) leading in terms of fast-food outlets (see Table 2.15). Research has revealed the mixed effects of the presence of supermarkets in a neighbourhood, including i) lower food prices due to economies of scale;[18] ii) increased variety of food, including fresh produce;[19] iii) displacement of local agricultural producer markets and/or small informal traders[18]—the latter being of particular importance for the most food insecure;[20] and iv) accessibility to unhealthy foods.[21]

The integration of the geolocations of food outlets with the National Income Dynamics Study (NIDS) by Otterbach *et al.*[17] allowed advanced and innovative analyses. Regression analyses that control for other factors affecting people's nutritional status (such as household socio-economic status, physical activity levels, ethnicity, etc.) suggest that a 10km decrease in the distance to the closest supermarket or fast-food restaurant was associated with a raised adult BMI by 0.14kg/m^2 and the probability of overweight and obesity by 1.2 percentage points.

Big food and fast food may not be the main drivers in South Africa, but they are likely to contribute to the problem of overweight and obesity.[17] Ndlovu *et al.*[22] argue that public health interventions should target areas whose food environment is characterised by high exposure to energy-dense food (such as from fast-food outlets rather than from food outlets providing healthy food options, such as supermarkets), thereby addressing structural rather than individual risk factors. Petersen and Charman[23] concluded that 39% of the total enterprises in informal settlements trade in food and that these enterprises—ranging from primary production, fresh produce retailing, grocery retailing from house and spaza shops, to informal foodservice enterprises—play an important role in creating cash employment and making food more affordable and locally accessible. Ndlovu *et al.*[22] concluded that in Gauteng province, the density of less healthy food outlets such as fast-food restaurants was much higher in low socio-economic areas, with fewer outlets providing healthier food options such as fresh produce.[22]

Table 2.15: Number of Western-style fast-food restaurants and supermarkets recorded by Otterbach *et al.*[17] in South Africa during 2017

SUPERMARKET		
COMPANY	NUMBER ON COMPANY WEBSITE	NUMBER ON GOOGLE
Shoprite	767	696
Checkers	243	814
OK	214	129
Pick n Pay	417	483
Boxer	143	72
Woolworths		289
SPAR	850	879
TOTAL	2634	2862

FAST-FOOD OUTLETS		
COMPANY	NUMBER ON COMPANY WEBSITE	NUMBER ON GOOGLE
KFC	850	955
Steers	542	612
Debonairs	473	526
Wimpy	492	440
Nando's	300	273
McDonalds	241	259
Chicken Licken	240	148
Fishaway	213	152
Roman's Pizza	202	295
Chesa Nyama	183	115
The Fish&ChipsCo	163	39
Hungry Lion	130	71

Table 2.15 continued

SUPERMARKET		
COMPANY	NUMBER ON COMPANY WEBSITE	NUMBER ON GOOGLE

FAST-FOOD OUTLETS		
COMPANY	NUMBER ON BUSINESS TECH	NUMBER ON GOOGLE
Domino's	125	87
Pizza Perfect	99	73
Panarottis	80	96
Mochachos	78	48
Burger King	70	66
Barcelo's	69	57
Milky Lane	59	14
Simply Asia	56	38
Zebro's	55	21
Rocomamas	48	4
Maxis	36	6
Pizza Hut	35	50
Walkaberry	34	5
TOTAL	**4863**	**4450**

Socio-economic status and food security were found to be associated with greater expenditure on food items in supermarkets but not with overall healthier food purchases.[24] The share of expenditure on sugar-sweetened beverages and snacks was higher than on fruit and vegetables in all socio-economic areas. Odenutan-Wayas *et al.*[24] concluded that food-secure shoppers spent more on food, but food items purchased frequently did not differ from those of food-insecure shoppers. According to the BFAP Baseline 2020–2029 report, low-income households make up 40% of the South African adult population and spend 36% of their income on food, contributing 20% to total food expenditure in the country. The 40% of adult South Africans in the middle-income group make the highest contribution to total food expenditure in the country (44%), although they spend only 23% of their income on food. Affluent households spend only 8% of their income on food, contributing 36% of total food expenditure in the country.[25]

Stacey *et al.*[26] used Kantar data on sugar-sweetened beverage consumption to illustrate the change in volume, sugar and energy provided by taxed and untaxed beverages before and one year after the implementation of the Health Promotion Levy (HPL). This revealed that the overall beverage consumption before the announcement of taxation was 801mL per person per day and changed to 755mL per person per day one year after the implementation of the HPL. The sales data from Kantar allowed the tracking of changes in beverage purchases, illustrating the decrease in taxed beverages from 65% of total volume consumed daily to 58%, which resulted in an estimated reduction of 3g of sugar per person per day. As mentioned in section 2.1, Kantar data are collected from a rolling panel of participants who document their food purchases by scanning barcodes of products.

2.4 DISCUSSION

The FAO[22,28] defines food self-sufficiency in broad terms as the extent to which a country can satisfy its food needs from its own domestic production. Based on the estimated average energy requirements of adults (at least 2500kcal per capita per day for the purpose of self-sufficiency), which is the energy provided by the food supply stated in this report, the imports and exports of the top 10 products[13] and the general perception that South Africa is self-sufficient[29] in terms of food production are confirmed.

In its action plan for the prevention of non-communicable diseases, the WHO[30] included guidelines for a healthy diet. It is recommended that such a diet includes:

- at least 400g (i.e., five portions) of fruit and vegetables per day, excluding potatoes, sweet potatoes, cassava and other starchy roots.
- less than 10% of total energy intake from free sugars, which is equivalent to 50g (or about 12 level teaspoons) for a person of healthy body weight consuming about 2000 calories per day, but ideally is less than 5% of total energy intake for additional health benefits. Free sugars are all sugars added to foods or drinks by the manufacturer, cook or consumer, as well as sugars naturally present in honey, syrups, fruit juices and fruit juice concentrates. No sugar should be added to complement foods for young children.
- less than 30% of total energy intake from fats, with saturated fats being reduced to less than 10% of total energy intake and trans-fats to less than 1% of total energy intake.
- less than 5g of salt (equivalent to about one teaspoon) per day. Salt should be iodised. No salt should be added to complement foods for young children.

The complex nutrient composition of foods renders FAO balance sheets and also industry data, such as Euromonitor data, inadequate for arriving at concrete conclusions about the quality of diets in a country. The data do, however, permit some conclusions to be drawn on fruit and vegetable consumption and sugar consumption, as illustrated by foods produced and foods sold in the country.

Four hundred grams (400g) of fruit and vegetables translate into around 195kcal per capita per day or 8% of a 2500kcal diet or 6.5% of the energy supply as per FAO balance sheets. The average total supply of 2% is therefore inadequate. It is noteworthy that fruits are the highest-value items in terms of exports from South Africa.[13] The economics of profit generation therefore appears to dictate either the lack of availability of fruit to South African consumers or the prices of fruit on local markets which renders fruit unaffordable for the South African population.

The growth in sweetened beverages sold over the period 2005–2019 is a cause for concern. Sugar-carbonated drinks sold translated into 250mL per capita per day, with an additional concentrate volume of 100mL per capita per day. Although the sugar content of beverages differs greatly, the sugar from sweetened beverages alone will contribute 20–40g of sugar per person per day—almost the maximum level of 50g of sugar recommended by the WHO[30] and exceeding the ideal recommendation to not acquire more than 5% of energy from sugar.

The low calcium intake of the South African population is well known. From the food retail data, it is again confirmed that, despite growth in shelf-stable milk, sour milk and yoghurt consumption, the total intake of calcium by the majority of South Africans (based on volume of liquid dairy and cheese sold) is likely to be less than 15% of the adequate intake[32] of 1000mg for adults 19–50 years. The cost of dairy products is usually mentioned as the most important reason why they are not consumed more often. Furthermore, the cost of refrigeration of dairy products also serves as a deterrent to regular use.

The growing volumes of ultra-processed foods that are consumed daily is a cause for concern. Ultra-processed foods are defined as food products manufactured from multiple ingredients, using a multitude of industrial processes to create the final product.[16] Ultra-processing causes deterioration in the original ingredients' food matrix and combines adulterated ingredients in ready-to-eat/heat, affordable and hyper-palatable products with increased energy density and sugars, saturated fats and/or salt contents, and with lower fibre content.[32] Such products may also contain a number of potentially harmful additives.[33] Higher consumption of ultra-processed foods has been associated with higher risks of non-communicable diseases, such as cardiovascular, coronary heart and cerebrovascular diseases.[34,35] It has also been found to contribute to weight gain in a clinical trial—even when the total energy content of the diets was similar.[36]

2.5 CONCLUSION

Based on our understanding of South Africa's particular context (as illustrated in the country's high poverty and unemployment levels), the differential consumption patterns based on regional and income deciles (as reported in Chapter 3) and our knowledge of food prices in the country, we can arrive at no resounding conclusion other than that there are extreme variations in intake, with low income being a key driver of food choices. Levels of procurement, as illustrated by retail changes of products such as shelf-stable meat/meat replacements, shelf-stable milk as well as some ultra-processed foods, are a case in point. The proportionate changes in ultra-processed foods and particularly beverage consumption should definitely be explored as a contributor to overweight, obesity and non-communicable disease in the country.

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CHAPTER 3

FOOD CONSUMPTION TRENDS DOCUMENTED IN NATIONALLY REPRESENTATIVE (AND OTHER) SURVEYS IN SOUTH AFRICA

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3.1 INTRODUCTION

Data mining of other studies may contribute to an understanding of food procurement and/or consumption; however, challenges are posed by the methodologies employed and the detail included in other studies that do not focus on food consumption or dietary intake. Other studies do, however, provide rich information on the context in South Africa. The foods people eat are driven by the context within which consumers live, with levels of poverty and access to resources related to food preparation and storage being important factors. This chapter reports on studies that provide insights into the context in the country and summarises relevant insights on food consumption—albeit from the perspective of expenditure, which cannot be directly translated into quantified food or nutrient intake (See Figure 1.2 in Chapter 1 for the conceptual framework.)

According to the Global Hunger Index (GHI), which measures and tracks hunger using a composite index of undernourishment, malnutrition (under 5-year-olds) and child mortality, South Africa has moderate levels of hunger, ranking 59th out of 117 countries, as assessed in 2019.[1] The Food and Agriculture Organization (FAO) estimates for undernourishment prevalence show that 6% of the country's population do not have access to diets that can meet daily dietary energy requirements.[*1] This is equivalent to 3.5 million people in a country with a population of 58.8 million people.[2] The undernourishment rate is a national estimate based on food supply data and provides limited information on the extent of food insecurity at the household or individual level. Therefore, while the prevalence of undernourishment may seem low, especially when compared to other countries in the region which report undernourishment rates of over 20%, household-level studies have consistently shown that a significant proportion of South African households experience hunger and consume poorly diversified diets.[3,4]

[*1] FAO Suite of Food Security Indicators: http://www.fao.org/faostat/en/#data/FS

In addition, South Africa's high levels of malnutrition, as measured by stunting and overweight/obesity, are indicative of the country's poor dietary intake. Estimates for under-5-year-olds show that 27% of children in this age group are stunted or have insufficient height for their age, while 13% of children in the same age category are overweight or obese.[5] Micronutrient deficiencies, such as vitamin A and iron deficiencies, are also highly prevalent among young children and women of reproductive age. Numerous studies have shown that poor diet is one of the main factors driving the high levels of malnutrition among young children and adults. Recent findings from the South African Demographic and Health Survey show that only 23% of children aged 6–23 months have access to the minimum acceptable diet, the vast majority of these being children from wealthier households.[6] The country's diet structure has also changed over time, with more consumption of Westernised diets that consist of foods high in salts, sugars and fats.[7,8]

Some of the drivers of food insecurity and poor dietary intake in South Africa are macro-level factors like climate change, which have affected agricultural production and food supply; global and country-level trade policies, which have contributed to increased imports of Westernised foods; and inflation, which has made healthy foods less economically accessible.[9] At the household level, the high cost of food and poverty reduce accessibility to healthy, nutritious and sufficient foods.[10] Estimates from StatsSA's income and expenditure surveys show that 56% of the country's population suffer from poverty, as measured by the upper-bound poverty line (R992 per person per month in 2015). A quarter of the country's population were living below the food poverty line in 2015 (R441 per person per month), meaning that they did not have enough money to satisfy their daily minimum nutritional needs.

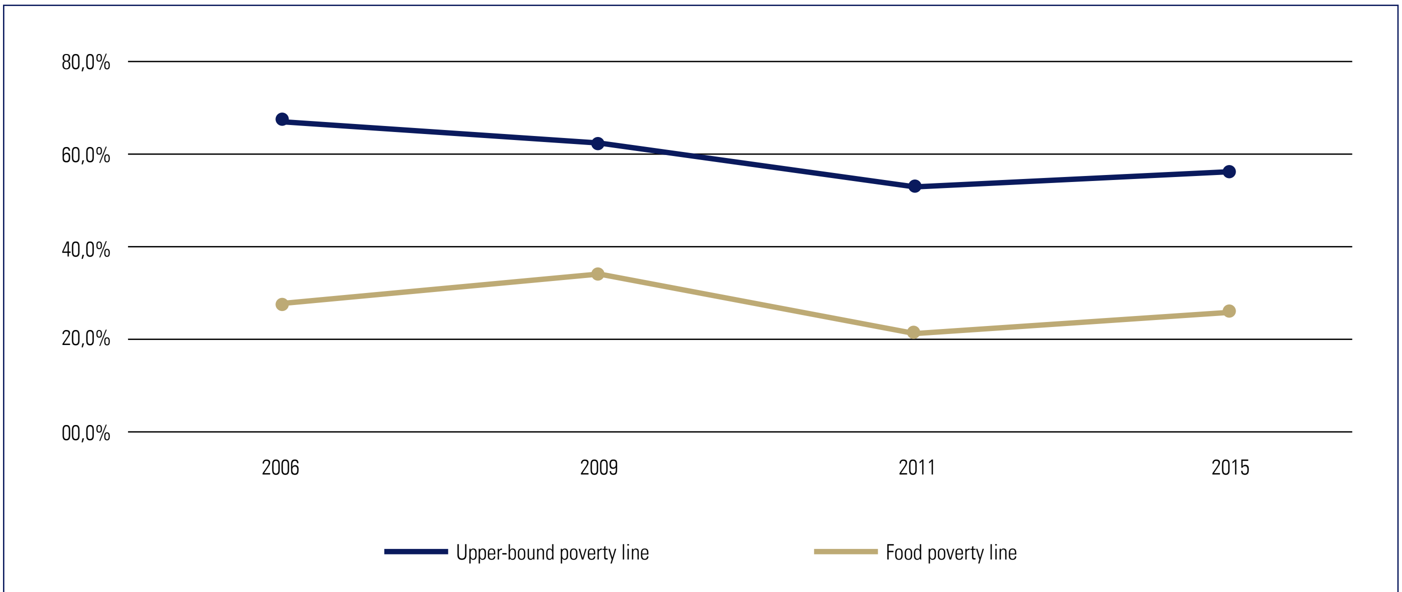


Figure 3.1: Poverty rates in South Africa, 2006–2015

In this review, the aim is to provide an overview of food security and nutrition trends in South Africa, focusing on nationally representative surveys that have been carried out to date. There are two main research questions that underpin this review:

1. What surveys (national/regional/district-level/community) have been conducted that have collected data on food and nutrition security?
2. What can these surveys tell us about food consumption in South Africa, and the trends over time?

This review focuses primarily on nationally representative surveys that have been conducted since 2000. The analysis is mainly descriptive, showing patterns and national/provincial trends over time where the data are available. Bivariate statistics are also used to show variations in food consumption across groups, such as geographical location (rural/urban), gender, age group and socio-economic status.

3.2 METHODOLOGY

This review draws on data from nationally representative surveys that have been carried out since 2000 by Statistics South Africa (StatsSA), the country's official statistical agency, and other research agencies. The surveys included in this review are outlined and discussed in more detail below.

- General Household Survey
- Income and Expenditure Survey(s)
- Living Conditions Survey(s)
- South African National Health and Nutrition Examination Survey
- South African Demographic and Health Survey

Although most of these surveys report on "consumption", they actually report on expenditure on foods consumed in the households. Out-of-household consumption, such as sit-down restaurants, are excluded.

National and regional surveys that reported on child hunger and adult food insecurity, and which are included in this chapter, are summarised in Tables 3.1–3.3.

3.2.1 The General Household Survey

The General Household Survey (GHS) is a longitudinal survey that has been carried out by StatsSA since 2002. It is a nationally representative survey, covering over 25,000 households each year, that collects data on household demography and socio-economic characteristics. The survey uses a two-stage, stratified sampling design, with the selection of the primary sampling unit from StatsSA's master frame, followed by the selection of the dwelling units. As such, estimates from the GHS are representative at national, provincial and, in some years, metro levels. There are a few indicators of food security that the GHS has continuously monitored, including household agricultural participation (2002–2018), child and adult hunger (2002–2018) and food accessibility (2009–2018). As from 2013, the survey began collecting data on food consumption based on a 24-hour recall period. The main food groups that respondents report consumption on are:

1) Maize, rice, sorghum, millet, bread and other cereals
2) Potatoes, sweet potatoes, cassava
3) Beans, peas, groundnuts, cashew nuts or other nuts
4) Spinach and wild green leaves
5) Other vegetables, carrots, relish, tomatoes, cabbage, beetroot, etc.
6) Fruit
7) Beef, goat, poultry (chicken), pork, fish, eggs, lamb

8) Milk, yoghurt and other dairy products
9) Sugar and sugar products
10) Oils, fat and butter

The GHS analysis included in this report covers the 2002–2018 period since the data for that period are publicly available.

3.2.2 The Income and Expenditure Surveys (2005/6 and 2010/11)

StatsSA conducts the Income and Expenditure Survey (IES) to collect statistical data on household income and consumption (expenditure) patterns that are then used to update the basket of goods and services included in the consumer price index (CPI) computation. These surveys are also used to produce poverty estimates for the country. The first Income and Expenditure Survey was conducted in 2000/01, followed by another in 2005/6 and the most recent one in 2010/2011.

3.2.3 The Living Conditions Surveys (2008/09 and 2014/15)

Another survey that is very similar to the IES is the Living Conditions Survey (LCS), first carried out in 2008/09 and then again in 2014/15. The aim of the LCS is to provide data for the analysis of living conditions and poverty trends in the country. The LCS is a much more extensive survey than the IES as it collects more detailed data, which allows for an assessment of poverty dynamics. However, like the IES, the LCS also collects detailed data on household consumption (expenditure). Both the IES and LCS are typically carried out over a one-year period and have large sample sizes. For example, the 2010/2011 IES covered 25,328 households, while the 2014/15 LCS covered 27,527 households. One of the main advantages of the IES and LCS is that in addition to a standard household questionnaire, the survey tools include a diary that records households' daily acquisitions (expenditure). The 2005/06 and 2008/09 surveys used four-week diaries to collect this information but in the later surveys, two-week diaries were used to reduce the burden placed on households. Through these diaries, the IES and LCS collect detailed data on expenditure on more than 300 food items, making it possible to analyse household spending on these items as well as produce estimates for household dietary diversity levels and the extent of consumption of processed and unprocessed foods. These surveys also produce data on household demographics and socio-economic status.

3.2.4 The South African National Health and Nutrition Examination Survey (SANHANES) (2011/12)

The SANHANES was designed as a national longitudinal survey that would provide data on the prevalence of non-communicable diseases (NCDs) and their demographic and socio-economic correlates. However, only one survey (2011/12) has been carried out to date. The survey used a multi-stage, disproportionate, stratified cluster sampling approach, with the selection of enumeration areas (EAs) from the 2001 census at the first stage and the selection of visiting points from EAs stratified by province, locality type and race (the latter being used for stratification in the urban areas only). The survey identified 8166 households for interviewing, although the realised sample was lower at 6305 households. The analysis contained in this report pertains to individuals aged 15 years and older. A total of 16,780 individuals in this age group were included in the survey. The SANHANES collected data on nutritional status of young children and adults, dietary intake and behaviour, as well as knowledge and attitudes towards NCDs, body image and weight management.

3.2.5 The South African Demographic and Health Survey (2016)

The aim of the South African Demographic and Health Survey (SADHS) is to provide information on health and nutrition indicators, including malnutrition and dietary intake. The 2016 survey was carried out by the National Department of Health in collaboration with StatsSA, the South African Medical Research Council and the ICF. Like other surveys carried out by StatsSA, the 2016 SADHS used a stratified, two-stage sampling design, where primary sampling units (PSUs) were selected in the first stage with probability proportional to PSU size using the 2011 census as the master sample frame. In the second stage, dwelling units were selected. In total, the SADHS successfully interviewed a sample of 11,083 households. The survey was designed to provide estimates that were representative of national, provincial and locality type (urban and non-urban areas). The analysis included in this review relates to young children aged under 5 years and individuals aged 15 years and older.

3.2.6 National and regional studies reporting on child hunger and adult food insecurity

Three national studies that reported on dietary intake in children included information on food security status within the household, using the Community Childhood Hunger Identification Project (CCHIP) Hunger Index.[11,12,13] The food security indicators used in the 2016 SADHS were based on whether the child went hungry because of insufficient food during the past 12 months.[14] Regional studies on children that reported on food security status of the household or the child used the CCHIP Hunger Index,[15,16,17] the Household Food Insecurity Access Scale (HFIAS),[18] the Children Food Insecurity Access Scale (CFIAS),[19] the Cornel Hunger Scale,[20] and the frequency of food available for consumption.[21]

In addition to the four national surveys mentioned above, two other national surveys and 14 regional studies reported on food security of adults within households. Assessment of food security depends to a large extent on the methodology employed to assess it. Food security was measured using the CCHIP Hunger index in the NFCS of 1999,[12] the SA NFCS-FB of 2005,[13] SANHANES[11] and AHA-FS.[22] Other tools that were used included the General Household Survey tool (FGT index),[23] Household Food Insecurity Access Scale,[24,25] the Cornell Hunger Scale,[20] USDA eight-questions tool,[27] Months of Adequate Dietary Diversity index,[25] Months of Adequate Household Food Provisioning,[25] Food Poverty Rate (based on a basic subsistence diet calculated as the cost of purchasing the very low-cost food ration scales)[28] and Coping Strategies index.[25] A single item household food insufficiency measure was used in three studies,[28–30] while a binary food insecurity tool was used in one study.[31] Finally, a food security measure based on the minimum per capita adult equivalent caloric intake was used in the Tugela Ferry irrigation scheme study.[32] The use of such a variety of tools to measure food security limits the comparability of the results of different studies.

3.3 RESULTS AND DISCUSSION

3.3.1 Trends in hunger, food insecurity and food accessibility in South Africa

Hunger is one of the most regularly monitored food security indicators in the GHS surveys. Usually, households are asked to state whether an adult or child went hungry in the 12 months preceding the survey, with the options presented to the respondent being: never, seldom, sometimes, often or always. Hunger is said to occur when children or adults reportedly go hungry sometimes, often or always.[33,34] The definition applied here is based on the Children's Institute children count definition used to assess child hunger levels in South Africa.**[*2]**Figure 3.2 shows the percentage of households that reported hunger among either children or adults. In

[*2] http://childrencount.uct.ac.za/indicator.php?domain=4&indicator=32

2002, 23% of households reported hunger but this declined gradually over the years to 10% by 2018. Despite this decrease, a significant proportion of households continued to report hunger, most notably in poor and rural households. In 2018, for example, 21% of households in the poorest income quintile reported hunger, compared to 3% of households in the richest income quintile.

Across provinces, the prevalence of hunger was highest in the North West province where 15% of households reported that either children or adults suffered from hunger (Figure 3.3). In contrast, the lowest hunger rates were in Limpopo province, which has high poverty rates but is also largely rural with significantly higher numbers of households participating in agricultural activities compared to other provinces. Despite being a relatively rich province compared to the rest, the Western Cape had relatively high levels of hunger, with 12% of households reporting hunger. This is possibly due to the high prevalence of poverty in the urban informal areas and the low levels of agricultural activity among households in the province. In contrast, hunger rates in Gauteng were the second lowest in the country, with 6% of households reporting hunger. KwaZulu-Natal and the Eastern Cape provinces, which have large populations and high levels of poverty, reported hunger rates of 13% and 8%, respectively.

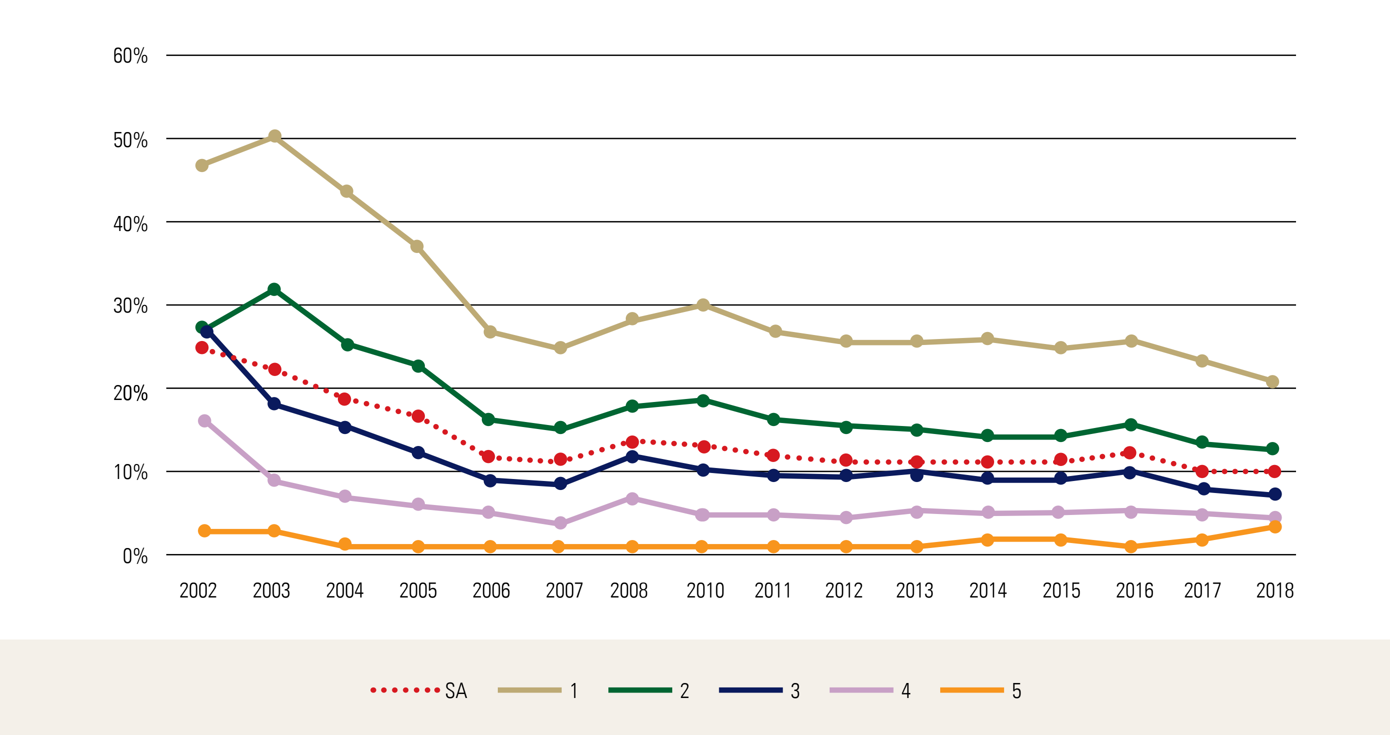


Figure 3.2: Hunger in households by income quintiles, GHS 2002–2018

Source: GHS 2002–2018; Analysis by W. Sambu and K. Hall

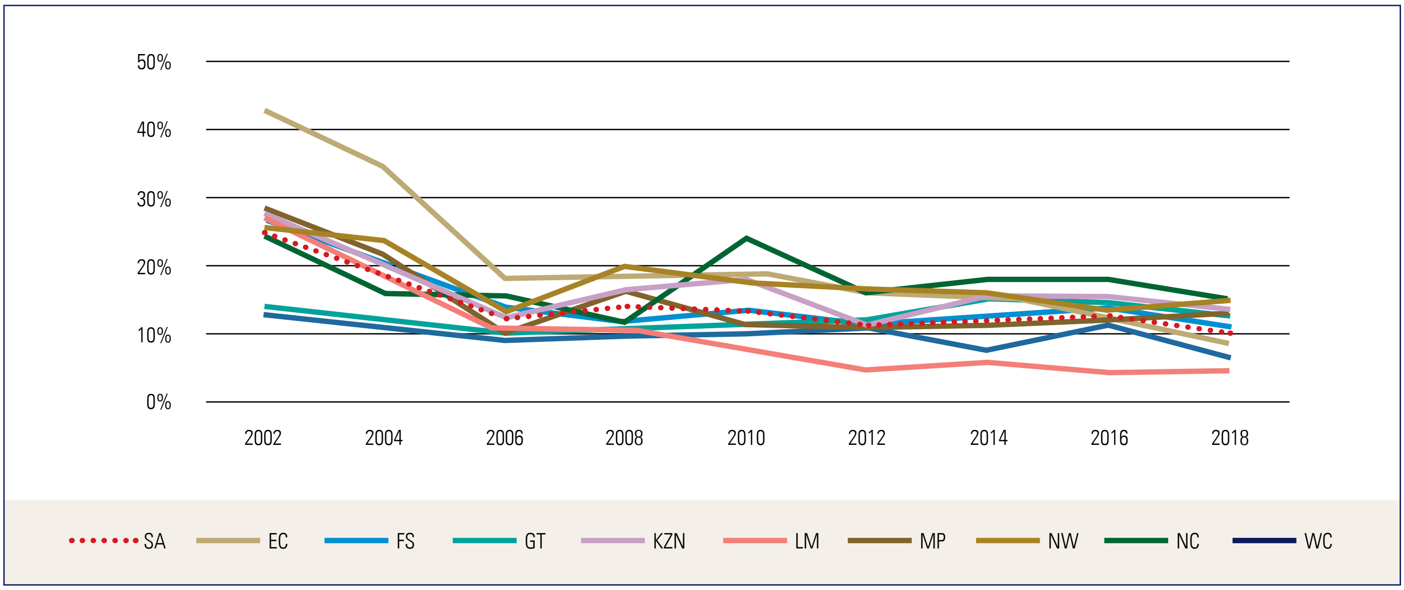


Figure 3.3: Hunger in households by province, GHS 2002–2018
Source: GHS 2002–2018; Analysis by W. Sambu

Since 2009, the GHS has collected data on household food access levels, based on the following indicators: whether or not households ran out of money to buy food, cut the size of the meals consumed, reduced the variety of meals or skipped meals altogether. These indicators are combined to generate household food insecurity access levels.[34]

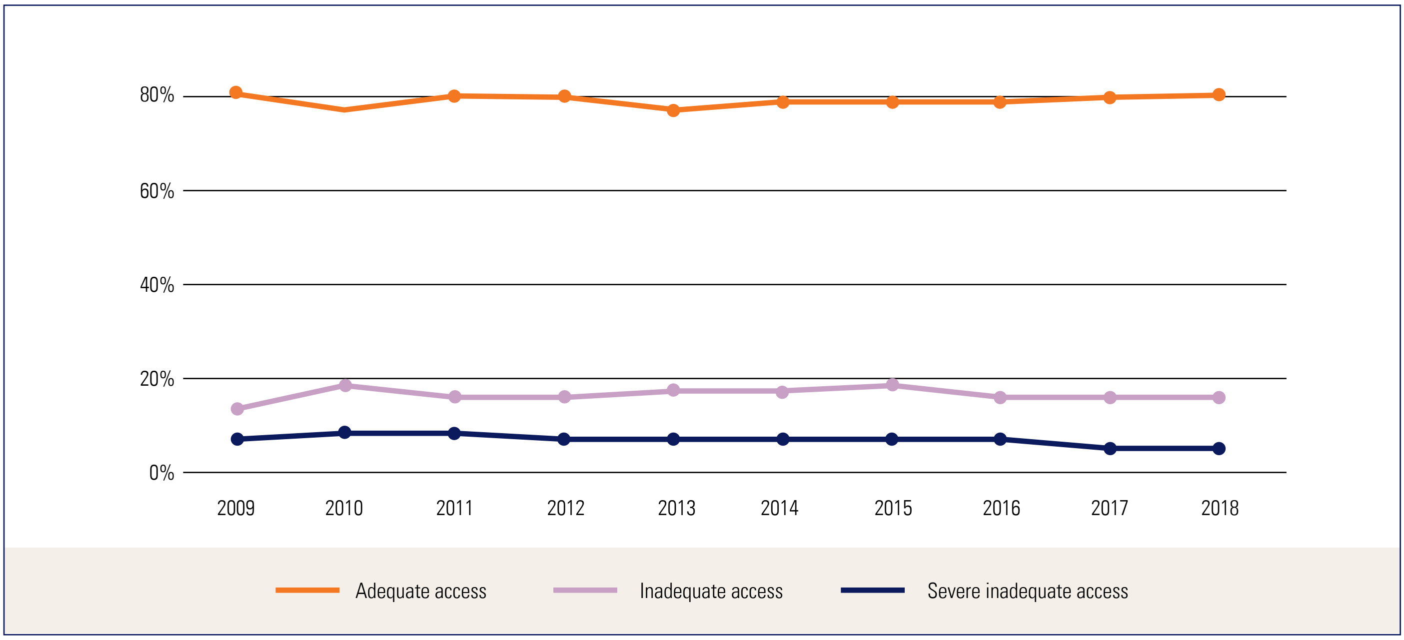


Figure 3.4: Food insecurity access levels, 2009–2018
Source: GHS 2009–2018; Analysis by W. Sambu

An analysis of trends between 2009 and 2018 presented in Figure 3.4 shows that, similar to the reported household hunger rates over a comparable period, food insecurity access levels remained fairly stable, with the percentage of households reporting inadequate or severely inadequate access averaging 16% and 6%, respectively, over the 10-year period. In 2018, 80% of the households were reported to have adequate access to food. However, as Figure 3.5 shows, there were significant disparities in food access levels across provinces. In Limpopo province, 93% of households reportedly had adequate food access, whereas the percentage was much lower in the North West province where only 63% of households reported adequate access. Mpumalanga, North West and Northern Cape provinces had the highest levels of severely inadequate food access, with prevalence rates of over 10%. These provinces also had the highest levels of hunger, as previously shown in Figure 3.3.

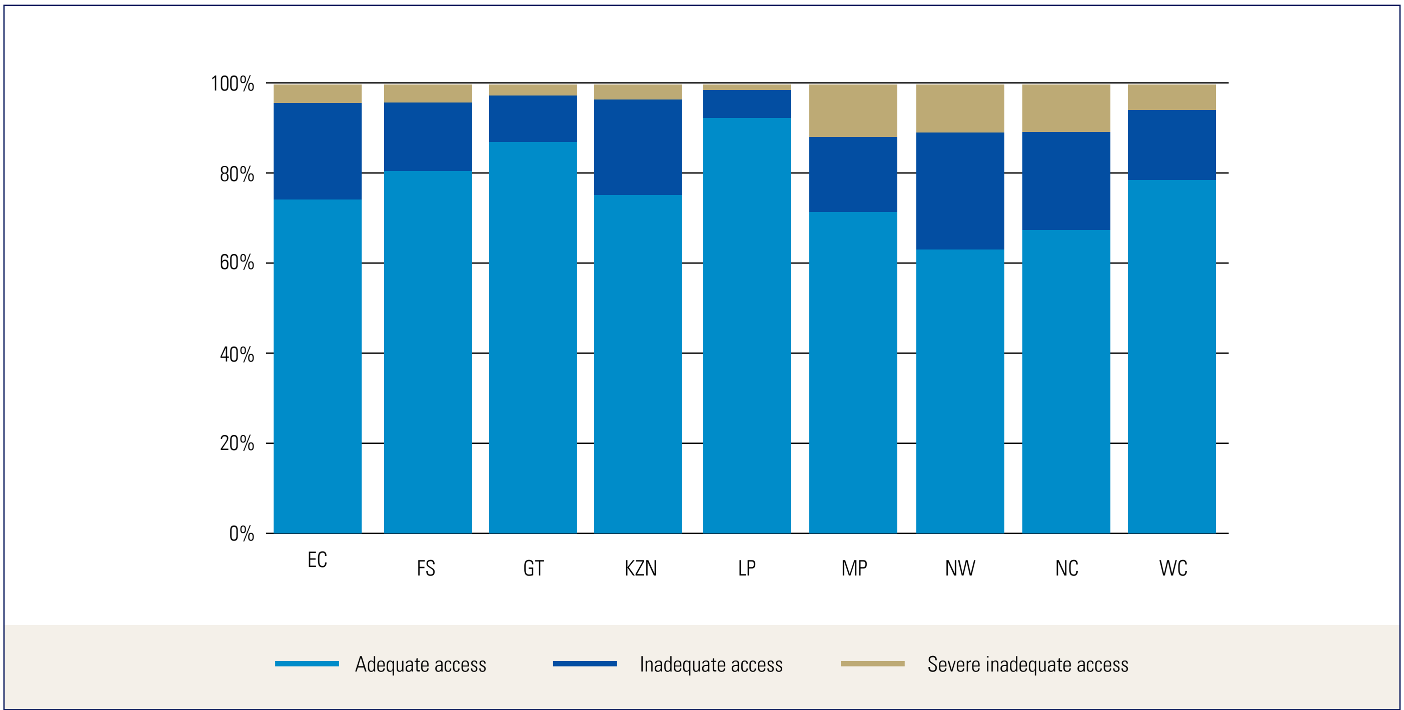
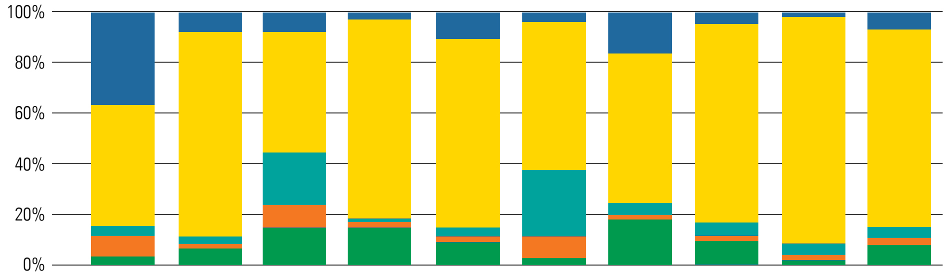


Figure 3.5: Food access levels across provinces, 2018

Source: GHS 2009–2018; analysis by W. Sambu

Previously, Limpopo province was found to be the province with the highest proportion of households producing any type of food for household use (StatsSA, 2019).[34] Interestingly, Limpopo had the lowest prevalence of hunger and highest food access level, despite the low socio-economic profile of the province. Household food production may therefore enhance self-sufficiency or resilience.



	Western Cape	Eastern Cape	Northern Cape	Free State	KwaZu-lu-Natal	North West	Gauteng	Mpuma-langa	Limpopo	RSA
As a leisure activity or hobby e.g. gardening	36,7	6,8	7,0	2,1	9,8	3,3	16,0	4,4	0,7	6,5
As an extra source of food for the household	48,3	81,9	48,4	78,4	75,1	59,2	58,7	79,0	91,4	78,5
As an extra source of income	3,9	3,6	21,6	3,3	4,2	26,6	5,6	4,6	4,4	5,3
As the main source of income/earning	8,2	1,2	7,8	2,5	1,5	8,2	1,7	2,7	1,7	2,2
As a main source of food for the household	3,0	6,5	15,2	13,6	9,4	2,7	18,1	9,3	1,8	7,5

Figure 3.6: Proportion of households that engage in household food production by province
Source: StatsSA (2019)[34]

For the national studies that used the CCHIP Hunger index, food security status was similar in 1999 and 2005[12,13] but an improvement was observed in 2012,[11] with the percentage of households experiencing hunger decreasing from just over 50% to 26.0% (Table 3.1). In 2012, experiencing hunger was highest in the Eastern Cape (36.2%) and lowest in the Western Cape (16.4%) and Gauteng (19.2%).[11] The recent Provincial Dietary Intake Study (PDIS) that was done in Gauteng and the Western Cape reported that just over 20% of households experienced food shortages (Table 3.2).[16] In a study conducted in Gauteng, coping strategies employed by caregivers when children experienced hunger were eating fewer meals and smaller portion sizes.[20]

Findings from national studies that reported on household food insecurity (adults and children) are summarised in Table 3.1 and regional studies in Table 3.2. Based on the findings of the NFCS 1999, 52% of all households experienced hunger, while 23% were at risk of hunger. Compared to urban formal (37%) and rural farm (48%), the prevalence of hunger was higher in participants from urban informal (61%), rural (62%) and tribal areas.[22] Six years later, the national NFCS-FB was undertaken.[13] Prevalence of hunger was very similar to that found in the NFCS of 1999, with 51.6% reporting experiencing hunger and 28.2% being at risk of hunger.[13] The percentage of participants on farms who experienced hunger increased from 48%[12] to 58%.[13] The SANHANES-1 followed in 2012.[11] By this time, the prevalence of hunger in all groups had decreased to 26.0%, with 28.3% reporting being at risk of hunger. More Black African South Africans experienced hunger (30.3%) than Coloured (13.1%), White (1.3%) or Indian (8.6%) households. Furthermore, fewer participants from urban formal areas (19%) reported hunger than those from urban informal (32.4%), rural formal (28.8%) and rural informal (37%) areas.[11] In 2016, the SA General Household Survey reported on food security in more than 20,000 households.[24] Nineteen percent (19%) of households were classified as having insufficient food, with those from KwaZulu-Natal (20.7%) and Gauteng (22.7%) being the hardest hit.[23]

Other studies published early on in the review period include the HelpAge study (data collection in 1995) which determined food poverty in more than 28 000 households (7194 headed by person ≥60 and 21510 headed by person <60 years) and found that 42.6% of all households were in food poverty. Food poverty rates were highest among households headed by female

Black Africans (61.7% vs 56.6%), followed by Coloureds (38.9% vs 36.6%), Indians (6.6% vs 3.7%) and Whites 6.9% vs 9.2%). Higher food poverty rates were found with decreasing income, increasing household size, among households headed by females and among households in rural areas.[27] The SASH study (2002–2004) included more than 4000 participants from all provinces. Only one question was asked to determine food security ("which of the following describes the amount of food your household has to eat: enough to eat, sometimes not enough to eat, or often not enough to eat?"). Nine percent (9%) of households reported often not having enough to eat, while 29% replied that they sometimes did not have enough to eat.[29]

Regional studies that have reported on adult food security include the STOP-SA study (2015–2016) which reported a food insecurity prevalence of 40.1% (33.0% in men and 42.7% in women) in the Eastern Cape and Western Cape;[31] the Gauteng, Sharpeville elderly study (2004–2016) which reported that 54.5% of participants ≥60 years were severely food insecure, 19.3% were moderately food insecure and 8% were mildly food insecure;[24] and the KwaZulu-Natal, Stanger study (2008) with a food insecurity prevalence of 48%.[28] The Gauteng, Vaal area study (2004) reported that 80.5% of households had experienced a shortage of money during the previous month;[20] the AHA-FS study (2007, 2009) found that 87.4% of urban households and 73.2% of rural households were food insecure;[22] and the Tugela Ferry irrigation scheme study (2012) reported food insecurity in 54.3% of participants in KwaZulu-Natal.[32] The Farm Worker Food Security study (2017, 2018) in the Northern Cape differentiated between food security status during different seasons and found that prevalence of food insecurity was higher during winter (30.8%) than during summer (18.4%) and autumn (10.0%).[25]

Four studies have reported on food security among university students (Table 3.3). Using the HFIAS, 12.5% of students at UKZN were classified as food insecure and 53.1% as at risk of food insecurity in 2012.[35] At the UFS, 64.5% of students reported that there were times when they ran out of food and could not afford to buy food, while 60% were classified as food insecure based on the USDA eight-question tool.[38]

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Table 3.1: Food security status of South African households (adults and children) based on national data (organised chronologically by assessment tool)

Food security status per study	Date of collection	Age	Ethnicity	Province	Area	n	Assessment tool and classification	Percentage (%) per classification of food security[ii]		
								Food secure	At risk of hunger	Experiencing hunger
NFCS 1999 Labadarios *et al.*, 2005[12]	1999	HH with child 1-9 yrs	B W C I/A		ALL	2735	**CCHIP Index**[i] • eight occurrence questions that represent a generally increasing level of severity of food insecurity (access), • nine frequency-of-occurrence questions that are asked as a follow-up to each occurrence question to determine how often the condition occurred in the previous four weeks (30 days). **Scoring** • ≥ 5 indicates the presence of food shortage in the household. Household members can be considered to be 'hungry'. • 1 to 4 indicates that members of the house hold are at risk of hunger. • 0 indicates that the household is food secure	25.0	23.0	52.0
					U All	1347		36.0	22.0	42.0
					UF	1060		41.0	23.0	37.0
					UI	287		21.0	18.0	61.0
					R All	1388		14.0	24.0	62.0
					R Farms	299		23.0	29.0	48.0
					R Tribal	1089		11.0	23.0	66.0
				WC		342		38.9	29.0	31.3
				EC		398		4.3	12.6	83.2
				NC		144		13.2	23.6	63.2
				FS		209		45.5	16.8	37.8
				KZN		525		26.7	25.9	47.4
				NW		226		13.3	25.2	61.5
				GP		409		36.7	21.5	41.8
				MP		150		21.3	26.0	52.7
				LP		332		19.3	26.2	54.5

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Table 3.1 continued

Food security status per study	Date of collection	Age	Ethnicity	Province	Area	n	Assessment tool and classification	Percentage (%) per classification of food security[ii]		
								Enough to eat	Sometimes not enough to eat	Often not enough to eat
SASH study Sorsdahl *et al.*, 2011[29]	2002 – 2004	≥18	B W C I/A	All	U R	4185	**Single-item household food insufficiency measure:** Which of the following describes the amount of food your household has to eat: enough to eat, sometimes not enough to eat, or often not enough to eat?	62.0	29.0	9.0
								Food secure	At risk of hunger	Experiencing hunger
NFCS-FB Labadarios *et al.*, 2007[13]	2005	HH with child 1–9 yrs as reported by women	B C W A/I	All		2429	**CCHIP index (see above)**	20.2	28.2	51.6
				WC		259		31.7	39.0	29.3
				EC		363		8.8	24.5	66.7
				NC		49		6.1	28.6	65.3
				FS		153		9.8	30.7	59.5
				KZN		428		23.8	32.9	43.2
				NWP		182		22.5	25.3	52.2
				GP		535		23.7	25.1	51.2
				MP		194		31.4	21.7	46.9
				LP		266		10.5	26.3	63.2
					U All			24.0	29.0	47.0
					UF			27.0	30.0	43.0
					UI			15.0	27.0	58.0
					R All			13.0	28.0	59.0
					R (F)			16.0	26.0	58.0
					R (T)			13.0	28.0	59.0

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Table 3.1 continued

Food security status per study	Date of collection	Age	Ethnicity	Province	Area	n	Assessment tool and classification	Percentage (%) per classification of food security(ii)		
								Food secure	At risk of hunger	Experiencing hunger
SANHANES Shisana et al., 2013[11]	2012	HH as reported by women		All		6115 HH	**CCHIP index (see above)**	45.6 [42.9–48.3]	28.3 [26.3–30.5]	26.0 [23.9–28.3]
			B					39.3 [36.6–42.2]	30.3 [28.1–32.7]	30.3 [27.8–33.0]
			C					61.8 [56.0–67.2]	25.1 [21.1–29.7]	13.1 [9.9–17.1]
			W					89.3 [81.3–94.1]	9.4 [4.8–17.6]	1.3 [0.5–3.3]
			A/I					62.9 [41.8–80.1]	28.5 [15.4–46.6]	8.6 [4.8–14.7]
				WP		813		57.9 [48.7–66.6]	25.6 [20.4–31.7]	16.4 [11.8–22.5]
				EP		788		31.4 [25.3–38.2]	32.4 [27.2–38.0]	36.2 [29.8–43.3]
				NC		398		56.5 [40.8–71.0]	22.8 [15.4–32.3]	20.7 [13.0–31.3]
				FS		419		39.3 [32.5–46.5]	31.9 [25.4–39.3]	28.8 [23.9–34.2]
				KZN		1206		37.3 [30.8–44.3]	34.4 [29.6–39.6]	28.3 [22.9–34.4]
				NW		583		40.4 [34.4–46.8]	30.0 [25.3–35.2]	29.5 [22.9–37.1]
				G		882		56.0 [49.5–62.2]	24.8 [20.1–30.3]	19.2 [14.6–24.9]
				MP		535		55.0 [44.7–64.9]	15.5 [10.4–22.3]	29.5 [22.0–38.4]
				LP		491		41.9 [35.9–48.2]	27.3 [23.1–32.0]	30.8 [26.2–35.7]
					U All			55.4 [51.2–59.6]	25.6 [22.6–28.9]	19 [16.0–22.4]
					UF			31.5 [26.0–37.5]	36.1 [31.0–41.5]	32.4 [27.1–38.3]
					UI			50.9 [41.0–60.8]	20.3 [15.6–25.8]	28.8 [22.2–36.5]
					R All			30.2 [26.7–33.8]	32.8 [29.5–36.3]	37 [33.3–40.9]
					R (F)			50.9 [41.0–60.8]	20.3 [15.6–25.8]	28.8 [22.2–36.5]
					R (T)			30.2 [26.7–33.8]	32.8 [29.5–36.3]	37 [33.3–40.9]

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Table 3.1 continued

Food security status per study	Date of collection	Age	Ethnicity	Province	Area	n	Assessment tool and classification	Percentage (%) per classification of food security[ii]			
								With sufficient food:		With insufficient food:	
SA General Household Survey (GHS) Omotayo et al., 2019[23]	2016	Adults	B C W A/I	All		2604 (21218 HH)	**General Household Survey tool** Foster-Greer-Thorbecke index (FGT Index)	81.0		19.0	
				WC	U R			88.4		11.6	
				EC				86.4		13.6	
				NC				93.7		6.3	
				FS				93.7		6.3	
				KZN				79.3		20.7	
				NW				92.5		7.5	
				GP				77.3		22.7	
				MP				92.9		7.1	
				LP				95.8		4.2	
SADHS Department of Health et al., 2019[14]	2016	HH with child aged 1–17yrs		All		5923	Child went hungry because of insufficient food, during the past 12 months	**Never**	**Seldom**	**Sometimes**	**Often/ always**
				WC		657		85.0	4.0	9.0	0.7
				EC		777		74.3	6.4	12.1	3.7
				NC		134		83.6	7.1	6.3	1.3
				FS		347		76.5	5.5	8.6	7.6
				KZN		1011		68.9	3.2	18.8	5.2
				NW		388		79.5	2.9	12.2	4.4
				GP		1436		87.9	2.3	5.9	1.1
				MP		486		80.7	3.0	11.8	3.1
				LP		686		82.2	1.9	11.8	2.8

Compiled by Corinna Walsh, Louise van den Berg, Salome Kruger, Linda Malan, Lizelle Zandberg, Marina V Visser, Mariaan Wicks, Mieke Faber & Rina Swart

[i] CCHIP, Community Childhood, Hunger Identification Project

[ii] Percentages do not add up to 100%, as for some the questions were not applicable.

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Table 3.2: Food security status of South African households (adults and children) based on regional data (organised chronologically by assessment tool)

Food security status per study	Date of collection	Age	Ethnicity	Province	Area	n	Assessment tool and classification	Percentage (%) per classification of food security[ii]	
								Not in food poverty	**Living in food poverty**
HelpAge International HelpAge International Africa REGIONAL Development Centre Report, 2004[27]	1995	≥60yrs	B C W A/I	All	U R	7194 HH headed by ≥60yrs; 21 510 HH headed by <60yrs	**Food poverty rate** based on a basic subsistence diet calculated as the cost of purchasing the very low-cost food ration scales. Households are in food poverty when their monthly spending on food, plus the value of food gifts received, plus the value of own-produced food, is less than their food poverty line.	57.4	42.6
				WC				76.1	23.9
				EC				51.8	48.2
				NC				38.5	61.5
				FS				44.9	55.1
				KZN				56.3	43.7
				NW				47.9	52.1
				GP				79.4	20.6
				MP				46.3	53.7
				NP				42.9	57.1
								Food secure	**Food insecure**
STOP-SA study Okop et al., 2019[31]	2015 – 2016	25–70 yrs	B		U R		**Food insecurity based on binary variable** (as those who experienced unavailability of food in the household or did not have enough food to meet their family's needs in at least one month of the last 12 months)	Male and Female combined	
				EC		247		59.9	40.1
				WC		553		Males	
						(285 U 268 R)		64.0	33.0
								Females	
								57.3	42.7
FS farm workers study Kruger et al., 2008[39]	n/d	18–57 yrs	n/d	FS	R	13 F (17 H)	Food security and coping mechanisms food-coping strategy (FCS) index scored as: "least severe" with a weighting score of 2, "moderately severe" with a weighting score of 4, "severe" with a weighting score of 6, and "very severe" with a weighting score of 8. A total average FCS score ≤ 55 is associated with a food-secure environment	Mean food coping score of 51.9 indicating a food-secure environment	

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Table 3.2 continued

Food security status per study	Date of collection	Age	Ethnicity	Province	Area	n	Assessment tool and classification	Percentage (%) per classification of food security(ii)
Vaal Area INP Oldewage-Theron et al., 2006[20]	2004	19–90 yrs	B	GP	IS	722 F (384 H)	**Cornell Hunger Scale, Maxwell food-based coping strategies**	**Experienced a shortage of money** 80,5% during past 30 days; 70.5% during past 5 days **Coping strategies employed by caregivers of children:** Procuring and cooking a limited variety of foods: (82.1% during the last 30 days; 74.7% during the last 5 days), Maternal buffering by limiting caregiver's intake to make food available for the children (84.7% during the last 30 days and 80% during the last 5 days), Skipping of meals (81.6% during the last 30 days and 68.4% during the last 5 days), and Limiting portion sizes (84.7% during the last 30 days and 75.8% during the last 5 days)
	2004	9–13 yrs	B	GP	IS	149	**Cornell Hunger Scale, Maxwell food-based coping strategies**	**Children experiencing hunger when going to sleep at night:** 78.4% during last 30 days; 73.7% during the last 5 days **Children experiencing being hungry after a meal:** 80.5% during last 30 days; 73.7% during the last 5 days
Stanger Study Naicker et al., 2015[28]	2008	35–55 yrs	B C	KZN	PU	984	**Single question:** "How often does your household run out of food?"	**Food secure** 52.0
AHA-FS) Walsh and Van Rooyen, 2015[22]	2007 – 2009	25–64 yrs	B C	FS	U	387 H	Four question scale from **CCHIP Index** (without questions related to children): • Does the family currently experience food shortage? • Does the household run out of money to buy food? • Does the family cut the size of meals or skip meals because there is not enough food in the house? • Does the family eat less because there is not enough money for food? **Categorised as:** A score of >2 of the possible 4 classified the HH as at high risk for food insecurity.	**Food secure:** 12.6 **High risk for Food insecurity:** 87.4
					R	499 H		**Food secure:** 26.8 **High risk for Food insecurity:** 73.2
						ALL		**Coping strategies:** Of the households that reported food shortage, most relied on assistance from family and/or neighbours for food (56% rural; 61% urban)

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Table 3.2 continued

Food security status per study	Date of collection	Age	Ethnicity	Province	Area	n	Assessment tool and classification	Percentage (%) per classification of food security[ii]			
Qwa-Qwa Project Oldewage-Theron et al., 2012[30]	2008 – 2009	21–60 yrs		FS	R	271 H M: 30 F: 241	Frequency of shortages of money for the purchasing of food or clothing	**Always or often do not have money to buy food or clothing**			
								38.5			
Agincourt HDSS Nawrotzki et al., 2014[40]			B	LP	R	8147 H	**One question:** "How often in the last month did your household NOT have enough to eat?" **Categorised** as never (= 4), rarely (= 3), sometimes (= 2), often (= 1) and very often (= 0)	**Mean food insecurity score**			
	2004							Mean score of 3.11 (rarely to never)			
	2007							Mean score of 3.64 (rarely to never)			
	2010							Mean score of 3.65 (rarely to never)			
Tugela Ferry irrigation scheme (TFIS) study Sinyolo et al., 2014[32]	2012	≥18 yrs	n/d	KZN	R	186	Food security based on the minimum per capita adult equivalent caloric intake (at 2,261 kcal per day) (Stats SA 2007), R5,032 per adult equivalent per annum was used as the food security line and then adjusted using the consumer price index (CPI) so that it reflected the 2012 purchasing power of the Rand. Households with food consumption levels greater than the cut-off line were considered food secure, while those below were considered food insecure	**Food secure**		**Food insecure**	
								45.7		54.3	
Sharpville elderly facility study Saha et al., 2019[24]	2004 – 2016	≥ 60yrs	B	GP	PU	88	**Household Food Insecurity Access Scale (HFIAS)**	**Food secure**	**Mildly food insecure**	**Moderately food insecure**	**Severely food insecure**
								18.2	8.0	19.3	54.4

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Table 3.2 continued

Food security status per study	Date of collection	Age	Ethnicity	Province	Area	n	Assessment tool and classification	Percentage (%) per classification of food security[ii]			
								Food secure	Mildly food insecure	Moderately food insecure	Severely food insecure
Richards Bay, Dundee and Harrismith Chakona et al., 2017[26]	2014 – 2015	15–49 yrs	B	KZN	U	183 F	**Household Food Insecurity Access Scale (HFIAS)**	66.0	23.0	2.0	9.0
					PU			50.0	20.0	22.0	8.0
					R			32.0	35.0	19.0	14.0
				KZN	U	173 F		53.0	13.0	32.0	3.0
					PU			13.0	19.0	41.0	27.0
					R			13.0	30.0	42.0	15.0
				FS	U	198 F		73.0	7.0	16.0	4.0
					PU			21.0	29.0	36.0	13.0
					R			31.0	31.0	31.0	7.0
Richards Bay, Dundee and Harrismith Chakona et al., 2018[18]	2014 – 2015	2–5 yrs	B	FS KZN	R/U	554	**Household Food Insecurity Access Scale (HFIAS)**	36.0	24.0	28.0	12.0
Moringa study Ntila et al., 2017[19]		7–12 months		LP GP	R/PU	149	**Community Food Insecurity Access Scale (CFIAS)**	4.5	7.5	6.5	82.5
Farm Worker Food Security (FWFS) study Devereux and Tavener-Smith, 2019[25]	2017 – 2018	Season		NC	R		**Months of Adequate Dietary Diversity Index (DDI)** Household Food Provisioning (MAHFP), Household Food Insecurity Access Scale (HFIAS) and Coping Strategies Index (CSI), Classified according to Drysdale et al., 2019 cut-offs	**Food secure**	**At risk of food insecurity**	**Food insecure**	
		Summer				196		62.7	18.9	18.4	
		Autumn				191		75.0	15.0	10.0	
		Winter				196		45.5	26.7	30.8	
Mothers at PHC clinics Iverson et al., 2011[17]	2007 – 2008	<5yrs				176	**CCHIP Hunger Index**[i]	44	56		

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Table 3.2 continued

Food security status per study	Date of collection	Age	Ethnicity	Province	Area	n	Assessment tool and classification	Percentage (%) per classification of food security[ii]		
								Food secure	**At risk of food insecurity**	**Food insecure**
Food insecurity, social welfare and low birth weight McLaren et al., 2018[15]	2015 – 2016	<24 months		EC	U	400	**CCHIP Hunger Index**[i]	23.0	47.0	31.0
PDIS Senekal et al., 2019[16]	2018	1–10yrs		GP	U/R	733	**CCHIP Hunger Index**[i]	58.1	21.8	20.1
				WC		593		49.1	28.6	22.3
Districts in EC & KZN Smuts et al., 2008[21]	2018	0–71 months					Food available for consumption	**Always enough**	**Sometimes not enough**	**Often not enough**
				EC	R	1794		14	50	36
				KZN	R	1988		2	22	75
							Priority to be fed available food	**Adults/ elderly**	**School children**	**Children 0-71 months**
				EC	R	1794		2	22	75
				KZN	R	1988		4	36	60

Compiled by Corinna Walsh, Louise van den Berg, Salome Kruger, Linda Malan, Lizelle Zandberg, Marina V Visser, Mariaan Wicks, Mieke Faber & Rina Swart

[i]CCHIP, Community Childhood Hunger Identification Project.

[ii]Percentages do not add up to 100%, as for some the questions were not applicable.

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Table 3.3: Food security status of university students in South Africa

Food security status per study	Date of collection	Age	Ethnicity	Province	Area	n	Assessment tool and classification	Percentage (%) per classification of food security			
University of KwaZulu Natal Munro et al., 2013[36]	2007 – 2010	≥ 18yrs	B, C, W, A/I, int	GP	R/IS/U	1708	**Household Food Insecurity Access Scale (HFIAS)** Reported only on three HFIAS questions which were converted to University Student Food Insecurity Questionnaire (USFIQ)	**Food secure** 38.3	**Low vulnerability to food insecurity** 40.4	**Serious vulnerability to food insecurity** 16.1	**Severe vulnerability to food insecurity** 4.7.
University of KwaZulu Natal (Health Sciences) Kassier and Veldman, 2013[35]	2012	n/d	n/d	KZN	n/d	269	**Household Food Insecurity Access Scale (HFIAS**	**Food secure** 34.4	**At risk of food insecurity** 53.1	**Food insecure** 12.5	
University of Witwatersrand (Wits) Rudolph et al., 2018[37]	2012	n/d	B C W A/I	GP	n/d	387	**Household Food Insecurity Access Scale (HFIAS)** Only Household Hunger Scale (HHS) reported	**Moderately food insecure** 6.0	**Severely food insecure** 1.0		
						30	Coping strategies followed by food insecure students	Leveraging support networks 23%; Going home to get food 13% Choosing cheaper food 30%; Avoiding expensive fast food places 30%; Meal pooling with friends 20%; Eating fewer meals 28%;			
University of the Free State Van den Berg and Raubenhaumer 2013[38]	2013	≥18	B C W A/I	FS	U R	1413	**Single item measure:** Classified as food insecure if answered “yes” to the following question: “In the last 12 months, during the academic term, were there any times that you ran out of food and couldn’t afford to buy any more?”	**Food secure** 35.5	**Food insecure** 64.5		
							USDA 8 question tool Scoring adapted	**Food secure** *(High and marginal food security combined)* 15.4	**At risk of food insecurity** *(Low food security)* 24.6	**Food insecure with hunger** *(Very low food security)* 60.0	

Compiled by Corinna Walsh Louise van den Berg & Rina Swart

The current review adds to previous reviews[41,42,43] and confirmed that although the percentage of South African adults who have experienced food insecurity and hunger has decreased over the review period, a large proportion of South Africans still experience food insecurity and hunger. The gains that have been made in reducing food insecurity have been affected significantly by the current COVID-19 pandemic.[45,46] It is yet unknown what consequences of the sudden increase in food insecurity will have on the nutritional status of South Africans, but it is very probable that undernutrition, overnutrition and micronutrient malnutrition will increase in the near future.

3.3.2 Trends in household food consumption (expenditure)

The IES and the LCS are good sources of data on household expenditure on both food and non-food items. Since 2005/06, through these surveys, StatsSA has collected household spending data on over 300 food items, based on the United Nations Classification of Individual Consumption According to Purpose (COICOP). The expenditure data are based on household daily acquisitions recorded in diaries that households kept over a two-week period. The 300 food items have been classified into 12 broad groups presented in Table 3.4 (cereals, roots and tubers, vegetables, fruits, meats, eggs, fish, pulses and legumes, dairy products, oils and fats, and spices and beverages). Table 3.5 uses data from the 2014/15 LCS to show the percentage of households that reported consuming foods belonging to the different food groups. Cereal products were the most commonly consumed food groups across the country, with 96% of households reporting consumption. This was followed by spices and beverages (82%), meat products (80%), vegetables (72%), dairy products (62%), sugary products (55%), and roots and tubers (52%). The least commonly consumed food groups were oils and fats (48%), fruits (36%), eggs (34%), fish (30%), and legumes and pulses (22%).

As expected, there were significant disparities in consumption across provinces, geographical localities and expenditure deciles. Higher proportions of households living in the wealthier provinces of Gauteng and the Western Cape reported consumption for each of the food groups. Fruit consumption was highest in the Western Cape, where 46% of households reported consumption, while the lowest fruit consumption was reported in the Northern Cape (24% of households) and Eastern Cape (28% of households) provinces. Fruit consumption was much higher in the urban areas of the country, compared to the rural formal and rural traditional areas, possibly due to better physical and economic access to fruit markets. Fruit consumption was also lowest in the poorest expenditure deciles where only one-fifth of households reportedly acquired fruits over the two-week period. In contrast, two-thirds of households in the richest decile reported consumption of fruits over the same period.

Similarly, while 37% of households in the poorest decile reported consumption of dairy products (milk and cheeses, for example), consumption was 48 percentage points higher in the richest 10% of households, where 85% reported consumption. A similar trend was observed in the consumption of eggs, and spices and beverages. While legumes and pulses were the least consumed food products across the country, with only 22% of households reporting acquisition, the consumption of these foods was particularly low in Limpopo and the Northern Cape provinces where less than 15% of households reported consumption.

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Table 3.4: Percentage of households acquiring foods in 12 food groups, across province, geographical area and expenditure deciles, 2014/15

		Cereals	Roots and tubers	Vege-tables	Fruits	Meats	Eggs	Fish	Pulses and legumes	Dairy products	Oils and fats	Sugar and sugary products	Spices and beverages
South Africa		95.5	52.4	72.3	35.8	80.0	33.5	29.9	21.7	62.1	47.7	55.0	81.7
Province	Eastern Cape	92.6	53.6	63.7	27.8	75.0	23.8	23.3	22.4	58.5	55.1	59.1	81.5
	Free State	94.1	63.0	77.1	37.8	82.2	34.1	29.2	20.5	70.4	42.9	61.4	84.5
	Gauteng	96.7	54.6	76.6	39.7	84.5	36.5	31.5	19.6	66.2	48.6	54.2	82.9
	Kwazulu-Natal	95.9	46.5	68.0	32.2	77.0	30.8	27.5	31.1	55.7	49.5	51.0	80.1
	Limpopo	95.8	33.7	67.4	32.6	72.7	24.6	27.7	12.9	40.5	40.2	44.4	74.3
	Mpumalanga	96.9	45.4	74.4	36.2	77.9	37.3	36.6	20.8	54.7	44.5	50.6	79.9
	Northern Cape	89.5	52.1	63.5	24.0	78.6	28.7	29.0	13.4	61.9	39.3	55.4	86.7
	North West	92.1	49.7	70.3	29.5	74.3	28.5	25.8	17.1	60.1	41.1	55.4	81.2
	Western Cape	97.7	71.2	78.4	45.9	87.9	47.9	36.2	25.2	84.3	52.0	67.7	86.9
Geographical area	Urban	96.0	56.6	74.2	39.0	82.4	37.1	30.3	21.7	68.1	47.8	55.9	83.5
	Rural traditional	94.7	42.5	68.2	28.6	73.5	24.6	27.7	21.1	46.8	46.3	51.9	76.4
	Rural formal	92.4	43.9	64.6	26.1	80.3	28.4	37.1	24.8	55.0	54.6	59.8	85.3
Expenditure deciles	1	91.8	42.5	68.1	18.7	66.6	17.9	21.3	14.8	36.8	37.0	46.3	65.6
	2	94.2	49.1	70.2	22.9	75.4	26.2	28.2	19.9	49.4	46.5	54.0	76.9
	3	96.0	50.8	73.2	26.7	79.5	29.9	28.6	23.3	53.3	47.7	56.3	79.1
	4	95.5	51.8	72.1	30.0	79.7	35.5	29.2	21.6	58.9	50.8	54.8	82.2
	5	96.3	54.5	73.7	31.7	83.8	35.2	30.2	23.7	60.3	51.5	55.5	83.9
	6	96.6	54.7	73.2	32.6	81.8	34.9	31.4	21.9	62.2	48.4	55.7	83.7
	7	96.5	51.5	70.9	35.5	84.3	37.3	29.8	23.2	65.7	47.0	51.4	83.5
	8	96.8	53.0	71.6	43.4	82.7	38.2	31.5	24.9	72.5	50.6	55.3	88.6
	9	96.2	56.6	71.6	50.5	82.5	38.0	32.8	23.7	77.2	49.8	59.1	86.8
	10	95.3	59.8	78.0	65.6	83.5	42.3	35.9	19.7	84.9	47.4	62.0	87.2

Source: LCS 2014/15; Analysis by W. Sambu

An analysis of meat (including beef, poultry and pork) consumption shows that across all expenditure deciles, more than two-thirds of households reported consumption. Consumption of meat was reportedly highest in the richest expenditure decile where 84% of households reported consumption. On average, 73% of households reported consumption of vegetables, but while 64% of households in the poorest decile reported consumption, the percentage was significantly higher in the richest decile where close to 80% of households reported acquiring these foods.

Figure 3.7 shows the expenditure shares of 12 broad food groups. The expenditure shares of each group represent the proportion of total household food expenditure that households allocated to each food group. As shown in Figure 3.7, cereals remained the most commonly acquired food group by households across the four time periods. In 2005/06, households allocated an average of 25% of household food expenditure to cereals, increasing to 29% in 2014/15. However, there was a much bigger increase in cereal consumption between 2005/06 and 2008/09. This was possibly due to the global financial crisis which affected the country in 2007/08 and may have increased demand for cheap staples. Vegetable consumption increased over time, from 5.7% in 2005/06 to 6.4% in 2014/15. In contrast, there were no significant changes in household spending on meat products or fruits.

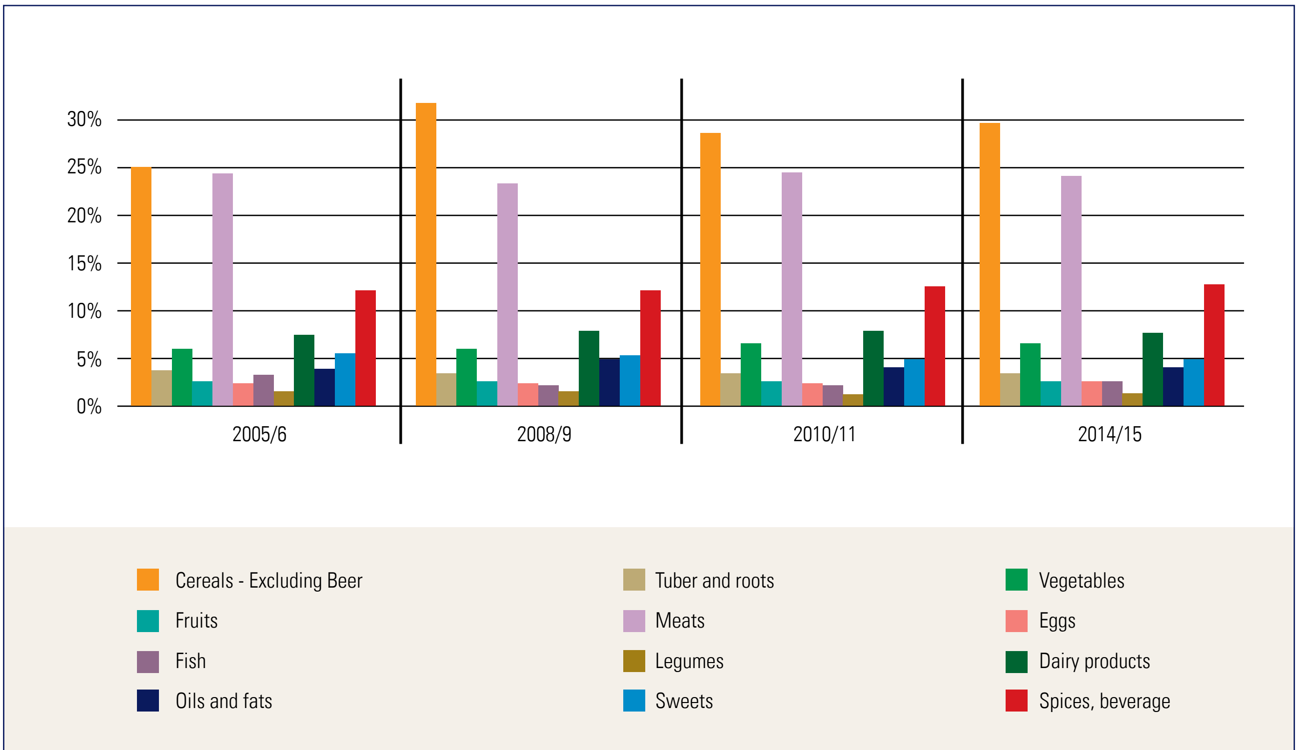

Figure 3.7: Food expenditure shares by food group, 2005–2014
Source: IES 2005/06 and LCS 2014/15; Analysis by W. Sambu

Table 3.5 uses the most recent LCS (2014/15) to compare average spending on the 12 food groups, across provinces and expenditure deciles. The average expenditure was lowest for pulses, eggs, fish and fruits, and highest for cereals, meats, and spices and beverages. As evident from the analysis, there were significant differences in spending across provinces and expenditure deciles. The highest spending on fruits and vegetables was in the Western Cape and Gauteng provinces, while the lowest was in the Eastern Cape. The average fruit expenditure in the Western Cape was 3.5 times that of households in the Eastern Cape. Similarly, spending on vegetables in the Western Cape was 50% above the national average and twice that of households in the Eastern Cape. The meat food group had the second-highest average expenditure, but like other food groups, there were significant differences across provinces and expenditure deciles. The average expenditure on meat products in the Western Cape was 1.6 times more than the national average and 2.7 times more than the average expenditure in the Eastern Cape. Expenditure on fish was also highest in the Western Cape and lowest in the Eastern Cape. A comparison of meat food group consumption across deciles shows that meat and fish expenditure in households in the richest deciles was at least five times that of households in the poorest decile. The widest disparities were in fruit consumption where the spending in the richest households was 19.5 times that in the poorest households.

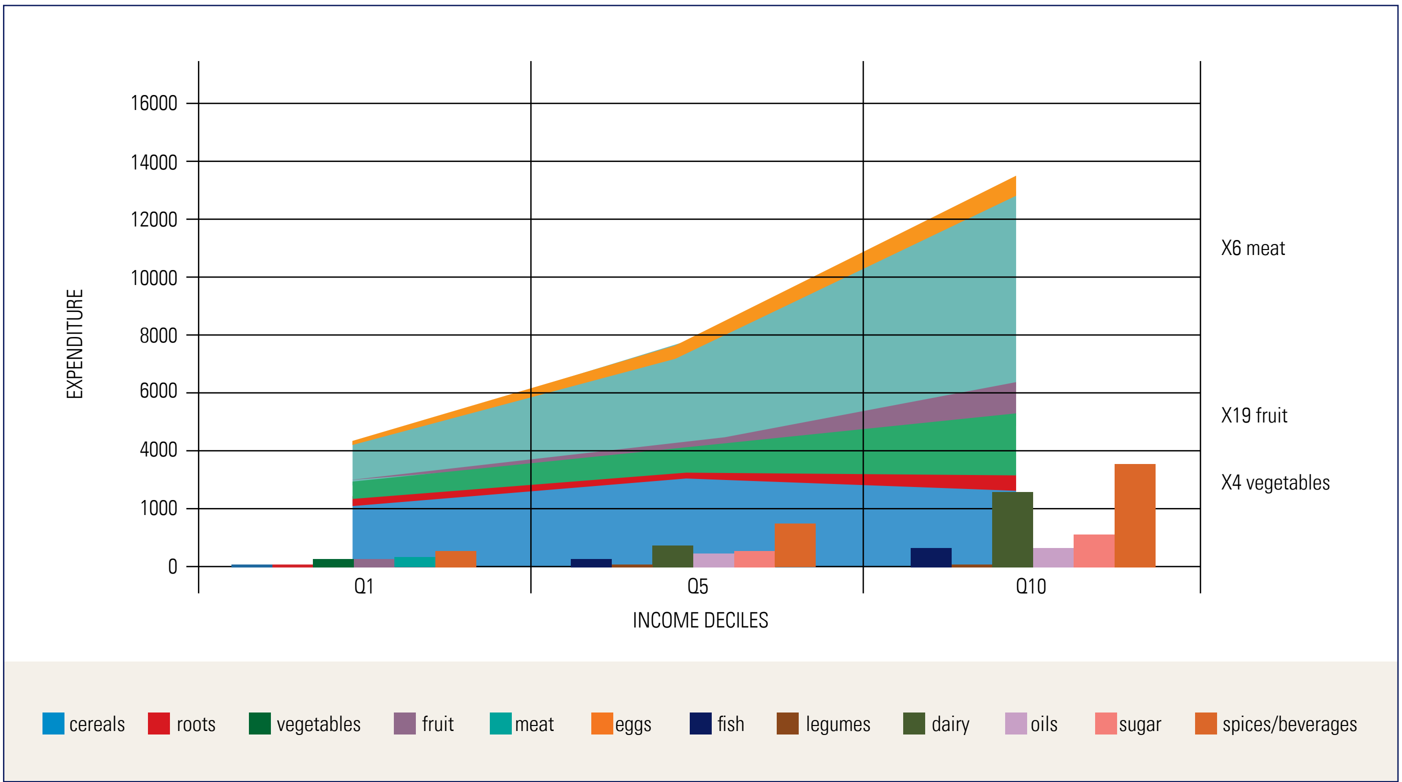

Figure 3.8: Expenditure on food groups by income deciles
Source: LCS 2014/2015

In terms of nutrients, the higher meat expenditure would most likely contribute to higher protein intake and possibly also saturated fat intake among the higher income deciles. However, the difference in total fat and type of fat may be cancelled out by the higher edible oil expenditure by the lower income deciles. The higher expenditure on fruit and vegetables by decile 10 would significantly improve this group's micronutrient consumption as well as fibre consumption.

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Table 3.5: Mean household food consumption (monetary value) across food groups, by province, geographical location and expenditure decile, 2014/15

		Cereals	Roots and tubers	Vege-tables	Fruits	Meats	Eggs	Fish	Pulses and legumes	Dairy products	Oils and fats	Sugar and sugary products	Spices and beverages
South Africa		3224	394	747	353	3639	290	340	163	1061	541	645	1724
Province	Eastern Cape	3218	446	485	188	2156	194	197	175	834	538	755	1288
	Free State	2510	392	694	323	3460	266	294	111	1081	401	631	1708
	Gauteng	3156	372	874	475	4277	330	400	121	1219	611	648	1897
	Kwazulu-Natal	3595	382	597	237	2898	261	237	329	772	600	579	1292
	Limpopo	3515	227	582	221	2332	284	311	93	569	424	423	1165
	Mpumalanga	3396	348	754	279	4142	336	408	159	913	495	537	1648
	Northern Cape	2216	357	589	202	4028	197	300	76	954	319	616	2561
	North West	2730	301	672	220	2830	224	199	94	808	409	575	1633
	Western Cape	3362	656	1122	652	5782	370	574	162	1974	598	941	2752
Geographical area	Urban	3041	416	813	426	4104	309	359	144	1248	552	651	1901
	Rural traditional	3755	338	585	177	2427	243	270	213	579	513	619	1189
	Rural formal	3026	379	627	206	3307	268	454	170	894	520	697	2070
Expenditure deciles	1	2567	260	435	71	1225	117	153	120	300	298	381	646
	2	3353	324	532	110	2006	197	218	162	513	446	533	1002
	3	3468	367	581	134	2406	230	224	178	611	476	586	1247
	4	3544	357	616	161	2922	277	253	162	700	512	614	1366
	5	3402	364	642	202	3225	295	284	158	841	542	611	1575
	6	3259	372	630	242	3397	271	315	157	933	514	571	1742
	7	3174	373	676	256	3998	347	328	171	1086	488	568	1660
	8	3173	386	747	387	4643	327	361	179	1310	575	610	1942
	9	3249	473	1032	588	5817	394	507	180	1743	838	802	2459
	10	3056	665	1577	1379	6753	449	758	165	2575	718	1171	3602

Source: LCS 2014/15; Analysis by W. Sambu

3.3.3 What are the most frequently consumed food items in South Africa?

Table 3.6 shows 35 food items with the highest levels of food expenditure, across all households, households in the poorest (4) deciles, households in the middle deciles (5–8), and the richest deciles (9–10). There were no fruits and vegetables in the top 10 items. Moreover, only tomatoes, onions, cabbages, apples and bananas appeared in this list of top 35 items. In 2014/15, nine food items constituted just over 50% of total household food expenditure: poultry, brown bread, mealie meal, beef and veal, white bread, carbonated cold drinks, rice, fresh full cream milk and edible oils. By way of comparison, in 2005/06, 10 food items accounted for 50% of total household food expenditure; in addition to the items previously listed, white sugar was included in this list. This suggests a small change in the number of food items acquired by households over time. Across all food groups, there was an increase in expenditure on brown bread, relative to other food groups. However, this increase was larger among the poorest households, compared to those in the richest deciles.

Across all households and in both years under consideration, the food item accounting for the highest expenditure was poultry, with approximately 12% of total household food expenditure allocated to that item. When comparisons are made across deciles, the expenditure share of poultry was highest in the poorest 40% of households. Generally, meat (poultry, beef) and dairy products like full cream milk saw an increase in expenditure shares, but the increase was more pronounced in the richest households (deciles 9 and 10). This is not unusual, given that these items are generally more expensive than staples such as brown bread, mealie meal and rice.

One notable observation that can be made is the decline in the expenditure share of potatoes in the poorest and middle deciles, but no changes in the richest deciles. The results also show that there was an increase in spending on carbonated cold drinks between 2005/06 and 2014/15. However, the average national increase was mainly driven by increases in the poorest and middle deciles where expenditure shares of these drinks increased by 2.3% to 3.7% in the poorest deciles and 4.5% to 5.2% in the middle deciles (5–8). The richest households recorded a slight decline in the expenditure share of carbonated drinks.

Table 3.6: Proportion of population consuming food items across deciles, 2005/06 and 2014/15

	ALL HOUSEHOLDS		DECILES 1–4		DECILES 5–8		DECILES 9–10	
ITEM	**2014/15**	**2005/06**	**2014/15**	**2005/06**	**2014/15**	**2005/06**	**2014/15**	**2005/06**
Poultry (incl. heads and feet)	12.1	11.6	13.1	12.9	13.0	12.4	8.3	7.2
Brown bread	8.9	6.2	11.2	8.1	8.4	6.0	5.0	2.8
Mealie meal/maize flour	6.9	6.6	10.2	10.8	6.1	5.1	2.1	1.1
Beef & veal (incl. heads & feet)	5.0	5.3	2.9	3.6	5.8	6.4	7.9	6.8
White bread	4.6	3.5	4.8	3.5	5.2	4.1	3.2	2.6
Carbonated cold drinks	4.5	3.6	3.7	2.3	5.2	4.5	4.5	4.8
Rice	3.1	2.9	3.9	3.7	3.1	2.8	1.7	1.3
Fresh full cream milk	3.0	2.4	2.2	1.8	3.3	2.7	4.2	3.3
Edible oils (e.g., cooking oils)	2.4	2.2	3.2	3.0	2.2	2.0	1.1	0.8
White sugar	2.3	3.4	3.3	5.0	2.1	3.0	0.9	1.2
Potatoes	2.2	2.5	2.9	3.5	1.9	2.1	1.2	1.1

Table 3.6 continued

	ALL HOUSEHOLDS		DECILES 1–4		DECILES 5–8		DECILES 9–10	
ITEM	**2014/15**	**2005/06**	**2014/15**	**2005/06**	**2014/15**	**2005/06**	**2014/15**	**2005/06**
Boerewors	1.7	1.6	1.3	1.2	2.1	1.9	2.0	1.9
Large eggs	1.5	1.5	1.4	1.4	1.6	1.7	1.5	1.3
Tomatoes (fresh)	1.4	1.4	1.8	1.7	1.3	1.3	1.0	0.9
Canned pilchards	1.4	1.0	1.7	1.2	1.5	1.0	0.6	0.3
Sour milk/maas	1.2	1.0	1.6	1.3	1.1	1.0	0.5	0.3
Cake flour	1.0	1.2	1.4	1.8	0.9	1.1	0.4	0.3
Onions	1.0	0.8	1.1	0.9	1.0	0.8	0.7	0.5
Fruit juices, not from food service outlets	0.9	1.1	0.5	0.5	0.9	1.2	1.9	2.3
Brown sugar	0.9	0.4	1.2	0.7	0.8	0.3	0.4	0.2
Cabbage (fresh)	0.9	0.8	1.4	1.3	0.7	0.6	0.2	0.2
Longlife full cream milk	0.8	0.8	0.7	0.7	0.8	0.8	1.2	1.0
Food hampers	0.8	0.4	0.8	0.4	0.7	0.3	1.0	0.4
Polony	0.7	0.4	0.6	0.3	0.9	0.5	0.7	0.4
Baby food (predominantly milk)	0.7	0.9	0.7	1.1	0.7	0.8	0.5	0.4
Potato crisps	0.7	0.4	0.4	0.2	0.7	0.4	1.0	0.8
Powder soup	0.6	0.6	0.9	0.8	0.6	0.6	0.3	0.4
Flavoured yoghurt	0.6	0.7	0.5	0.5	0.6	0.7	0.9	1.2
Lamb (incl. heads and feet)	0.6	0.8	0.1	0.3	0.5	0.9	1.8	1.8
Apples	0.6	0.6	0.4	0.4	0.6	0.6	0.9	0.9
Bananas	0.6	0.5	0.4	0.4	0.6	0.5	1.1	0.8
Instant coffee	0.6	0.7	0.4	0.5	0.5	0.7	1.2	1.1
Baked beans in tomato sauce	0.6	0.5	0.6	0.4	0.7	0.6	0.4	0.4
Medium eggs	0.6	0.4	0.7	0.5	0.6	0.5	0.3	0.1
Pork (incl. heads and feet)	0.6	0.5	0.3	0.3	0.6	0.4	1.1	0.9

Source: IES 2005/06 and LCS 2014/15; Analysis by W. Sambu

Table 3.7: Proportion of population that reported consumption of food items across provinces, 2014/15

ITEM	SA	EC	FS	GT	KZN	LP	MP	NC	NW	WC
Poultry (incl. heads and feet)	12.1	11.2	12.5	12.4	10.1	14.3	12.8	13.2	14.1	11.0
Brown bread	8.9	5.8	6.1	9.5	9.8	15.5	12.4	4.4	8.4	3.6
Mealie meal/maize flour	6.9	7.3	9.6	6.2	6.7	11.3	8.9	5.0	9.4	1.5
Beef & veal (incl. heads & feet)	5.0	1.4	3.7	7.3	5.2	2.8	5.8	3.5	4.3	4.9
White bread	4.6	1.9	3.1	4.0	6.8	4.1	3.8	4.2	3.2	8.3
Aerated cold drinks	4.5	3.2	5.1	4.5	3.9	6.1	4.9	6.3	5.7	3.5
Rice	3.1	6.5	1.5	2.4	5.0	1.8	2.3	2.4	2.9	2.0
Fresh full cream milk	3.0	1.5	5.4	3.5	2.2	1.6	2.5	3.3	3.7	4.3
Edible oils (e.g., cooking oils)	2.4	3.8	2.0	1.9	3.2	2.6	2.2	1.8	2.2	1.2
White sugar	2.3	5.6	2.7	1.4	2.7	1.1	1.1	3.2	2.8	2.3
Potatoes	2.2	3.6	2.9	1.4	2.7	1.5	1.7	2.5	2.1	2.5
Boerewors	1.7	0.7	2.3	2.4	1.3	1.6	2.7	2.1	1.8	1.1
Large eggs	1.5	1.3	1.6	1.4	1.6	1.9	1.7	0.8	0.9	1.7
Tomatoes (fresh)	1.4	0.8	1.6	1.6	1.3	2.2	1.7	0.9	1.9	0.7
Canned pilchards	1.4	1.4	1.5	1.2	1.5	1.8	1.7	1.7	1.6	0.8
Sour milk/maas	1.2	2.8	1.0	1.0	1.6	0.7	0.8	0.3	0.7	0.6
Cake flour	1.0	2.4	1.0	0.5	1.3	0.9	0.6	1.4	1.2	0.6
Onions	1.0	1.1	0.6	1.0	1.1	1.0	1.0	0.6	0.8	0.9
Fruit juices	0.9	0.6	0.8	1.2	0.9	0.8	0.7	0.8	0.8	1.2
Brown sugar	0.9	0.2	1.1	0.9	0.8	1.5	1.6	0.8	1.4	0.2
Cabbage fresh	0.9	1.1	1.2	0.8	0.9	1.0	1.2	0.4	1.0	0.3
Long life full cream milk	0.8	2.4	0.8	0.5	0.6	0.4	0.5	1.7	0.6	1.2
Food hampers	0.8	0.7	1.2	0.4	0.0	0.0	0.1	4.4	1.7	2.7
Polony	0.7	0.6	0.5	0.7	1.1	0.4	0.7	0.5	0.5	0.9
Baby food (predominantly milk)	0.7	0.8	0.4	0.7	0.8	0.5	0.8	0.9	0.5	0.5
Potato crisps	0.7	0.4	0.8	0.8	0.4	0.6	0.5	0.7	0.6	0.9
Powder soup	0.6	1.4	0.5	0.5	0.8	0.5	0.6	0.6	0.6	0.3
Flavoured yoghurt	0.6	0.9	0.4	0.5	0.6	0.5	0.5	0.4	0.5	1.0
Lamb (incl. heads and feet)	0.6	0.3	0.8	0.5	0.4	0.1	0.2	3.4	0.2	2.1
Apples	0.6	0.6	0.7	0.7	0.6	0.6	0.6	0.4	0.5	0.5
Bananas	0.6	0.5	0.5	0.7	0.5	0.7	0.5	0.4	0.5	0.7
Instant coffee	0.6	0.7	0.4	0.5	0.3	0.2	0.4	1.3	0.7	1.4

Table 3.7 continued)

ITEM	SA	EC	FS	GT	KZN	LP	MP	NC	NW	WC
Baked beans in tomato sauce	0.6	0.5	0.4	0.6	0.9	0.6	0.7	0.4	0.5	0.3
Medium eggs	0.6	0.3	0.6	0.6	0.3	0.7	0.9	0.8	1.1	0.4
Pork (incl. heads and feet)	0.6	0.7	0.9	0.4	0.3	0.2	0.6	0.7	0.3	1.3

Source: IES 2005/06 and LCS 2014/15; Analysis by W. Sambu

3.3.4 Individual-level food consumption patterns

Very few national surveys collect data on individual dietary intake, one example being the 1999 Food Consumption Survey whose data, though, are not publicly available. More recent surveys that have collected this kind of data include the SANHANES, but the publicly available data limit the analysis to individuals aged 15 years and over. An analysis of consumption of 10 food groups based on a 24-hour recall methodology is presented in Table 3.8, covering just 14,000 individuals who responded to questions about food consumption. As in other survey results, starchy staples (including cereals and roots and tubers) were the most common food items listed by individuals interviewed during the survey. The food groups with the lowest proportion of households reporting consumption included organ meats, dark green vegetables, eggs and vitamin A-rich fruits and vegetables. More households in urban areas than in rural traditional areas reported consumption across all the food groups. Generally, the proportion of White individuals reporting consumption, compared to other population groups, was highest across all food groups, except cereals and dark green vegetables.

There were no significant differences in reported consumption of food groups across age groups, except for vitamin A-rich fruits and vegetables and dairy products, where the proportion of those reporting consumption was higher in the older age groups. There were also no significant gender-based differences.

Table 3.8: Proportion of adults aged 15 years and older who reported consumption of various foods, SANHANES 2012.

	Starchy staples	Vitamin A-rich fruits and vegetables	Other fruits and vegetables	Dark greens	Meat and fish	Organ meats	Eggs	Legumes, nuts and seeds	Milk and other dairy products
South Africa	94.9	27.6	53.5	16.9	69.2	15.0	23.2	16.1	49.1
Province:									
EC	96.1	27.2	53.1	11.4	53.7	8.0	16.6	15.1	45.4
FS	94.7	22.1	43.6	19.7	66.3	16.9	20.7	16.1	50.7
GT	94.9	38.9	60.8	22.4	78.6	24.0	36.5	16.6	60.7
KZN	93.3	19.7	48.7	9.3	61.5	9.5	12.8	20.5	39.2
LM	98.8	23.2	64.5	56.3	77.2	25.5	22.9	18.3	38.6
MP	92.1	24.6	55.0	23.8	70.2	20.4	23.6	16.9	36.0
NW	95.2	13.9	37.3	12.0	61.2	14.5	14.7	7.6	34.0

Table 3.8 continued

	Starchy staples	Vitamin A-rich fruits and vegetables	Other fruits and vegetables	Dark greens	Meat and fish	Organ meats	Eggs	Legumes, nuts and seeds	Milk and other dairy products
NC	93.9	18.4	43.4	5.2	70.0	9.4	14.6	5.0	54.0
WC	94.7	32.5	54.6	5.9	75.9	6.0	26.8	14.7	64.0
Geographical location:									
Urban formal	93.7	35.3	57.2	15.9	75.0	16.7	28.9	17.3	60.4
Urban informal	95.5	23.3	50.6	14.5	60.0	13.1	20.8	14.2	39.4
Rural traditional	96.4	15.0	49.9	22.0	61.6	12.4	12.7	16.1	28.6
Rural formal	96.8	18.4	44.0	11.6	65.9	14.1	19.1	10.3	46.4
Population group:									
African/Black	95.3	23.7	50.8	19.0	66.6	16.3	21.8	15.2	42.0
Coloured	95.1	29.1	51.5	5.4	79.9	8.5	26.2	16.1	64.3
Indian/Asian	91.2	24.0	55.6	6.0	59.0	5.4	13.2	25.2	63.1
White	93.2	54.4	74.2	16.2	80.9	14.4	32.7	19.4	80.8
Gender:									
Male	95.0	27.1	52.4	16.8	70.5	15.7	24.7	16.8	48.6
Female	94.9	27.9	54.4	17.1	68.1	14.5	22.0	15.5	49.5
Age group:									
15–24	95.7	24.3	52.7	15.5	68.2	16.1	23.2	15.5	45.1
25–34	94.9	27.7	54.7	17.0	68.9	16.8	24.2	15.5	47.4
35–44	94.0	28.8	55.0	16.9	70.4	13.8	24.8	15.9	49.3
45–54	95.5	28.4	51.6	16.9	72.2	14.0	24.6	13.9	55.1
55–64	95.1	29.1	51.3	19.4	68.1	14.7	20.8	20.4	53.6
65+	93.3	32.9	54.5	19.4	66.4	10.9	16.3	19.9	53.3

Source: SANHANES; Analysis by W. Sambu

Since 2013, the General Household Survey has been collecting data on food consumption in individuals and households based on a 24-hour recall methodology in terms of 10 broad groups. An analysis of trends in the consumption of the 10 food groups appears in Figure 3.9. It is important to note that the GHS is not a food consumption survey and the results presented have several limitations. First, the results do not show the quantity or the quality of foods, or the share of expenditure that was allocated to each food group. Rather, these estimates show whether or not the foods were consumed within or outside the household, giving a sense of the range of diversity in the diets of the respondents. Another limitation of the results is that consumption did not necessarily relate to what household members consumed; instead, it may have reflected the consumption of the respondent only.

Similar to the findings from the IES, the LCS and SANHANES, cereals remained the most commonly consumed foods in the country across the six-year period, according to the GHS, followed by meat and fish, oils, sugars and other vegetables. The least commonly consumed foods across the six-year period were pulses, spinach and wild greens, and fruits. With the exception of 2015 when there was a slight decrease in consumption across all food groups, the estimates generally showed a gradual increase in the proportion of households reporting consumption across all food groups.

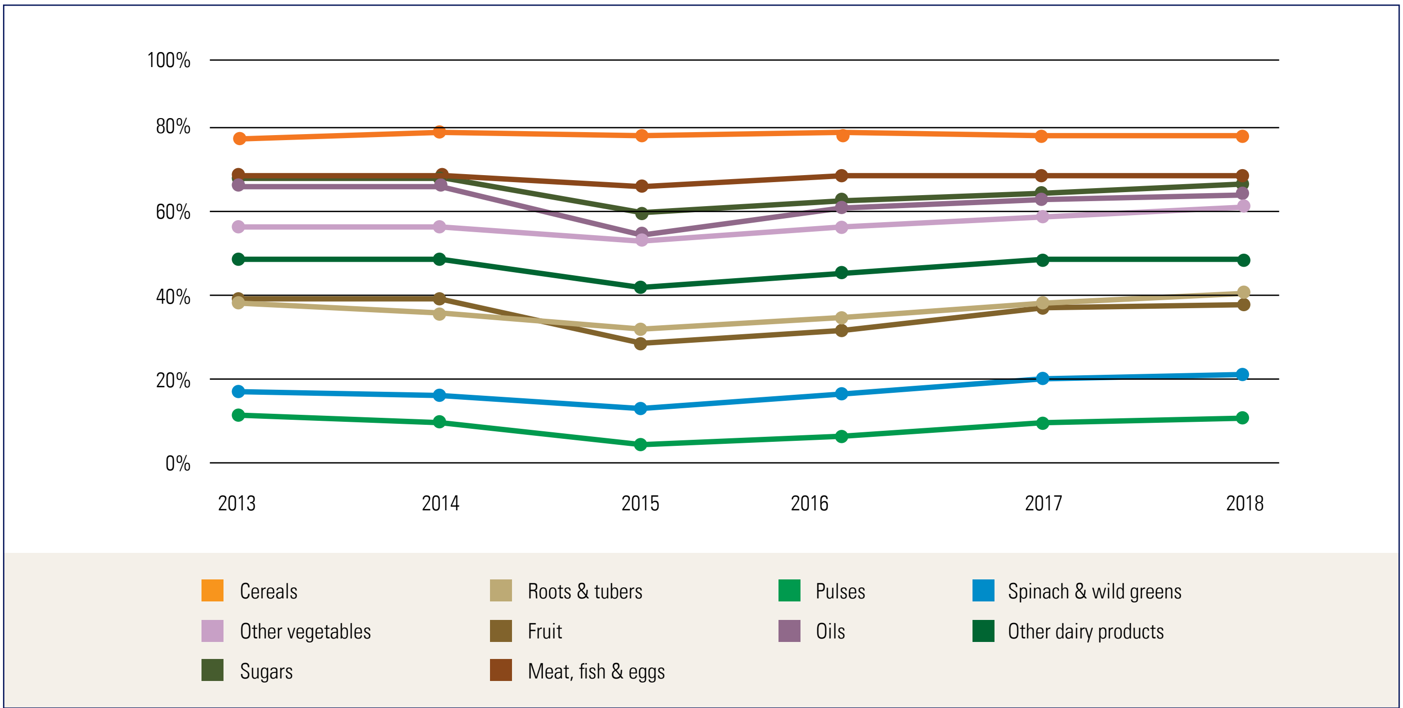

Figure 3.9: National consumption of food groups, 2013–2018

Source: GHS, 2013–2018; Analysis by W. Sambu

Figure 3.10 uses the 2018 GHS to show variations in household consumption across geographical areas, provinces and income deciles. The analysis revealed that the main disparities manifest in the consumption of fruit, pulses, meat, fish and eggs, and dairy products. In the North West, Free State, and Northern Cape provinces, less than 50% of households reported fruit consumption while in the Western Cape close to two-thirds of households reported fruit consumption.

Across income deciles, while 79% of the richest 10% of households reported consumption of fruit, only 38% of households in the poorest deciles reported fruit consumption. The same patterns were visible in the consumption of dairy products and vegetables (spinach and wild greens). However, the Western Cape revealed relatively low consumption of spinach and wild greens, much lower than more rural and poorer provinces like Limpopo. In fact, Limpopo and Gauteng provinces had the highest proportion of households consuming vegetables compared to other provinces. Overall, pulses remained the least-consumed food items in the country, with particularly low consumption in the North West province where only 17% of households reported consumption. KwaZulu-Natal and the Eastern Cape provinces had the highest proportion of households reporting consumption of pulses Consumption of sugar or oils was fairly high across all provinces and income deciles.

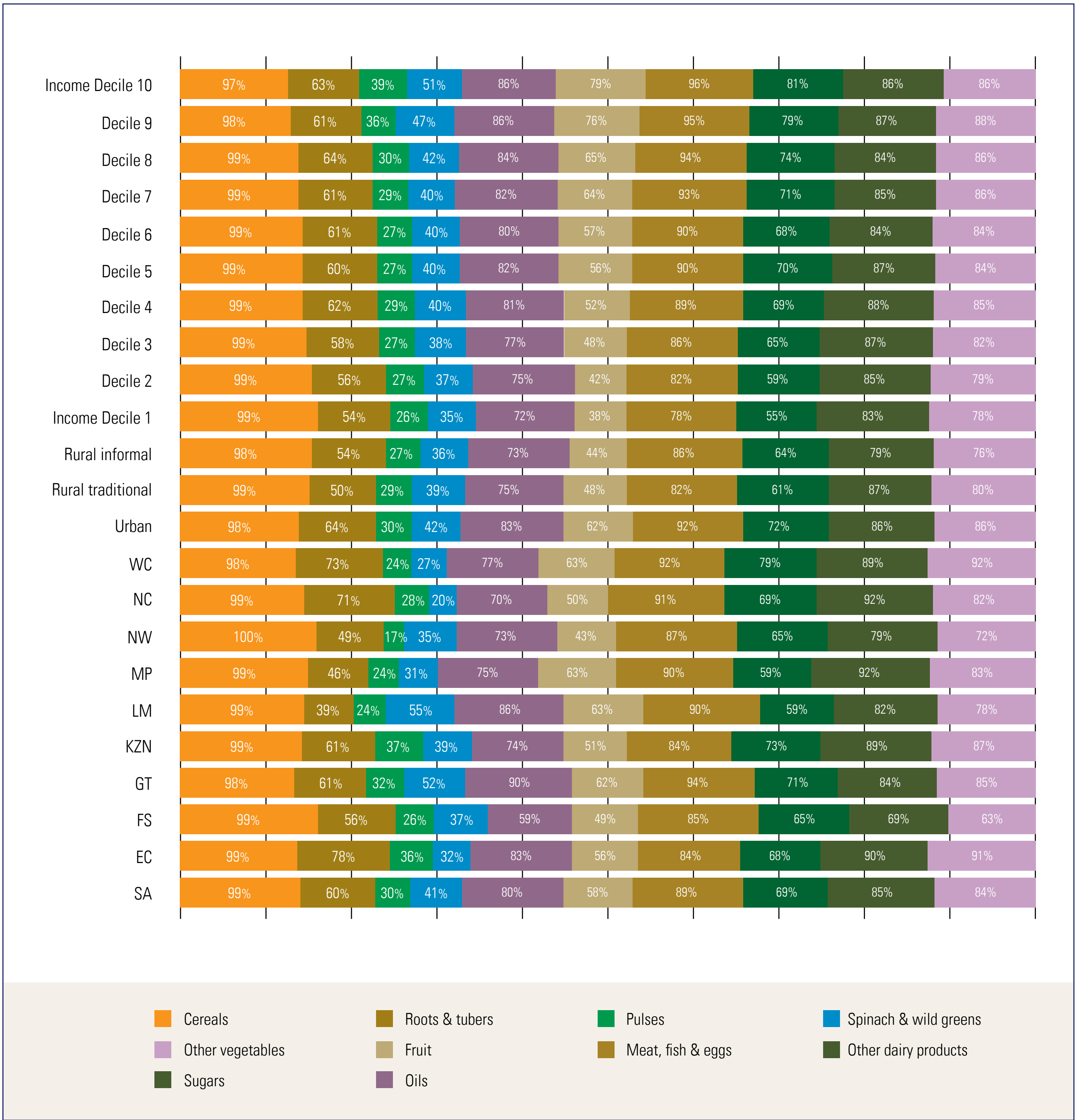

Figure 3.10: Proportion of population that reported consumption of food groups across provinces, geographical areas and income deciles
Source: GHS, 2018

3.3.5 How diverse are South African diets?

Results from the SANHANES revealed that the average number of food groups consumed in 2012 over a 24-hour period was approximately three. In the country's urban areas, as well as in the Gauteng, Mpumalanga and the Western Cape provinces, the average number of food groups consumed was four. Across population groups, White respondents reported consuming an average of five food groups, compared to three among Black African and Indian respondents, and four among Coloured respondents. There were no significant gender-based differences in the number of food groups consumed, although there were some differences across age groups, with older respondents (35–64 years) reporting consumption of foods from four groups, compared to three among the younger age groups.

The nine food groups consumed, according to the SANHANES (see Table 3.8), were used to generate an individual dietary diversity score that reflects the number of food groups consumed, with each food group allocated a score of 1. The dietary diversity scores for all individuals were then classified into three equal distributions in order to classify households' dietary diversity levels into three groups (low, medium and high). Figure 3.11 presents the results of the analysis of the dietary diversity levels (low, medium and high). Nationally, the majority of respondents consumed diets low in diversity (58%) and only one-fifth consumed diets high in diversity. The provinces with the highest percentages of individuals who consumed diets low in diversity were Limpopo (80%) and North West (77%). In the Western Cape and Gauteng provinces, the majority reported consuming diets that were either of medium or high dietary diversity. Similarly, across race, while approximately one-third of Black African individuals consumed diets that were either of medium or high diversity, more than three-quarters of White respondents reported medium or high dietary diversity. There were no visible differences in dietary diversity levels across gender and age groups, except for the 15–24-year age group which had significantly more pronounced low dietary diversity relative to other age groups.

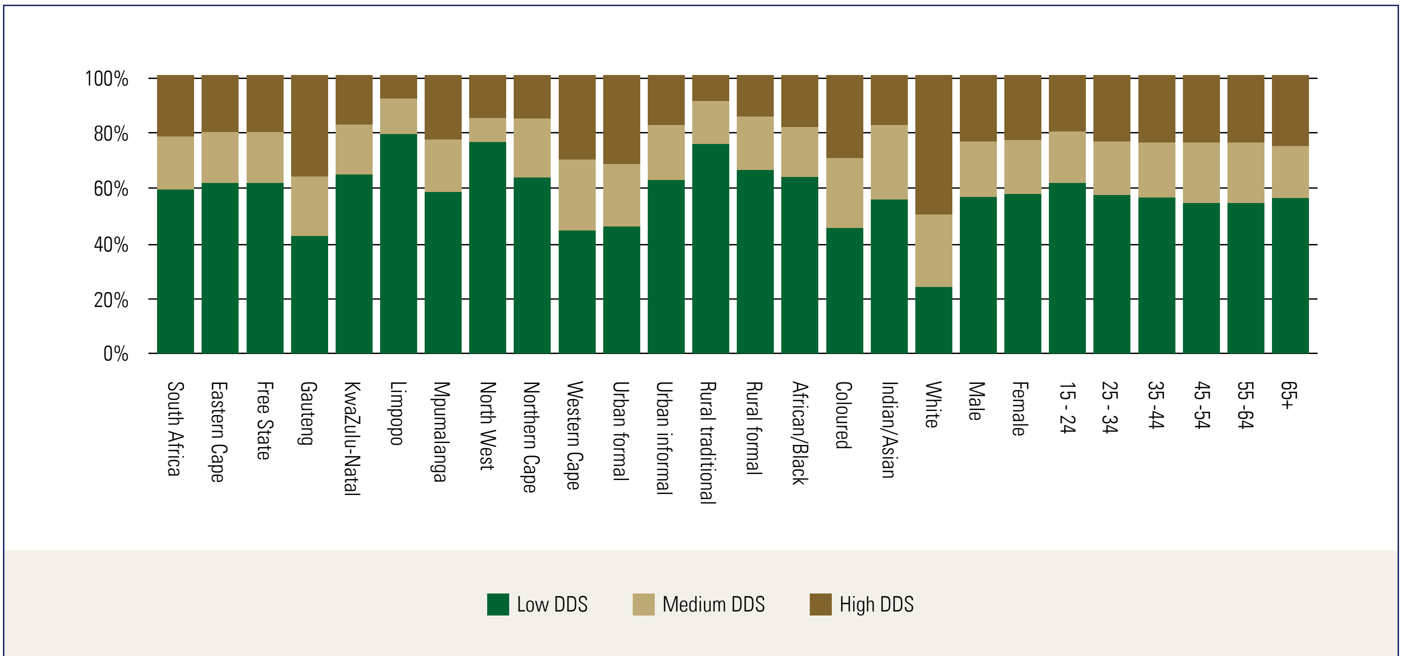

Figure 3.11: Dietary diversity levels by province, geographical type, race, gender and age group, SANHANES 2012

Similarly, the 10 food groups included in the GHS were categorised to generate a dietary diversity score, after which households were classified as low, medium or high diversity based on the methodology applied in the SANHANES data. The results presented in Figure 3.12 show an increase in households reporting medium or high dietary diversity over time, with the most recent data showing that 59% of households had diets that were either of medium or high diversity. Figure 3.13 shows that over three-quarters of households in the Western Cape had access to medium or highly diversified diets, compared to 43% in the Free State. Household dietary diversity levels increased with income deciles, with over 70% of those in the richest decile reporting medium or high dietary diversity compared to 41% in the poorest income decile.

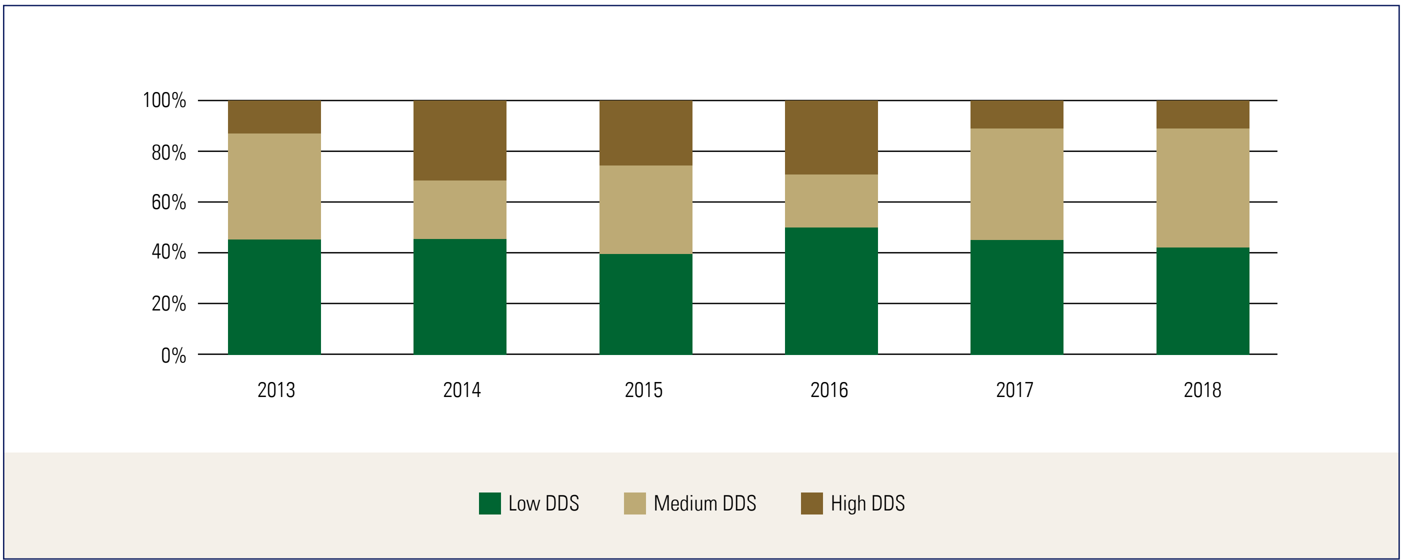

Figure 3.12: Household dietary diversity levels, GHS 2013–2018

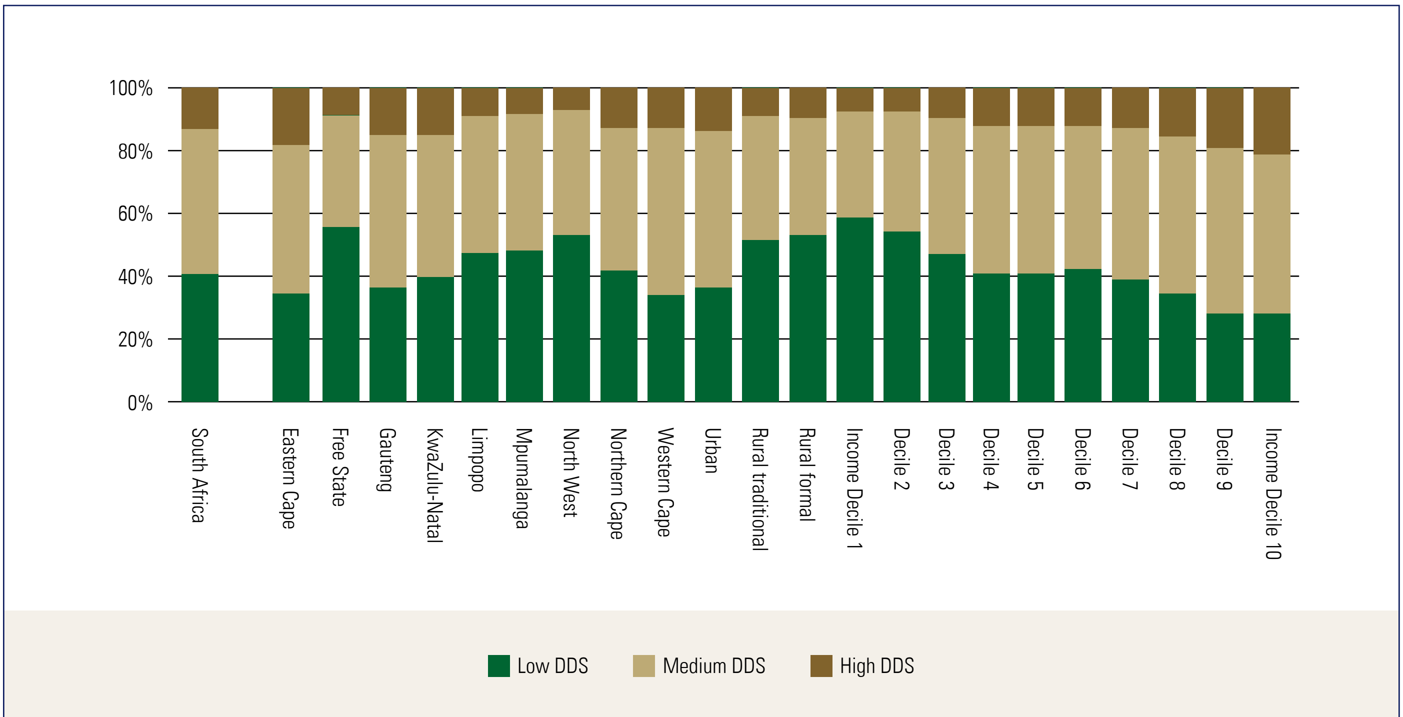

Figure 3.13: Dietary diversity categories across provinces, geographical locations and income deciles, GHS 2018

3.3.6 Trends in processed food consumption in South Africa

The nutrition transition that has occurred across the globe has also been reported in South Africa through various population-based studies that have revealed increasing consumption of processed foods and a decline in minimally processed foods. This review uses data from the national household surveys to examine changes in consumption of selected processed foods to determine if their consumption is rising.

Beginning with food expenditure data from the IES and the LCS, Table 3.9 compares spending patterns between the 2005/06 and 2014/15 surveys, focusing on five broad processed food groups attracting the highest levels of spending. The results showed an increase in the expenditure share of carbonated cold drinks, with the increase in household food expenditure going to these drinks being approximately 1 percentage point over the 10-year period. This represents a 23% increase in the share of expenditure that households allocated to carbonated cold drinks. The largest increases were seen in the North West and Limpopo provinces where households allocated an extra 3 percentage points and 2 percentage points of household food expenditure, respectively, to carbonated cold drinks. Whereas among the poorest households, the expenditure allocated to carbonated drinks increased by 2 percentage points (and by 139%), spending among the richest deciles declined—although households in this group still had the highest expenditure share of carbonated drinks compared to those in other deciles.

Processed bread consumption increased significantly during this period, with households across all provinces and deciles allocating more money towards the purchase of these foods. While nationally the food expenditure share of processed bread increased by 4 percentage points, in KwaZulu-Natal and the Western Cape, the expenditure shares increased by over 5 percentage points. Particularly notable was the fact that the highest increase in spending on processed breads was among the poorest households; in deciles 1 and 2, spending shares increased by 7 percentage points and 5 percentage points, respectively. These increases are important as they indicate that households increased spending on processed breads, which are relatively cheaper compared to other foods and are more filling and long lasting.

3.3.7 Frequency of consumption of processed foods

The IES and the LCS provide information on household spending on processed foods, but do not offer any insights into the frequency of consumption or the quantity consumed. The SANHANES survey carried out in 2012 did provide data on the frequency of consumption of a small number of foods (and food groups), including those that are ultra-processed. Figure 3.14 contains an analysis of frequency of consumption of these foods as well as the frequency of consumption of high-fat diets from fast-food outlets and street vendors.

Focusing first on the out-of-home consumption of fast or fried foods, the analysis shows that the majority (51%) of individuals reported the consumption of fried foods from street vendors either daily or at one to three times per week. Just over 40% reported consuming food from fast-food outlets either on a daily basis or at least one to three times per week. In total, 46% and 56% of individuals ate foods from fast-food vendors and fried street food, respectively. However, the percentages were significantly different across localities, as shown in Table 3.10: 58% and 61% of those living in the urban formal areas reported eating foods from fast-food and street vendors, compared to 29% and 50%, respectively, in the rural traditional areas. While over 60% of White individuals ate from fast-food vendors, only 43% of Black Africans reported doing so, although 60% of the latter reported consuming foods from street vendors.

The foods with the lowest reported consumption were low-fat and medium-fat fish, with less than 40% of individuals reporting consumption of either, although consumption was highest among White individuals, with over 50% reporting consumption of medium-fat fish and two-thirds reporting consumption of low-fat fish. In contrast, consumption of canned fish, which constitutes

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Table 3.9: Proportion of population reporting consumption of processed foods, IES vs LCS, 2005/06 and 2014/15

	CARBONATED SOFT DRINKS (E.G., SODAS)		HAM AND POLONY		PROCESSED BREAD		POWDERED SOUP		SALTY SNACKS		CHOCOLATES	
	2005/06	2014/15	2005/06	2014/15	2005/06	2014/15	2005/06	2014/15	2005/06	2014/15	2005/06	2014/15
S Africa	3.6	4.5	2.3	3.4	10.1	14.0	0.8	0.9	0.7	1.2	0.5	0.8
EC	2.6	3.2	1.7	3.2	6.2	8.1	1.0	1.6	0.7	0.9	0.4	0.7
FS	3.6	5.1	3.0	4.3	7.3	9.6	0.6	0.8	0.9	1.7	0.6	0.7
GT	5.1	4.5	2.4	3.2	10.6	14.2	0.8	0.7	0.8	1.2	0.6	0.9
KZN	2.4	3.9	2.1	3.6	11.5	17.0	1.1	1.0	0.6	1.3	0.4	0.4
LM	4.0	6.1	2.1	2.7	16.1	19.9	0.7	0.7	0.7	1.5	0.2	0.5
MP	3.7	4.9	2.2	3.5	13.6	16.6	1.1	0.9	0.6	1.2	0.4	0.5
NW	3.3	6.3	2.4	3.4	5.4	8.9	0.8	0.8	0.5	1.0	0.6	0.5
NC	3.9	5.7	2.4	2.8	9.2	11.9	0.7	0.9	0.6	1.1	0.5	0.6
WC	3.3	3.5	2.7	3.7	7.5	12.7	0.6	0.6	1.0	1.3	1.2	1.4
Urban	4.0	4.5	2.5	3.5	9.7	13.7	0.8	0.8	0.8	1.3	0.7	0.9
Rural	2.9	4.4	1.9	3.1	10.9	14.8	1.0	1.1	0.6	1.0	0.2	0.4
1	1.4	3.3	1.8	2.8	11.5	18.7	0.9	1.0	0.6	1.2	0.1	0.3
2	2.1	3.5	2.0	3.2	11.4	16.4	0.9	1.2	0.5	1.0	0.1	0.4
3	2.7	3.8	2.0	3.6	12.0	15.0	0.9	0.9	0.6	1.0	0.2	0.5
4	2.9	4.3	2.4	3.3	11.7	15.0	0.8	0.9	0.6	1.3	0.2	0.4
5	3.3	5.0	2.4	3.5	11.1	14.5	0.9	0.8	0.6	1.1	0.3	0.4
6	4.1	5.1	2.4	3.7	10.9	14.9	0.9	0.9	0.7	1.1	0.4	0.6
7	5.0	5.3	2.3	3.5	10.3	14.2	0.8	0.7	0.6	1.2	0.3	0.7
8	5.4	5.4	2.6	3.4	9.6	12.7	0.8	0.8	0.9	1.6	0.7	0.9
9	5.0	5.2	2.3	3.4	7.9	11.5	0.7	0.7	1.0	1.5	1.2	1.3
10	4.5	3.8	2.4	3.1	5.0	7.4	0.8	0.7	1.2	1.5	1.9	2.2

processed food, was highest among Black African and Indian respondents where close to 60% of individuals reported consumption compared to less than half of White respondents. While just over 50% of all respondents reported consuming fresh fruit juice at least once over a seven-day period, over 70% reported consumption of fresh fruit. However, like other unprocessed foods, there were significant disparities across population groups. For example, 68% of Black African respondents reported consumption of fresh fruit compared to 85% of White respondents.

Close to 80% of respondents reported consumption of fats like butter, ghee and margarine, with 29% reporting consuming these products daily. Like other food products, these fats were consumed by higher proportions of the population in urban formal areas and by lower proportions of the population in the rural areas and among the Indian and White population groups. Consumption of sweet foods and snacks like chocolates and cookies were highest among those in the urban areas and among younger age groups, declining significantly in older age groups. Consumption of chocolates, fudge and toffees was reported by 71% of those aged 15–24 years, by 61% of those aged 25–34 years, and by 43% for those aged 65 years and over. Similar observations were made in terms of savoury snacks like chips and crisps which were consumed by 60% of the respondents at least once a week, but the percentage was significantly higher among urban respondents and among the 15–34-year age group.

Consumption of salted snacks like biltong was comparatively low at 39% but was particularly low among individuals from the Black African (35%) and Indian (36%) populations. However, it was significantly higher among White individuals, with close to 60% reporting consumption of these snacks. Less than 50% of individuals reported consumption of healthier snacks like nuts. The percentage was lowest in the rural traditional areas (37%) and among Coloured (43%) and Black African (45%) individuals. Two-thirds of the respondents reported consuming sweetened cold drinks, with 11% reporting they consumed these drinks on a daily basis, with a significantly higher percentage (71%) among individuals in urban formal areas. Consumption of these drinks was reportedly highest among those aged 15–34 years as well as among individuals from the Coloured and Indian population groups. Similar observations were made in terms of the consumption of sweetened fruit juices.

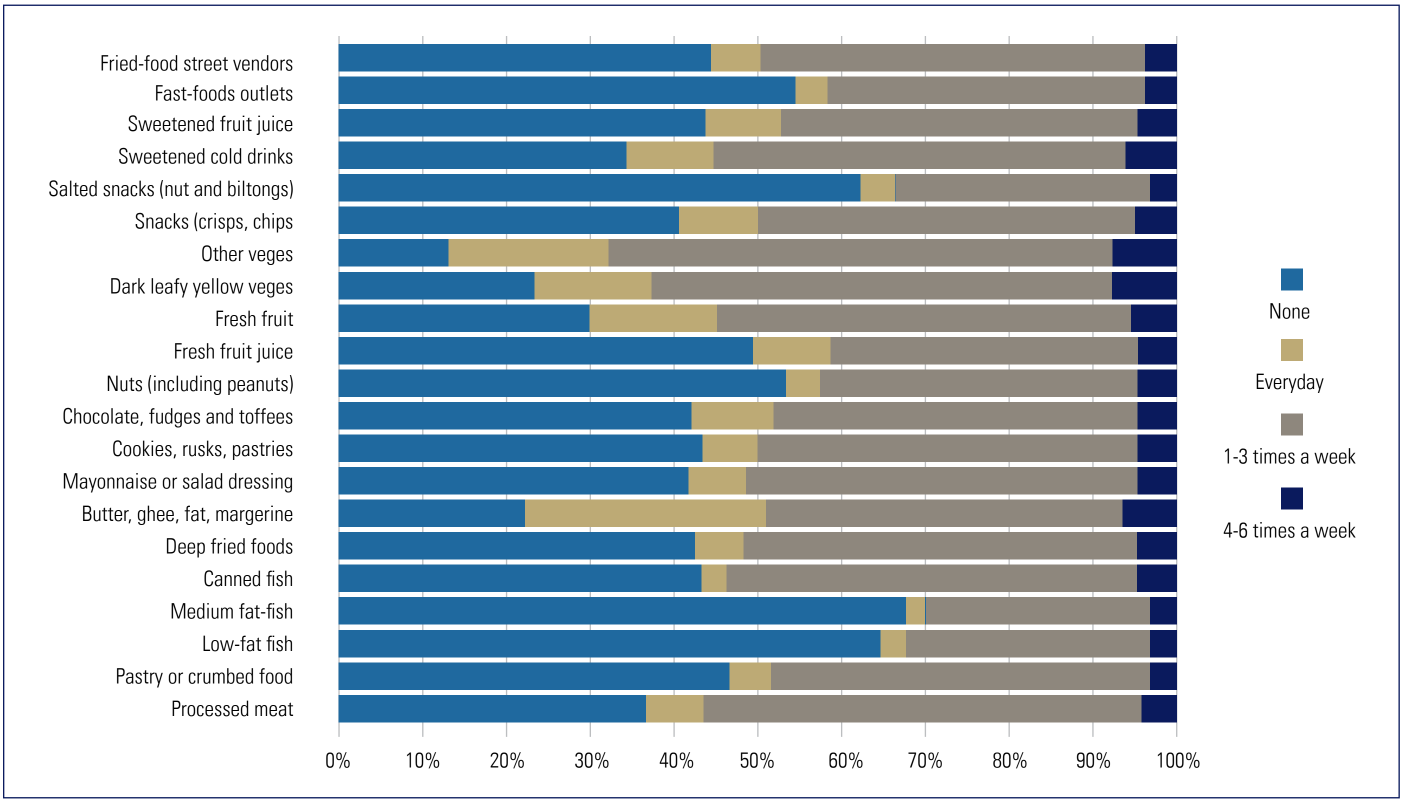

Figure 3.14: Frequency of food consumption among individuals aged 15 years and older, 2012

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Table 3.10: Proportion of study sample that reported food consumption across geographical area, gender, age and population group, SANHANES 2012

	SA	GEOGRAPHICAL AREA				GENDER		AGE GROUPS (YEARS)						POPULATION GROUP			
	All	Urban formal	Urban informal	Rural traditional	Rural formal	Male	Female	15–24	25–34	35–44	45–54	55–64	65+	Black African	Coloured	Indian/ Asian	White
Nuts (e.g., peanuts)	47	55	39	37	37	53	42	45	50	50	48	43	39	45	43	52	62
Low-fat fish	36	46	22	25	26	37	35	33	37	39	37	39	31	31	41	51	65
Medium-fat fish	33	41	21	23	34	35	32	32	35	34	36	32	28	29	45	40	55
Canned fish	57	57	56	58	56	57	57	56	59	60	57	52	51	59	49	58	47
Fresh fruit juice	51	60	40	41	39	52	50	50	52	52	54	47	44	48	49	63	70
Fresh fruit	71	78	65	62	60	70	71	70	73	72	72	68	64	68	76	79	85
Dark leafy yellow vegetables	77	82	71	71	75	76	78	73	76	79	80	81	80	75	82	78	90
Other vegetables	87	90	86	83	83	87	88	86	88	89	87	89	86	87	89	91	88
Processed meats	64	75	63	45	54	65	63	67	67	66	63	56	46	60	79	62	72
Pastry or crumbed foods	54	64	51	39	41	54	53	55	58	56	53	49	38	51	60	58	66
Butter, ghee, fat, margarine	78	84	77	70	69	79	77	78	80	79	77	77	71	76	80	86	87
Mayonnaise or salad dressing	59	70	50	44	45	57	60	56	63	63	60	53	49	56	62	61	75
Cookies, rusks, pastries	57	66	48	45	46	54	59	62	58	56	53	50	48	53	64	72	77
Chocolate, fudge and toffees	57	66	52	51	45	56	60	71	61	55	48	47	43	54	68	67	76
Snacks (crisps, chips)	60	67	58	50	47	59	61	75	63	59	51	42	36	58	70	63	62
Salted snacks (nuts and biltong)	39	48	24	25	40	42	36	38	40	43	40	33	29	35	47	36	59
Sweetened cold drinks	66	71	67	61	53	67	65	71	71	66	63	55	47	66	72	74	61
Sweetened fruit juice	57	61	58	51	45	56	57	61	61	57	54	49	40	57	63	54	50
Deep-fried foods	58	63	54	51	54	60	57	65	62	57	56	45	43	58	59	66	55
Fast-food outlets	46	58	38	29	33	47	45	48	51	48	45	39	27	43	49	54	61
Fried food (street vendors)	56	61	58	50	44	58	54	66	62	53	50	43	35	60	44	27	43

More recent estimates from the South African Demographic and Health Survey, which used a 24-hour recall methodology to assess food consumption for selected food groups, also showed high consumption of processed foods and associated disparities across demographic profiles, socio-economic groups and geographical location. Over one-third (36%) of individuals aged 15 years and over reported consuming sugar-sweetened beverages (SSBs) while 14% drank fruit juice. Consumption of SSBs in the wealth quintiles 2, 3, 4 and 5 was fairly close to the national average, but in the lowest quintile only 28% reported drinking SSBs. The proportion of those consuming fruit juices in quintile 5 was 14% points higher than those in the poorest wealth quintile. Consumption of SSBs was higher among men than women. Consumption of both SSBs and fruit juice was found to be inversely related to age, with the youngest age groups reporting the highest percentage (42%) of SSB consumption and the oldest age group reporting less than 20% of SSB consumption. Across provinces, the highest consumption of SSBs was reported in the North West and Mpumalanga provinces, while the lowest was reported in the Eastern Cape and Free State provinces. A comparison of fruit and vegetables shows that consumption was highest among individuals from urban areas, from the wealthiest or White households. The Northern Cape province had the lowest proportion of individuals consuming fruits and vegetables.

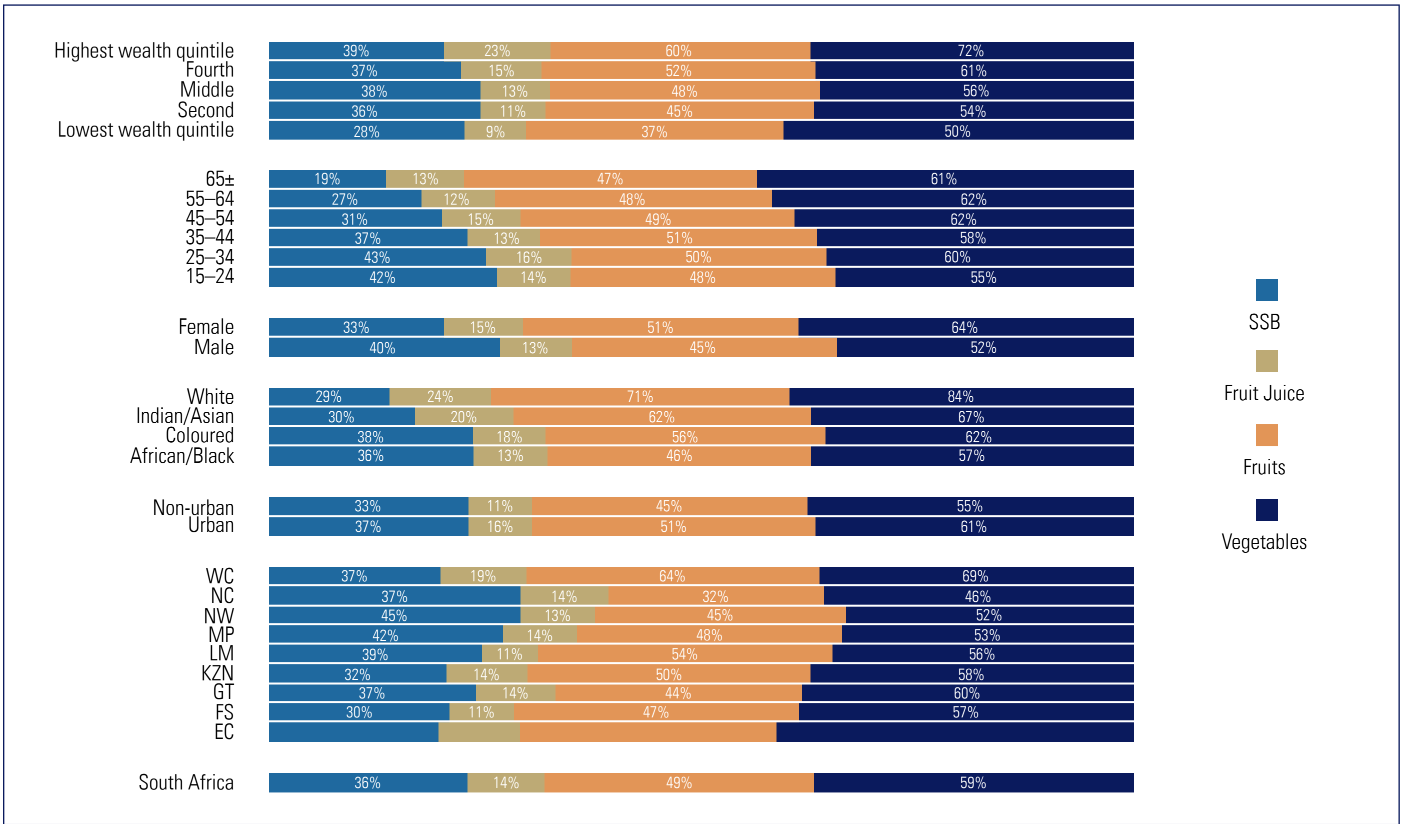

Figure 3.15: Proportion of the study sample reporting consumption of selected foods, SADHS 2016

In Table 3.11, estimates on consumption of processed foods over a seven-day period show that close to 50% of respondents consumed fried foods, one-fifth consumed fast foods, and just over 40% consumed salty snacks or processed meats. The Eastern Cape and Limpopo provinces had the lowest proportion of individuals reporting consumption of these foods, while Mpumalanga, Gauteng and the Western Cape provinces had the highest levels of consumption. Generally, more individuals in the urban areas reported consumption of these food groups, compared to those in the rural areas of the country. Consumption of all these foods was more prevalent among individuals from the Coloured and Indian population groups, compared to the Black African and White population groups. In terms of gender, while consumption of fried foods was more prevalent among men than women, the reverse was evident in the consumption of salty snacks. In all cases, the consumption of these foods was more prevalent in the wealthier quintiles (4 and 5) compared to the poorest wealth quintile.

Table 3.11: Proportion of the study sample that reported consumption of processed foods, SADHS 2016

	FRIED FOODS	FAST FOODS	SALTY SNACKS	PROCESSED MEATS
South Africa	47	21	41	43
Province:				
EC	34	14	34	34
FS	48	21	44	43
GT	51	26	41	46
KZN	49	25	39	48
LM	36	9	34	25
MP	54	25	48	50
NW	47	17	51	45
NC	45	19	38	42
WC	51	20	50	50
Geographical area:				
Urban	50	24	44	47
Non-urban	39	15	37	35
Population group:				
African/Black	46	20	41	43
Coloured	53	22	50	52
Indian/Asian	61	37	48	46
White	51	26	40	35
Gender:				
Male	52	20	37	45
Female	43	21	44	42
Age group (respondent):				
15–24	54	24	58	51
25–34	52	27	48	51
35–44	48	22	40	46
45–54	44	17	31	38
55–64	34	12	23	29
65+	31	10	20	25

Table 3.11 Continued

	FRIED FOODS	FAST FOODS	SALTY SNACKS	PROCESSED MEATS
Wealth quintiles:				
Lowest	33	11	29	25
Second	43	17	40	40
Middle	49	21	44	45
Fourth	52	23	47	55
Highest	55	31	46	50

3.3.8 Food consumption among young children

The 2016 South African Demographic and Health Survey also collected data on food consumption among young children. Among children aged 6–23 months, 44% were reported to consume salty snacks and 35% sugary snacks, while 18% drank sugary drinks during the preceding 24 hours (Figure 3.16). Figure 3.17 shows that food consumption among young children is generally inadequate. Only 23% of children aged 6–23 months consumed foods that met the minimum acceptable diet, only 52% were reported to meet the minimum meal frequency standards and only 49% consumed foods that met minimum dietary diversity levels.[3] As was evident in earlier analyses, these percentages were significantly higher among children in the wealthiest quintiles and those living in the urban areas. A comparison of breastfed and non-breastfed children showed that while 11% of the former were fed minimum acceptable diets, 31% of the latter were fed minimum acceptable diets.[14]

Figure 3.16: Proportion of young children who consumed sugary drinks and foods, and salty snacks the previous day, SADHS 2016

[3] Minimum meal frequency occurs when a child is fed solid, semi-solid or soft foods at least twice a day (for those aged 6–8 months) and at least three times a day for those aged 9–23 months. The minimum dietary diversity level is defined as consumption of at least four food groups out of seven standard groups. The minimum acceptable diet measure combines both minimum meal frequency and minimum dietary diversity.

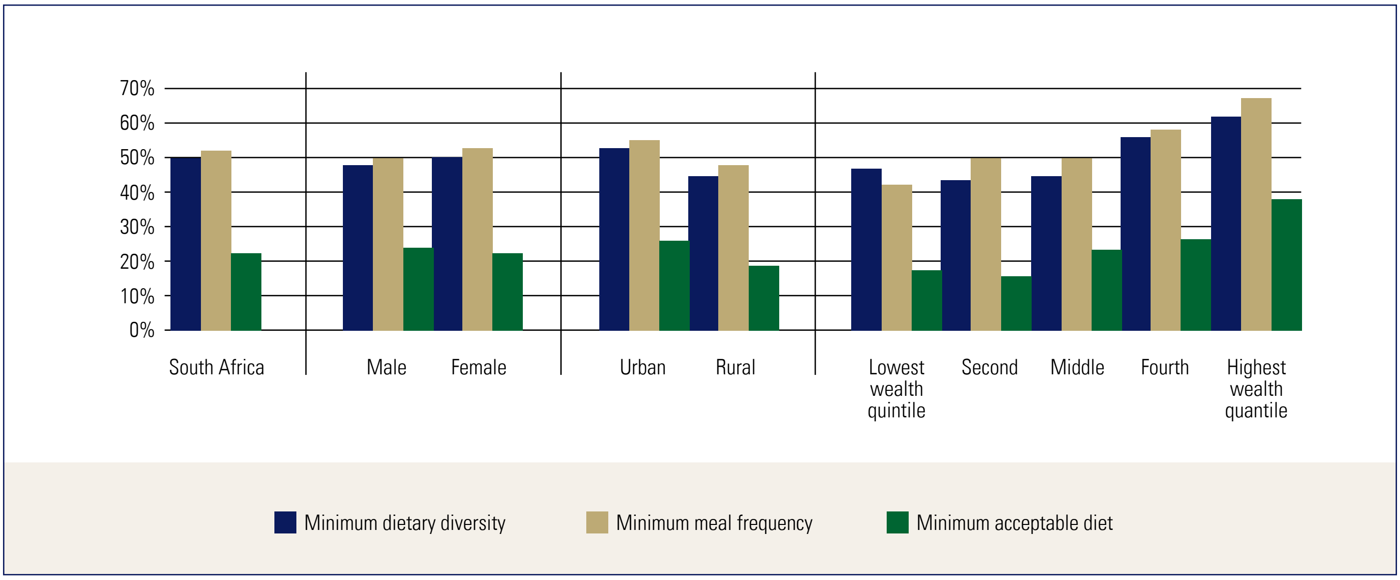

Figure 3.17: Dietary intake levels among children aged 6–23 months, SADHS 2016

3.4 CONCLUSION

National data show a decrease in the prevalence of food insecurity (based on the CCHIP Hunger index). Hunger has declined nationally since 2002, by 12 percentage points. However, the 2020 COVID-19 pandemic and control measures such as lockdowns have triggered job losses and subsequent food insecurity. In the NIDS-CRAM (National Income Dynamics Study—Coronavirus Rapid Mobile) Survey, 40% of households reported a loss of income[44] and it is estimated that unemployment in South Africa has risen to an all-time high of 32.5%. It is likely that this will have resulted in hunger and food insecurity levels reverting to levels recorded in 2002 or higher, and all forms of malnutrition are expected to increase in low- and middle-income countries.[45,46]

Most of the studies presented above relate to household spending patterns and therefore do not provide individual-level information on consumption. The differences in household food consumption measured in terms of food expenditure illustrate the stark differences between income deciles. In general, the lowest five deciles spend similarly small proportions of money on the different food groups. Thereafter, each decile increases expenditure on food groups, with decile 10 spending 19 times more on fruit, six times more on meat and four times more on vegetables. Furthermore, consumption of meat types differed, with lamb and pork featuring more in higher-income deciles, while poultry meat was the primary meat expenditure item of deciles 1–4. Increased meat consumption as income rises seems to be an international phenomenon.[47]

The food groups consumed by individuals in the SANHANES 2012 survey revealed interesting provincial differences—most of which were, in all likelihood, a function of income. First, more expensive food items such as eggs, fruit, meat and fish were reported to be consumed by larger proportions of participants in Gauteng and the Western Cape. The dry, arid provinces of the Northern Cape and North West reported the lowest proportion of individuals who consumed vitamin A-rich fruit and vegetables as well as nuts and legumes, while in KwaZulu-Natal, Limpopo, Mpumalanga and North West a relatively low proportion of individuals ported to consumed dairy products (ranging between 34–39%). Limpopo had the highest proportion of individuals who reported consumption of different types of vegetables and animal protein—probably as a result of agricultural production.

Dietary diversity was low for most South Africans, with only 21% of decile 10 respondents consuming a high diversity diet. In deciles 1 to 4, almost 60% of respondents consumed less than four of the food diversity groups.

Expenditure on ultra-processed foods, such as beverages, snack foods and processed meats, increased in most income deciles between 2005 and 2015. Consumption of soft drinks increased proportionately more in low-income groups and was almost equal to high-income groups at a 3.5–5% level of expenditure. Expenditure on processed meat and salty snacks increased by approximately the same amount in each income decile (i.e., 0.5 percentage points). The same pattern was evident for chocolates at 0.3 percentage points, except for the two highest deciles where chocolate consumption made up 1.5% of expenditure. Processed bread intake increased more significantly in lower-income deciles, while decile 10 demonstrated the lowest increase and the lowest absolute level of expenditure at around 7%. The lower-income deciles spent around 18% on processed bread.

As far as urban-rural differences are concerned, expenditure on soft drinks and on ham and polony was similar—which means that rural expenditure has changed dramatically. The increase in expenditure on processed bread, salty snacks and chocolate was very similar among rural and urban respondents. Rural expenditure on soup powders was still higher than in urban areas, while expenditure on chocolate was lower than in urban areas.

The frequency of consumption of specific foods was indicated as one to three times per week by 40–50% of respondents, except for fish NOT being eaten by 60% of the respondents. It is noteworthy that vegetables were consumed by about 50–60% of respondents, with 40% consuming them one to three times per week. The same frequency of consumption of less healthy foods, such as fast food, sweetened fruit juice, crisps, chocolates, sweet biscuits, deep-fried foods, pastry and processed meats, was reported by 40–50% of respondents. The consumption of fruit one to three times per week was reported by only 49% of respondents.

The consumption trend of sugar-sweetened beverages (SSBs) by age group is a cause for concern. The relatively low level of consumption of SSBs by those >65 years (19%) is unlikely to be the result of the elderly not liking SSBs, but rather the unfamiliarity of their generation with SSBs. Would this then imply that more than 42% of the next generation (currently aged 5–14 years) reported having consumed SSBs the previous day? Concerns about the quality of eating habits of future generations appear to be real as only 23% of children aged 6–23 months met the minimum acceptable dietary requirements. The quality of young children's diets in South Africa makes no distinction between genders and is only slightly better in the higher-wealth quintiles.

Overall, it is recommended that methodologies used in regular surveys by StatsSA be harmonised with dietary methodology studies. Key modules should be developed which will guide researchers in including standardised information whenever data are collected. This will allow for the use of meta-analyses and big data analyses to provide information on dietary changes within the population. National surveys conducted by central statistics offices in other countries, such as Brazil,[48] the United Kingdom[49] and Bangladesh,[50] include information that is sufficiently detailed to allow for the calculation of nutrient intake. This option has been explored with the South African Income and Expenditure Survey, but as no quantities have been recorded, it has not been impossible. Plans to obtain historical price data from supermarket chains are still being considered, but this is also not a foolproof strategy. Consequently, potentially rich data sources cannot be utilised to regularly monitor the dietary intake of South Africans.

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CHAPTER 4

DIETARY INTAKE AND NUTRITIONAL STATUS OF CHILDREN (0–18 YEARS) IN SOUTH AFRICA: A REVIEW OF THE LITERATURE FROM 1997–2019

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4.1 INTRODUCTION

4.1.1 Background

A large proportion of the population of South Africa is made up of children, with almost 10% of the population younger than 10 years and one-third younger than 18 years.[1] Early investment in child health is important for promoting optimal growth and development. It also contributes to a healthy and productive adult workforce. The first 1000 days of life as well as adolescence are critical windows of development, determining susceptibility to adult obesity and cardiometabolic health.

Environmental insults during these rapid development phases may result in irreversible adverse outcomes.[2] Exclusive breastfeeding for the first six months of life[3] and appropriate complementary feeding provide infants with optimal nutrition and reduce the risk of morbidity and mortality.[4,5] Optimal nutrition in school-age children promotes physical and mental development and contributes to both social and economic development.[6] A national survey conducted in 1999 found that South African children's diets were deficient in iron, calcium, zinc and most vitamins,[7] while a more recent national survey in 2005 highlighted a high prevalence of poor iron and zinc status in children of 1–9 years of age.[8] A recent study of first-grade South African learners showed that even moderate stunting and wasting among children were associated with suboptimal school performance and motor function skills.[9]

The double burden of malnutrition is evident from the results of the most recent national survey, with stunting (27.4%) and overweight and obesity (13.3%) the most prevalent forms of malnutrition in South Africa among children younger than five years.[10] Smaller proportions of preschool children were underweight (5.9%) and wasted (2.6%), while childhood anaemia was relatively common. The infant and under-5 mortality rates for the five-year period preceding the survey were 35 and 42 deaths per 1000 live births, respectively. Among adolescents 15 years and older, 20.7% of boys and 6.7% of girls were underweight, 6.1% of boys and 15.8% of girls were overweight, and 2.5% of boys and 11% of girls were obese.[10] The highest prevalence of stunting is generally found among children younger than five years, but stunting has also been reported among school-age children[11] and up to late adolescence.[12] One-third (34%) of girls and 17.2% of boys 15 years and older were anaemic. Most (84%) children born in the two years before the survey were breastfed for some time after birth, while one-third (32%) of children under six months were exclusively breastfed.[10]

Besides these national surveys, a large number of regional studies provide important information on the regional differences in nutritional status and dietary intakes of South African children. Such information is important to inform policies and programmes in countries with limited resources, so that the most vulnerable groups and provinces can be targeted.

4.1.2 Motivation and aims of this review

Although eight nationally representative surveys were conducted between 1999 and 2016, a large number of regional studies that provide more detailed data on the dietary intakes and micronutrient status of South African children were also published. The aim of this review was to conduct a comprehensive, systematic review of the available literature on the dietary intakes and nutritional status of South African infants and children from 0–18 years old, to determine the extent of nutritional status research, the representation of age groups and geographical areas, and the methods and cut-points used, as well as to report on trends relating to improvement or deterioration in intakes and nutritional status over the period 1997–2019.

4.1.3 Structure of this review

This section includes the background, motivation and aims, and explains the structure of this review. The methods used to search and select the literature and compile the tables are described in the next section. The results are presented in section 4.3 and organised by anthropometric data, biochemical nutritional status and dietary intakes. The results are presented according to age group and province. A discussion follows the results and is also presented according to the sub-sections in the results. In addition, recommendations for future studies as well as nutrition interventions are presented. All references cited are included at the end of this review.

4.2 METHODOLOGY

4.2.1 Collection and selection of studies

The protocol was drafted using the Preferred Reporting Items for Systematic Reviews and Meta-analysis Protocols (PRISMAP) and was revised by the research team. The protocol was not registered at PROSPERO, since no health-related outcomes were included in this review. Strictly, this was also not a scoping review to identify gaps in the available literature.

4.2.2 Methods

Eligibility criteria for study selection

Included in this review were observational cross-sectional studies, as well as the baseline data of randomised controlled trials or prospective studies published in English after 1996 on the dietary intake and nutritional status of South African children. For some cohort studies with a baseline before 1997, the most complete data from a year between 1997 and 2019 were included, but data from the same cohort or subgroups from the same study were not included more than once. The inclusion criteria were the following: healthy South African children, 0–18 years old, original quantitative data on assessment of dietary intakes, anthropometric and/or biochemical nutritional status. Data from some studies included adolescents or high school children up to the age of 19 years. Data for the 19-year-old adolescents were included in the grouped data on adolescents and were therefore also included. Studies reporting quantitative estimates of dietary intake, anthropometrical or biochemical nutritional status of South African children, such as prevalence of malnutrition, nutrient intakes or dietary habits, were included.

Studies were excluded if they were intervention studies or clinical studies on patient subgroups, young pregnant or lactating women and/or particularly vulnerable groups. However, studies on large groups with a low socio-economic status were included, as a large proportion of South African children live in low socio-economic households. In studies where both HIV-positive and -negative participants were included, the results of the HIV-negative children were included—if available—separately. Narrative and systematic reviews, letters, editorials, case-control and qualitative studies, as well as studies with data collection before 1997 were excluded. Most of the latter were included in a previous review of the nutritional status of South African children.[13]

Search strategy

Literature searches were performed in PubMed, Ebscohost, CINAHL and the South African ePub databases for the period 1 January 1997 to 31 December 2019 using a structured search strategy based on the eligibility criteria. The search strategies were drafted by an experienced librarian (Gerda Beukman) and further refined through team discussions. Relevant keywords were identified from the Medical Subject Headings (MeSH) terms and adapted for PubMed.

The researchers used an iterative approach to identifying appropriate search terms, including a term regarding nutritional status, malnutrition (undernutrition, underweight, stunting, wasting, overweight or obesity), dietary intakes (diet, food, nutrient, dietary diversity or dietary patterns), biochemical nutritional status (anaemia, iron deficiency, zinc deficiency, vitamin A deficiency, iodine deficiency or micronutrient status) and children (terms for the different age groups). The researchers also included "South Africa" and the date of publication in the search string. No grey literature was included because most studies from South African students' dissertations are published in South African scientific journals. In addition, unpublished dissertations would probably not achieve a quality score of at least 5 for inclusion in this review.

Title, abstract and full-text screening and quality assessment

Titles and abstracts retrieved from electronic searches were screened by six independent reviewers, working in pairs, after the initial removal of duplicates. If the two reviewers could not agree on the inclusion of a particular study, they consulted with a third reviewer and made a final decision through consensus. Eligible studies were selected on the basis of inclusion and exclusion criteria. Finally, full-text articles were screened and the reasons for exclusion were noted. Reviews were excluded, but additional studies were identified from the reference lists of systematic and narrative reviews. Eligible studies were further screened by three independent reviewers to assess the quality of the reported data, based on the Joanna Briggs Institute critical appraisal scoring system for studies reporting prevalence data proposed by Munn *et al.*[14] The three reviewers worked in pairs to score the studies grouped according to anthropometric, dietary and biochemical outcomes. A "Yes" answer to each question received a score of 1, while a "No" answer received a score of 0, with a maximum score of 9. A minimum total score of 5 was used as the threshold for the final inclusion of a study in the systematic review, but studies with a higher score were excluded if incorrect cut-points for child nutritional status were applied.

The data were presented according to three age groups: infants and preschool children (0–5.9 years), primary school-age children (6–12 years) and adolescents (13–18 years). When the data were reported according to overlapping age groups, for example 10–14 years, the data were presented in the category representing most of the children.

Data extraction and synthesis

A flowchart showing the number of studies assessed and included in the review is shown in Figure 4.1. A data extraction form was developed by the review team based on the objectives of the review. Two reviewers piloted the form and added columns to include important information, which was different for the three sections of the review (anthropometric, biochemical or dietary intake data). Four reviewers used the final form to record the data extracted from each of the eligible studies. Three reviewers extracted data on infants, school-age children and adolescents, respectively, while one reviewer extracted all biochemical nutritional status data. A second reviewer checked each set of extracted data and in case of differences, the data were discussed with a third reviewer.

The following information was extracted from all eligible articles: (a) first author's surname; (b) publication date; (c) province in which the study was conducted; (d) the study setting; (e) participants' age range; (f) representativeness of the sample; (g) sample size; (h) mean ± standard deviation or median and interquartile range of anthropometric, biochemical or dietary intake nutritional status marker; and (i) prevalence of nutritional status category. The data extraction sheet for anthropometric data also included (j) a reference to indicate anthropometric nutritional status, i.e., WHO 2006 for infants and children 0–5 years, WHO 2007 for children 5–19 years, Center of Disease Control (CDC), National Center of Health Statistics (NCHS), or International Obesity Task Force (IOTF) cut-points for overweight and obesity. The dietary data extraction included (k) the dietary assessment method (24-hour recall, a quantitative food frequency questionnaire (QFFQ), weighed record); and (l) The reference used to indicate adequacy of nutrient intake. Most studies were represented by a single article, but in a small number of cases, the required data were available from more than one article, e.g., studies presenting dietary intakes, anthropometric and/or biochemical data stratified in different articles. The data were extracted and tables were compiled with stratification for sex, age and province, where possible.

The data were synthesised on the basis of the different objectives. Data from studies on anthropometric nutritional status, biochemical nutritional status and dietary intakes were summarised. Studies were grouped according to age category, different forms of malnutrition (stunting, underweight, wasting, overweight and obesity) and province where the data were collected. The intakes of key nutrients and the prevalence of different nutritional status indicators per age category over time were compared to detect any trends signalling improvements in nutritional status markers over the period of study (1997–2019).

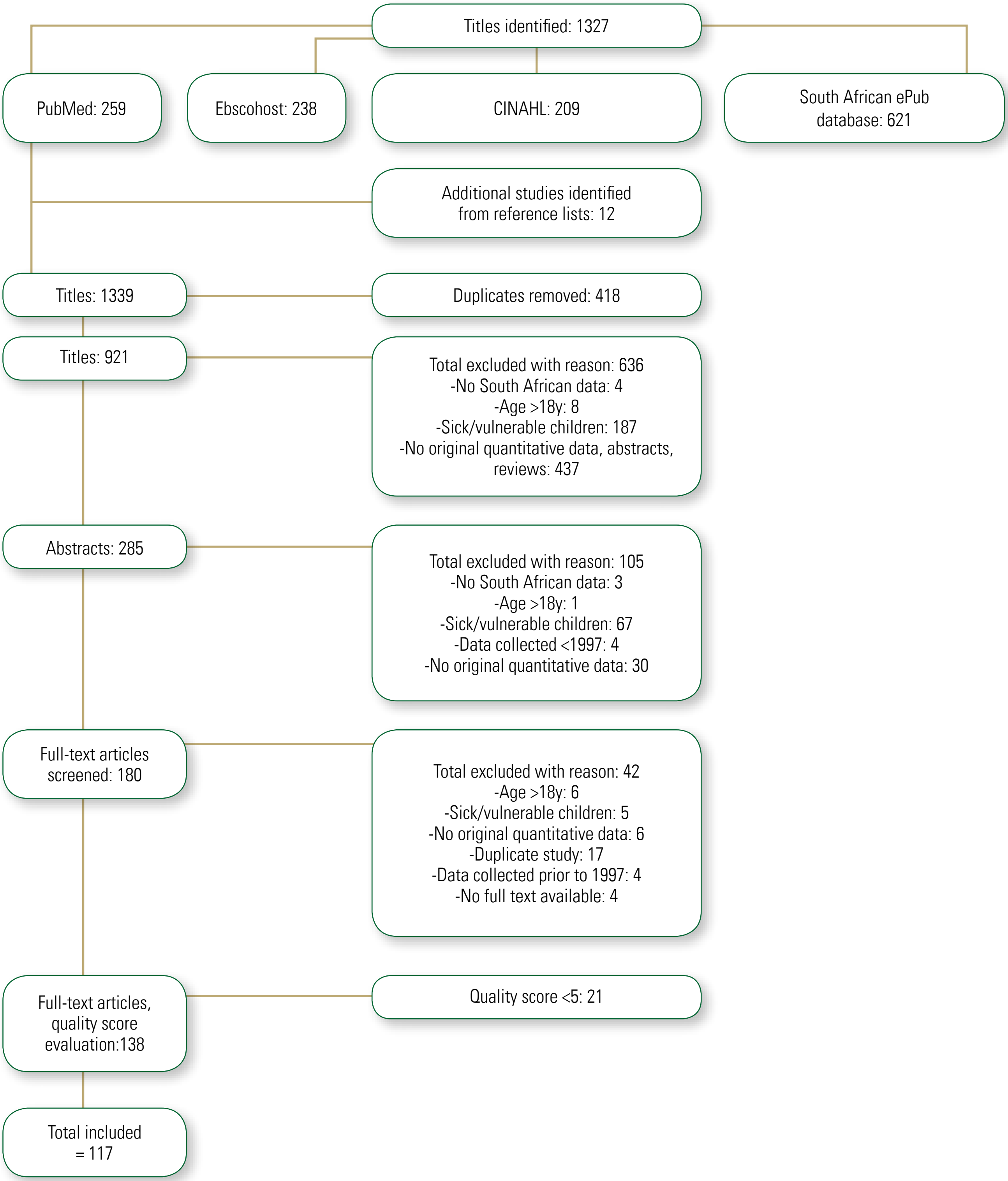

Figure 4.1: PRISMA flow diagram of the screening procedure followed to identify eligible studies

4.3 RESULTS

4.3.1 Data available for this review

In total, 921 titles, 285 abstracts and 180 full-text articles were screened for inclusion (Figure 4.1). Of these, 138 full-text articles were assessed in terms of quality, which yielded the final number of 117 studies. The kappa statistic for agreement between the scores of two independent reviewers was 0.37 (P<0.0001) and the intra-class correlation for single measures was 0.76 (P=0.0001). Kappa was interpreted using 0.21–0.40 as fair agreement, 0.41–0.60 as moderate and >0.60 as very good agreement.[15] Intra-class correlation coefficients of 0.50–0.75 were interpreted as moderate and >0.75 as good agreement.[16] The reviewers' scores were therefore interpreted as fair agreement based on the kappa statistics and good agreement based on intra-class correlation.

4.3.2 Description of studies, study participants and methods used to assess nutritional status

The studies included in the current review presented data on a total of 117 studies, including eight national surveys and all nine provinces of South Africa, [8,10,11,12,17,18,19,20] with the sample sizes within the 117 individual studies ranging from 40 to 10,195 participants. Of the eligible regional studies identified, most had been conducted in KwaZulu-Natal (22.3%), the Western Cape (18.4%) and Limpopo (16.5%), while the smallest proportion of studies had been conducted in Mpumalanga (4.8%) and the least-densely populated Northern Cape province (3.9%). Although most of the studies presented data on both boys and girls, one study presented data on girls only.

The most commonly used reference to define anthropometric nutritional status was the NCHS cut-points in publications up to the year 2010.[21] The IOTF cut-points that define overweight and obesity have often been used since 2005,[22] while the most recent studies have applied the WHO 2006 definitions for malnutrition among children 0–5 years old and the WHO 2007 definitions for children 5–19 years old.[23,24] The CDC cut-points and the recent IOTF cut-points for thinness were also used.[25]

The biochemical indicators included serum retinol, haemoglobin (Hb), serum ferritin, transferrin receptor (TfR), serum zinc and urinary iodine, serum vitamin D, red blood cell folate and serum vitamin B12, as well as markers of inflammation. Dietary intakes were presented as macronutrients, key minerals and vitamins, and specific food groups, together with dietary diversity. Infant feeding, specifically breastfeeding, exclusive breastfeeding and other infant feeding practices were described.

4.3.3 Anthropometric nutritional status

Most regional studies on preschool children (0–6 years) were conducted in rural areas (59%), while a similar proportion of studies were conducted among school-age children in rural and urban areas. The race and ethnicity of the study participants were not always reported. However, no studies exclusively on Indian children were reported, while a few studies on White children[26] and children of mixed ancestry were included in this review.[27,28] National studies and studies with a large sample size generally included children from all race groups.

Infants and preschool children

The anthropometric nutritional status of Black or predominantly Black, Coloured, Indian and White infants and children 0–5 years old is presented in Tables 4.1A to 4.1D and summarised in Table 4.1E. All tables referred to in this chapter can be found after the References. Few studies have been done exclusively on Coloured and White children, and no studies were found on Indian children only. Limited evidence of a high prevalence of stunting among Coloured children and a high prevalence of overweight and obesity among White children is presented in Tables 4.1B and 4.1D. A higher prevalence of stunting was reported in KwaZulu-Natal (10.7–17.7%),[29,30,31,32] the Eastern Cape (8–19.1%)[30,31] and Limpopo (12–34%)[33,34] than in urban areas in the Western Cape (1.8–10.9%)[28,35] and Eastern Cape (9%).[36] A high prevalence of stunting was also reported in two studies in low socio-economic settings in urban North West province (28.5%)[37] and Gauteng (19%).[38]

In regional and national studies, within the total under-5 group, the highest prevalence of stunting was found in children from the Northern Cape.[17,27,39] A similar, persistently high prevalence of stunting was reported among children younger than 5 years in nationally representative studies after 1999.[8,10,17,18] The highest prevalence of underweight and wasting was also found in children from the Northern Cape,[27,39] except in studies where particularly low socio-economic groups were targeted in other provinces.[40] In most other studies, relatively small proportions of preschool children were underweight or wasted. In nationally representative studies, the prevalence of underweight and wasting generally decreased from 1999–2016.[10,17] The most recent national survey showed that the highest prevalence of under-5 stunting was found in the Free State and Gauteng provinces (34%), in the age range 18–23 months and among children from the poorest households.[10]

The mean WHZ of infants younger than one year was within the range of 0.7–1.7 in most studies,[32,41,42] while a lower mean WHZ (-0.5–0.5) was reported among older infants and young children.[10,42,43] Based on the IOTF cut-points, a comparison of overweight and obesity prevalence between preschool children from the NFCS 2005[8] and the SANHANES 2012[11] showed that overweight prevalence increased from a range of 12% to 16% to 18.1%, while obesity remained at a similar level. Based on the NCHS and WHO references, a combined overweight and obesity prevalence below 10% was reported in earlier studies,[8,44,45,46] and a prevalence above 10% in most studies conducted after 2013.[11,40,47,48]

School-age children

The prevalence of stunting, overweight and obesity among Black, Coloured and White primary school-age children is presented in Tables 4.2A–4.2D and summarised in Table 4.2E. No studies exclusively on Indian children were found. A high prevalence of stunting was reported in studies in low socio-economic settings in Limpopo (30%),[49] Gauteng (30.8%),[50] KwaZulu-Natal (25.9%) and the Western Cape (19.3%).[51] The prevalence of stunting reported over time among children 7–14 years old in nationally representative studies since 1999 remained at the same level, between 13% in 1999 and 12.5% in 2012.[8,11,17] In these national studies the prevalence of stunting was almost 50% lower among children 7–9 years old than among those in the 1–3 years old group.[8,11] Children from low-income settings in Limpopo,[49] North West province,[52] Gauteng[50] and the Free State[53] had a higher prevalence of underweight than children from the Western Cape,[51,54] KwaZulu-Natal,[55,56,57,58] the Eastern Cape[59] and Mpumalanga.[60]

In national studies there was a trend of decreasing underweight prevalence, from 8% in 1999 to 1.7% in 2012.[10,17] A comparison of overweight and obesity prevalence between 7–9 year-old children from the NFCS 1999 (overweight 6.5%, obesity 3%) and the SANHANES 2012 (overweight 8.3%, obesity 3.4%) showed that overweight and obesity prevalence remained at similar levels.[11,17] The prevalence of combined overweight and obesity was higher than 20% in regional studies in the Western Cape (21–28.1%),[51,54,61] KwaZulu-Natal (27.4–28.7%),[56,62] Gauteng (20.2–24.1%)[48,63] and North West province (22%).[64]

Adolescents

The prevalence of stunting, overweight and obesity among adolescents is presented in Tables 4.3A–4.3E. A high prevalence of stunting was reported in studies in low socio-economic settings in Limpopo (30%),[65] KwaZulu-Natal (23.2%)[66] and North West province (16.3%).[67] The prevalence of stunting reported over time among adolescents in nationally representative studies was lower in 2002 than in 2011 (11.4% vs 12.9%).[19,20] In these national studies, the prevalence of stunting among adolescents was similar to the prevalence among children 7–9 years old.[8,17] Adolescents from low-income settings in Limpopo[65] and the Western Cape[68] had a higher prevalence of underweight than children from KwaZulu-Natal,[57] Gauteng,[69] Free State[70] and Eastern Cape.[71] In national studies, the underweight prevalence decreased from 9% to 7%, while the overweight and obesity prevalence increased from 16.9% and 4% to 23.1% and 6.9%, respectively, in 2011.[19,20] The prevalence of combined overweight and obesity was higher than 20% in regional studies in the Western Cape (22–23.5%),[72,73] KwaZulu-Natal (29.2%),[66] Gauteng (21.3%),[69] Free State (22.2%)[70] and the Eastern Cape (42.3%).[74]

4.3.4 Biochemical markers

Vitamin A status indicators

Vitamin A status in infants and children 0–6 years old as well as primary school children has improved since the early 2000s, both in rural and urban areas in South Africa (Table 4.4). The prevalence of vitamin A deficiency ranged from 34.7% to 67.3% prior to 2001, except in a small study in urban infants aged 1–6 months in the Western Cape,[43] where vitamin A deficiency was 10%. Between 2008 and 2016, the prevalence ranged from 1.4% to 16.1%, except in a study conducted in rural Limpopo, where prevalence was 57% in children of 2 years.[75] Only one study adjusted for inflammation, as suggested by the WHO.[76,77] That study showed that when correcting for inflammation, the prevalence of vitamin A deficiency was less than half the estimated prevalence if no adjustment was made.[78] The improvement in the vitamin A status in infants and children in South Africa is visible where continuous data are available for one province, e.g., rural children 0–6 years old in KwaZulu-Natal (Table 4.4).[32,41,46,78] Therefore, vitamin A deficiency changed from being a severe to now being a moderate public health problem in South Africa. Most studies have used the cut-off of retinol <20 µg/dL (<0.7 µmol/L) to define vitamin A deficiency, which is in line with the WHO guidelines.[79]

Anaemia and iron status indicators

Among infants and children of 0–6-years, the prevalence of anaemia ranged from 21.7% to 52.0%, with infants below 1 year seemingly more seriously affected, with a prevalence from 36.2% to 52.0% among both rural and urban infants (Table 4.5). More recent studies in this age group are scarce and the prevalence varies, with 10.7% nationally[11] and 42% in rural Limpopo.[75] Anaemia prevalence among rural primary school children varies widely by province, with studies from 2013 and later ranging from 3.9% to 56.9%, with Free State being the lowest[53] and one of the studies in KwaZulu-Natal showing the highest prevalence.[82] The anaemia prevalence in urban primary school children was low at 5.4 to 7.1%.

Iron deficiency in both rural and urban primary school children ranged from 3.3% to 28.7%. Iron deficiency ranged from about half to more than three times the anaemia prevalence in these children. Inflammation should be considered when ferritin is used as an indicator of iron status. This can be done by excluding individuals with inflammation (CRP >1 mg/L and/or AGP >1 g/L), using higher cut-off values (30 µg/L instead of 12 µg/L in children 0–59 months old, and 70 µg/L instead of 15 µg/L in individuals older than 5 years) or using adjustment factors.[86] Most studies used ferritin <12 µg/L and less than half adjusted for inflammation, either by excluding participants with inflammation or adjusting with factors. Nevertheless, the prevalence of iron deficiency may have declined when comparing more recent data to data from the early 2000s, except in rural Limpopo.[75]

Zinc

The prevalence of zinc deficiency is high in South African children, especially among 0–6 year-olds, ranging from 39.3% to 47.8% (Table 4.6). The latest data in this group were collected before 2014, making it difficult to assess the current situation.[80] In the primary school-age group, data are variable and scarce, ranging from 12.1% in the urban North West and 25.0% in rural Free State to 75.5% in rural North West.[53,87,88] Current cut-off points for zinc deficiency are <9.9 μmol/L for children <10 years (morning, non-fasting) or <8.7 μmol/L (afternoon, non-fasting).[89]

Urinary Iodine concentration

Urinary iodine concentration (UIC) is an effective biochemical indicator to assess recent dietary iodine intake. The reference range for adequate iodine status is age-specific. For children aged 0–2 years and lactating women, UIC <100 μg/L is an indicator for inadequate iodine intake. The median urinary iodine concentration indicative of iodine deficiency is further classified as mild, moderate or severe. The UIC median for school-age children (6 years and older) of between 50 and 100 μg/L is considered mildly deficient, whereas a UIC of 20–49 μg/L and <20 μg/L are considered to be moderate and severely deficient, respectively.[90] The 0–6 year-old age group, represented by data in 1–9 year-old children, has a prevalence of urinary iodine less than 100 μg/L (Table 4.6) ranging from 0% (Northern Cape) to 28.8% (Eastern Cape). There were no new data after 1999.

Vitamin D status

Since 1997, vitamin D deficiency in South Africa has only been assessed in urban primary school children in the Bone Health sub-cohort in the Birth-to-Twenty cohort in Gauteng[91,92] (Table 4.7). At age 10 years, 7% of the children were vitamin D deficient and 35% insufficient, whereas 5% were deficient and 19% insufficient in older age groups (11–20 years; n=423; data not included in the table).[92] A serum 25-hydroxyvitamin D (25(OH)D) concentration of below 20 ng/mL (50 nmol/L) is considered to indicate vitamin D deficiency, whereas a 25(OH)D of 21–29 ng/mL (52.5–72.5 nmol/L) is considered to be insufficient.[93]

Folate and vitamin B12 status

Before the National Food Consumption Survey–Fortification Baseline (NFCS-FB) in 2005, only one study in Limpopo between 2000 and 2003 reported 22.8% and 19.6% folate deficiency among the same children at age 1 and 3 years, and 10.2% vitamin B12 deficiency at age 1 year, which was reduced to 0% at age 3 years (Table 4.7).[94,95] Generally, WHO cut-off points were used.[96]

Markers of inflammation

The prevalence of low-grade acute inflammation in South African infants and children aged 0–6 years and at primary school (including one study up to 18 years) ranged from 4.8% to 26.1% from 2005 to 2019 (Table 4.8). When considering C-reactive protein (CRP), which rises to a maximum between 24 and 48 hours after inflammatory stimuli, the prevalence of CRP >5 mg/L was generally above 15%, except in one study in primary farm school children from rural North West province,[88] where it was lower (4.8%). If defined as CRP >10 mg/L, the prevalence of low-grade inflammation was generally below 10%, but it was above 20% when the cut-off of 5 mg/L currently suggested by the WHO was used.[77,78,87] There were no clear trends for low-grade acute inflammation among different ages, years of study, or urban and rural areas. The prevalence of alpha-1-acid glycoprotein (AGP) >1 g/L, particularly useful for monitoring the later stages of inflammation, ranged from 10.4% to 41.8% in rural and urban infants and children of 0–5 years, with no apparent difference between areas (Table 4.8).[41,78,81]

4.3.5 Dietary intakes

Dietary energy, macro- and micronutrient intakes

Dietary assessment methods

The dietary assessment methodology applied in each study needs to be considered when comparing and interpreting the reported energy and nutrient intakes. In the studies reviewed, dietary intake was assessed using either a single 24-hour recall (n=9),[45,46,63,78,97,98,99,100,101] two 24-hour recalls (n=4),[102,103,104,105] three 24-hour recalls (n=3),[28,105,106] four 24-hour recalls (n=1),[65] ten 24-hour recalls over the duration of physical activity intervention (n=1),[107] a quantified food frequency questionnaire (QFFQ; n=2),[50,108] a QFFQ plus single 24-hour recall (n=2)[34,109] and a QFFQ plus two 24-hour recalls (n=1).[102]

Nineteen (19) studies assessed adequacy of nutrient intakes. Seven (7) studies (published mostly before 2005) used the 1989 RDA to assess adequacy,[110] while 12 (published since 2005) used the Dietary Reference Intakes (DRIs).[111] Adequacy of energy and nutrient intakes was assessed in various ways, e.g., (i) by calculating the percentage of the study participants with an intake below the recommended dietary allowance (RDA) or 67% RDA or the estimated average requirement (EAR), respectively; and (ii) by comparing the mean or median intake with either the RDA or EAR. Current guidelines recommend that when assessing nutrient adequacy for groups, the mean or median intake should not be compared to either the RDA or EAR; nor should the RDA be used as a cut-off value. This is because (i) a mean intake above the RDA does not imply an adequate intake as a significant percentage of the study sample may have an intake below the EAR, depending on the distribution of the intake data, and (ii) the percentage of the study sample with an intake below the RDA will be an overestimation of inadequacy.[112] The percentage below the EAR provides an estimate of the percentage of individuals with an inadequate intake, but it does not identify which individuals have an inadequate intake.[112] For this review, reported data on inadequate nutrient intakes are tabulated only where 67% RDA or EAR was used as the cut-off value.

Energy and macronutrient intake

Energy intake is presented in Table 4.9. Two studies reported intakes based on both a 24-hour recall and a QFFQ, and both reported higher energy intakes for the QFFQ compared to the 24-hour recall.[34,109] In the NFCS 1999, for urban and rural combined, the percentage of 1–9 year-old children with low energy intake (<67% RDA) ranged from 26% to 32% based on OFFQ data. However, the percentages of low intake based on 24-hour recall data were higher, ranging from 45% to 50%.[109] For 3 year-old children in Limpopo, 7.4% had a low energy intake based on QFFQ data, versus 66.7% based on 24-hour recall data.[34] When assessing adequacy of energy intakes, current guidelines recommend comparing the mean intake to the estimated energy requirements (EER) for the group.[113] Three studies, using either a 24-hour recall or repeated 24-hour recalls, compared the median energy intake with the EER, for 2–5 year-old children in the Northern Cape,[101] 7–11 year-old children in Gauteng,[102] and 14–18 year-old adolescents in KwaZulu-Natal.[103] Energy intakes ranged from 66% to 79.5% of the EER.

Protein intake is presented in Table 4.10. In the NFCS 1999, for urban and rural combined, the percentage of 1–6 year-old children with inadequate protein intake (<67% RDA) ranged from 3% to 4.5% based on OFFQ data; with slightly higher percentages of low intake based on 24-hour recall data (8.5% to 10%).[109] In regional studies, less than 5% of 0–5 year-old children in Limpopo,[34] North West[98] and Western Cape (Coloured infants), and 21% of Black infants in the Western Cape,[28] had inadequate protein intakes (<67% RDA; <0.87 g/kg).

For primary school-age children, three studies reported the percentage of children with protein intakes below either 67%RDA or the EAR.[105,106,109] In the NFCS 1999, inadequate protein intake (<67%RDA) ranged from 5% to 15%.[109] A high percentage (53.6%) of 9–13 year-old children in rural Free State reported an inadequate protein intake.[105] It should be noted that these children also had a substantially lower mean energy intake (4309 kJ) compared to other rural primary school-age children (ranging from 5100 to 9302 kJ; Table 4.9). No data are available on adequacy of protein intake for adolescents.

Animal and plant protein intakes are presented in Table 4.11 and are reported as a percentage of total energy intake (%TE),[45,109] a percentage of total protein intake (%TP)[63] or grams per day.[46,65,100,102,105,106] The NFCS 1999 reported that for 1–9 year-old children, those living in urban areas consumed more or less equal amounts of animal protein (7%TE) and plant protein (6.5%TE), while children living in rural areas consumed more plant protein (8%TE) than animal protein (5%TE).[109] In regional studies, across all age groups, children consumed more or less equal amounts of animal and plant protein in North West province (rural),[106] Gauteng,[63,102] and Free State.[100,105] Compared to animal protein, the intake of plant protein was more or less double in rural KwaZulu-Natal,[45,106] and between 1.5 and 3.5 times higher in Limpopo.[34,65]

The energy contribution of the three macronutrients (protein, fat and carbohydrates) is indicated in Table 4.12. 1–3 year-old children, the acceptable macronutrient distribution range (AMDR) is 5–20% for protein, 30–40% for fat and 45–65% for carbohydrates.[111] The percentage energy (%TE) from carbohydrates and protein was within the acceptable range for all the studies, but low fat intake was reported for children in Limpopo (approximately 22%TE)[34] and North West province (28.6%TE).[98] Inclusion of infants (<12 months) in the data reported for the 1–3 year-old group limits comparison with the AMDR.

For 4–18 year-old children, the AMDR is 10–30% for protein, 25–35% for fat and 45–65% for carbohydrates.[111] The %TE from protein fell within the AMDR for all studies (Table 4.12), although the %TE was at the lower end of the AMRD (10.3% to 14.5%). In the NFCS 1999,[109] the %TE from fat was higher in urban children (25%) compared to rural children (19.5%, which is below the minimum AMDR). The same trend was observed for the regional studies, with the %TE from fat being higher in urban children (ranging from 20% to 32.7%)[63,65,78,103,106] compared to rural children (ranging from 16% to 27%).[46,65,78,104,106] The %TE from fat was low for children in Limpopo (16% to 22%),[65,78] KwaZulu-Natal (23%)[78,106] and North West province (21.9% to 22.1%).[106] None of the studies reported fat intake above 35%TE.

Carbohydrates provided at least 50% of total energy and in many instances the upper limit of the AMDR for carbohydrates was exceeded. In the NFCS 1999, the %TE from carbohydrates was higher in rural children (74%) compared to urban children (66.5%).[109] The same trend was observed in the regional studies, with %TE from carbohydrates being higher in rural children (ranging from 63.1% to 76%)[46,65,78,104,106] compared to urban children (ranging from 50.6% to 69%).[63,65,78,103,106] The %TE from carbohydrates exceeded the upper AMDR limit in Limpopo,[65,78] North West province[106] and some[46,106] but not all studies in KwaZulu-Natal.[78,103] The %TE from carbohydrates was lowest (although still within the AMDR) in Gauteng (50.6%),[63] Western Cape (51.3%)[78] and Northern Cape (52.2%).[78]

Micronutrient dietary intakes

Calcium

Dietary intake for calcium is presented in Table 4.13. When the DRIs for calcium were originally published in 1997, calcium requirements were based on Adequate Intake (AI), and groups with a mean intake above the AI were considered to have low probability of inadequate intake.[114] In 2011, EAR values were published for calcium, except for infants.[115]

For infants, the mean or median intakes were above the AI,[28,97,98] indicating low probability of inadequate intake. The NFCS 1999 reported inadequate calcium intakes (<67% RDA) in 1–9 year-old children ranging from 48% to 80% based on OFFQ data; and from 62% to 88% based on 24-hour recall data.[109] For 3 year-old children in Limpopo, 72.8% had a low calcium intake based on QFFQ data, versus 93.8% based on 24-hour recall data.[34] Three recent studies used the EAR cut-off method and reported inadequate calcium intakes of 75% for children aged 12 months and 18 months in North West province,[98] and 96.3% to 100% for primary school-age children in North West province and Gauteng.[63,106] None of the studies in adolescents used 67% RDA or the EAR as cut-off values to determine inadequate intake. Whereas the EAR for calcium (9–18 years) is 1100mg,[115] median intakes well below the EAR were reported for adolescents, ranging from 303 mg to 642mg.[65,103,107,116]

Vitamin A, iron and zinc

The National Food Fortification Programme (NFFP) was implemented in 2003, whereby fortifying maize meal and wheat flour, with among others, vitamin A, iron and zinc, became mandatory.[117] Therefore, intakes reported for studies that were done before 2003 or, if the date of data collection is unknown, that were published up to 2005, are reported separately from those done after 2003 or published after 2005. Software used to convert food intake data into nutrients is indicated in the provided tables. For studies that used 'SAS and FCT', it is assumed that the most recent version of the South African Food Composition database at the time of data analysis was used. Ten (10) studies used FoodFinder to convert food intake data into nutrients.[34,63,65,99,102,103,104,105,106,107] FoodFinder is an application that includes the South African Food Composition database. It was released before 2003 and the database therefore does not include the fortified values for maize meal and bread. Users do have an option to update the nutrient values in the database. However, it is not known whether the studies that used FoodFinder after 2003 included the fortified values.

Vitamin A values in the South African Food Composition database are given as retinol equivalents (RE) whereas the DRIs are based on retinol activity equivalents (RAE). In two studies,[78,98] the vitamin A values for plant foods, given as μg RE in the South African Food Composition database, were divided by two to obtain μg RAE values. For animal foods and fortified foods, μg RE is equal to μg RAE.

Dietary intakes for vitamin A before mandatory fortification of maize meal and wheat flour are presented in Table 4.14, while those based on data collected after 2003 or published after 2005 are presented in Table 4.15. For infants (<12 months), studies done either before or after implementation of the NFFP, reported mean or median vitamin A intakes above the AI,[28,97,98] and a low probability of inadequate intake can therefore be assumed.

In the NFCS 1999, before implementation of the NFFP, the percentage of 1–9 year-old children with low vitamin A intake (<67% RDA) ranged from 29% to 65% based on OFFQ data; and from 60% to 85% based on 24-hour recall data.[109] For 3 year-old children in Limpopo, 49.4% had a low vitamin A intake based on QFFQ data, versus 79.6% based on 24-hour recall data.[34] In the NFCS 1999, an inadequate vitamin A intake was higher in rural areas compared to urban areas, but the magnitude of the difference was higher for QFFQ data (rural: 51% to 65%; urban: 29% to 47%) compared to 24-hour recall data (rural: 70% to 79%; urban: 60% to 85%).[109]

In studies done after implementation of the NFFP, inadequate dietary vitamin A intakes in babies were reported for 6.5% and 13.1% at age 12 months and 18 months, respectively.[98] The reported percentage of primary school-age children and adolescents with inadequate vitamin A intake ranged from 36.4% to 46% in North West province[106] and from 72.2% to 91.2% in the Free State,[105] Gauteng[63] and KwaZulu-Natal.[103,106]

Dietary intakes for iron before implementation of the NFFP are presented in Table 4.16, while those based on data collected after 2003 or published after 2005 are presented in Table 4.17. In the NFCS 1999,[109] before mandatory fortification of maize meal and wheat flour, the percentage of 1–9 year-old children with low iron intake (<67% RDA) ranged from 30% to 62% based on OFFQ data; and from 53% to 80% based on 24-hour recall data.[109] For 3 year-old children in Limpopo, 8% had a low iron intake based on QFFQ data, versus 69.7% based on 24-hour recall data.[34] After implementation of the NFFP (Table 4.17), the reported percentage of primary school-age children and adolescents with inadequate iron intake ranged from 12.8% to 23.4% in North West province,[106] Gauteng[63] and rural KwaZulu-Natal,[106] versus 46.4% to 66.3% in the Eastern Cape,[104] Free State[105] and urban KwaZulu-Natal.[103]

Dietary intakes for zinc before implementation of the NFFP are presented in Table 4.18, and those based on data collected after 2003 or published after 2005 in Table 4.19. In the NFCS 1999, before mandatory fortification of maize meal and wheat flour, the percentage of 1–9 year-old children with a low zinc intake (<67% RDA) ranged from 43% to 80% based on OFFQ data; and from 63% to 90% based on 24-hour recall data.[17] For 3 year-old children in Limpopo, 0.6% had a low zinc intake based on QFFQ data, versus 17.9% based on 24-hour recall data.[34] After implementation of the NFFP (Table 4.19), the lowest prevalence of inadequate zinc intake was reported in North West province (7.2% to 25%),[106] followed by KwaZulu-Natal (37.7% to 51.9%).[103,106] The highest prevalence of inadequate zinc intake was reported in the Free State (97.9%).[105] Inconsistent results were reported for the studies in the Eastern Cape and Gauteng, with the prevalence of an inadequate zinc intake ranging from 16.2% to 83.5%.[63,102,104]

Nutrient contribution of the National Food Fortification Programme

Three studies reported on the nutrient contribution of the NFFP towards energy and/or micronutrient intake (Table 4.20). For preschool-age children, vitamin A intake from fortified maize meal and/or bread ranged from 122 to 160 µg RAE (57% to 59% of total vitamin A intake) in two rural sites (KwaZulu-Natal and Limpopo), and from 65 to 76 µg RAE (28% to 38% of total vitamin A intake) in two urban sites (Western Cape and Northern Cape).[78] In children aged 24–59 months in urban Northern Cape, fortified maize meal and bread provided 65 µg RE of vitamin A.[118] In a cohort in North West province, dietary intake was assessed at age 6, 12 and 18 months. The percentage of consumers of fortified maize meal, and to a lesser extent bread, on the day of recall increased from 23% at age 6 months to 96% at age 18 months. For consumers, these two staple foods provided 11% of total energy intake at age 6 months and 29% at age 18 months. At age 12 months, 51.4% of consumers of the two fortified staple foods on the day of recall had intakes above the EAR for all eight fortificant nutrients, compared to 25.0% of non-consumers.[98]

Nutrient contribution of commercial infant products and nutrient density of the complementary diet

Two studies reported on the nutrient contribution of commercial infant products,[97,98] and three reported on the nutrient density of the complementary diet (Table 4.21).[97,98,119] Intakes of various key micronutrients (e.g. calcium, iron, zinc and vitamin A) and nutrient densities of the complementary diet were higher for children who consumed commercial infant products on the day of recall compared to children who did not consume any infant products. Commercial infant products contributed substantially towards total iron intake in particular.

The nutrient density of the complementary diet for 6–12 month-old infants in rural KwaZulu-Natal was shown to be less than half the desired density for calcium, iron and zinc, respectively.[97] A more recent study in KwaZulu-Natal (urban and rural) showed very similar results, with more than 80% of breastfeeding children of age 6–17 months consuming a complementary diet with low densities for calcium, iron and zinc, as well as niacin.[119]

Infant feeding practices

The percentage of children who were initially breastfed, exclusively breastfed and breastfed, as well as the introduction and consumption of key complementary foods are presented in Table 4.22. Less-healthy foods consumed by children younger than 2 years, expressed as a percentage of children who consumed the food during the reference period, are presented in Table 4.23.

Data on breastfeeding practices for children younger than 2 years, include three national studies,[10,18,120] and 13 smaller studies covering the Eastern Cape,[121] KwaZulu-Natal,[29,35,97,119,121] Limpopo,[42,122,123] Free State,[100] Mpumalanga [124] and the Western Cape.[35,125,126,127]

At a national level, initial breastfeeding rates were just over 80% in both 2012 and 2106.[10,120] While the 2016 SADHS showed no difference in initial breastfeeding rates between urban and non-urban areas (84% in both),[10] smaller studies showed rural versus urban differences. The initial breastfeeding rate was above 95% for five of the six studies in rural areas,[29,42,121,122] compared to only one of the five studies in urban areas[125] (Table 4.22). In the study by Goosen *et al.*,[127] which was done in 2011 in the Western Cape, 14% (n=19) of the mothers reported that they were HIV positive, of whom none initiated breastfeeding. The rates of exclusive breastfeeding in children under 6 months of age at national level showed an increase from 8.3% in 2003[18] to 31.6% in 2016.[10] The study in Mpumalanga reflected higher rates of early initiation of breastfeeding (89% vs. 64%) and exclusive breastfeeding (60% vs. 48%) in areas where public-sector maternity facilities are accredited as being baby friendly, compared to areas with no baby-friendly public-sector maternity facilities.[124] According to the 2016 SADHS,[10] 74.8% of infants under 6 months of age were breastfed, but continuous breastfeeding, particularly after 12 months in age, was low. The smaller studies reflected a similar trend.

Although infant cereal is the most popular first food at a national level,[120] there are areas in the country where maize meal porridge is the most popular first food.[119]

The 2016 SADHS[10] and studies in the Western Cape[125] and KwaZulu-Natal[119] indicate that unhealthy foods such as salty snacks, sweets, confectionery and sugar-sweetened beverages are consumed regularly from a very young age (Table 4.23).

Dietary diversity for infants and children

Four studies reported dietary diversity for children under the age of 2 years (Table 4.24), based on the seven food groups used in the WHO infant and young child feeding indicator.[128] Three studies used a 24-hour reference period,[10,119,126] and one used a 7-day reference period and calculated the dietary diversity score on foods consumed daily.[125] According to the 2016 SADHS, 49.3% of children aged 6–23 months met the minimum dietary diversity requirement (at least four of the seven food groups). Achieving minimum dietary diversity was lowest for Limpopo (29.7%), followed by the Eastern Cape, Gauteng, KwaZulu-Natal, Northern Cape and North West (43.9% to 49.7%), while achieving minimum dietary diversity was highest for the Free Sate, Mpumalanga and the Western Cape (61.2% to 65.9%).[10] In a regional study in the Western Cape (urban), 44% of children aged 6–23 months achieved minimum dietary diversity.[126]

For children under the age of 2 years, achieving the minimum dietary diversity increased with age. Achieving the minimum dietary diversity ranged from 23.5% (age 6–8 months) to 63.7% (age 18–23 months) in the 2016 SADHS;[10] from 3.7% (age 6–11 months) to 23.1% (age 18–24 months) in a study in KwaZulu-Natal (urban and rural);[119] and from 4% (age 6 months) to 80% (age 12 months) in the Drakenstein Child Health Study cohort in the Western Cape.[125]

Higher dietary diversity of the complementary diet was shown to be associated with higher nutrient density for protein and several of the micronutrients, including calcium, iron and zinc.[119]

Minimum dietary diversity, in combination with minimum meal frequency for the child's breastfeeding status, reflects the minimum acceptable diet indicator.[128] In the 2016 SADHS,[10] only 22.9% of children aged 6–23 months consumed a minimum acceptable diet. This was lowest for Limpopo (6.7%) and highest for the Free State (42.3%) and Western Cape (40.2%). Du Plessis *et al.*[126] reported similar results for children aged 6–23 months in the Western Cape, with 44% consuming a minimum acceptable diet.

Dietary diversity for children older than 2 years is presented in Table 4.25. The mean dietary diversity score (DDS) for children aged 1–9 years in the NFCS 1999 was 3.58,[129] which is very similar to the mean DDS reported for children aged 24–59 months in the Northern Cape (3.44).[118] A DDS of 4 was shown to be the best indicator for micronutrient adequacy of the diet.[129] A mean DDS above 4 was reported for Gauteng[63] and the Western Cape.[130] The percentage of children who consumed a diet with low diversity ranged from 37.5% to 55.7%.[51,63,119,129,130]

Foods consumed by children and adolescents

One national and 10 smaller studies that were included in this review reported the top foods consumed. Foods were ranked according to the percentage of participants who reported an intake during a single 24-hour recall period (n=5);[45,46,78,97,109] the number of times reported over a 2-day recall period (n=1);[131] the total amount (g) for the group (n=2) based on two 24-hour recalls[103] and three 24-hour recalls;[105] the average daily amount per person based on a QFFQ (n=2);[50,102] and the percentage contribution towards energy and macronutrient intakes based on a OFFQ over a 6-month period (n=1).[63]

The top 15 foods consumed are presented for children aged 1–9 years at national and provincial level, as reported by the NFCS 1999 (Table 4.26); children under the age of 5 years (Tables 4.27 and 4.28); primary school-age children (Tables 4.29 and 4.30), and adolescents (Table 4.30). For studies that ranked foods on the basis of either average daily amount or total amount for the group, foods were re-ordered according to the percentage of consumers and are listed in the tables on the basis of the percentage of consumers. Foods eaten in small amounts by a large proportion of the study population (e.g., sugar, margarine) may therefore be missing from the top food lists, as the total amount eaten will be low relative to, for example, staple foods. For the foods listed in the tables, the average portion size and the average amount consumed per day by consumers are also indicated, where possible. Two studies reported the 10 most commonly consumed foods, but the percentage of consumers were not reported.[34,65] These frequently consumed foods are listed in Table 4.31. Two studies reported frequency of intake on the basis of a shortened, unquantified food frequency questionnaire.[121,132] These foods are presented in Table 4.32.

Dietary practices for high school children, as reported in the National Youth Risk and Behaviour Study (NYRBS) for both 2008 and 2011, are presented in Table 4.33.[12,20] The percentage of children who frequently (>4 times during the preceding week) consumed certain foods and the portion size for each of the food items are reported. Tables 4.34A–4.34C present data on the consumption of fast foods, sugar-sweetened beverages, confectionery and salty snacks, and meals and snacking for children aged 13–18 years in Gauteng (BtT cohort),[133,134,135] Grade 4 children in the Western Cape,[130] children of the AHDSS in Mpumalanga aged 11–15 years,[134] children aged 10–13 in KwaZulu-Natal,[135] and children aged 10–12 in Limpopo.[132]

Most commonly consumed foods (Tables 4.26–4.32)

Porridge made with maize meal was among the five most commonly consumed foods in all the studies, except for children in the Western Cape in two studies.[78,109] Bread was among the 10 most commonly consumed foods, except for two studies on children under the age of 2 years in KwaZulu-Natal.[45,97] Sugar and tea were among the 10 most commonly consumed foods in most studies. Legumes were among the 10 most commonly consumed foods in KwaZulu-Natal in all the smaller studies, but not in the NFCS 1999 (in which it was ranked 12th). The most commonly consumed flesh food was chicken. Fruits and vegetables were often reported individually, and it was therefore difficult to interpret. Salty snacks (e.g., crisps) were among the 10 most commonly consumed foods for children aged 3 years in Limpopo,[34] preschool-age children in the Northern Cape and Western Cape,[78] and primary school-age children in Gauteng,[63] Limpopo[65] and the Free State.[105]

Vegetables and fruit

The NYRBS 2011 reported that 49.2% of high school children had eaten fresh fruit often (>4 days during the preceding week),[20] with the lowest prevalence in the Eastern Cape (42.4%) and the highest prevalence in the Free State (54.7%). Uncooked vegetables were eaten often by 33.9% and cooked vegetables by 43.8% of high school children. Mpumalanga had the lowest prevalence of frequent consumption of uncooked (30.6%) and cooked (38.6%) vegetables, respectively. KwaZulu-Natal (37.8%) and the Western Cape (36.3%) had the highest prevalence of frequent consumption of uncooked vegetables, and Gauteng (47.2%) had the highest prevalence of frequent consumption of cooked vegetables. Fresh fruit, uncooked vegetables and cooked vegetables, respectively, were eaten often by fewer children in 2011 compared to 2008.[12,20]

For children aged 10–12 years in Limpopo, >50% ate vegetables 1–3 times/week and <18% 4–7 times/week, while most ate fruit 1–3 times/week.[132] Faber *et al.* reported that African leafy vegetables were eaten at least once a week in rural sites (KwaZulu-Natal, 79.4%; Limpopo, 65.9%), but not in urban sites (Northern Cape, 9.3%; Western Cape, 1.0%).[78] In children aged 10–13 years in KwaZulu-Natal, socio-economic status (SES) was shown to be inversely associated with daily vegetable intake: Low SES, 95.2%; Middle SES, 73.3%; High SES, 65%.[135] In contrast, in KwaZulu-Natal, cost was reported to be the major constraint to not eating vegetables and fruit daily.[131]

Limited available data point to a low intake of vegetables and fruit. The daily per capita intake of vegetables and fruit was reported for children aged 2–5 years (99g) and Grade 6 and 7 learners (109g) in KwaZulu-Natal;[131] children aged 1.5–6 years in rural KwaZulu-Natal (78g), rural Limpopo (67g), urban Northern Cape (43g) and urban Western Cape (75g);[78] and adolescent females in KwaZulu-Natal (88g).[103] For children aged 2–5 years and learners, respectively, who consumed fruits and/or vegetables during recall periods, such fruits and/or vegetables contributed towards their total dietary intake of fibre (16% and 21%), calcium (13% and 18%), vitamin A (28% and 27%) and vitamin C (47% and 49%).[131]

Milk and dairy products

The NYRBS 2011 reported that 42.9% of high school children drank milk (and/or amasi) often (>4 times during the previous week), with the lowest prevalence being in Mpumalanga (39.4%) and Limpopo (37.4%), and highest being in the Western Cape (47.5%).[20] In the NFCS 1999 (Table 4.26), the percentage of children aged 1–9 years who consumed whole milk during the day of recall was lowest in Limpopo (13.4%, with an average daily intake of 144mL), and highest in North West (63.9%, with an average daily intake of 141mL), Free State (63.9%, with an average daily intake of 203mL) and the Western Cape (63.9%, with an average daily intake of 247mL).[109] For the Eastern Cape and KwaZulu-Natal, both milk and amasi were among the top 15 foods (Eastern Cape: milk 36.6% and amasi 22.2%; KwaZulu-Natal: milk 26.3% and amasi 27.6%).

Fast foods and unhealthy food options

The NYRBS 2011 reported that 37.7% of high school children ate fast foods often, with 21.8% of children having eaten at least super-size portions each time they ate fast foods.[20] At least 90% of adolescents in the BtT cohort and AHDSS ate fast food more than three times per week.[134] In the NYRBS 2008, nearly half of high school learners frequently consumed cakes and/or biscuits and sweet cool drinks.[12] Frequent consumption of sugar-sweetened beverages, confectionery and salty snacks were reported for the BtT cohort[133] and primary school children in the Western Cape.[130]

4.4 DISCUSSION

The double burden of malnutrition is evident from the results of this review. Overweight and obesity prevalence appears to be higher among infants and adolescent girls than among other age groups, while a significant proportion of school-age boys are underweight. The prevalence of undernutrition is decreasing, whereas overweight and obesity are increasing among infants and adolescents.

This systematic review is characterised by a high degree of variability in indicators of malnutrition across age groups and provinces. The prevalence of overweight among preschool children was very low and seldom recorded before the year 2000, particularly in rural areas.[32,44] Recently, higher proportions of infants and preschool children from rural and urban settings were reported to be overweight, but comparison is difficult because different reference cut-points were used. Some of these studies were not representative and had small sample sizes; therefore, a clear conclusion about an increase in overweight and obesity among preschool children cannot be arrived at.

Anthropometric nutritional status: Infants and preschool children

The prevalence of stunting was higher among infants (0–2 years) from low socio-economic areas[30,37,94] than from urban areas.[28,35,38,43] The highest prevalence of stunting, underweight and wasting in under-5 year-olds was found in children from the Northern Cape.[17,27,39] The prevalence of stunting has remained at similar levels among children younger and older than 5 years in nationally representative studies conducted over time since 1999.[8,10,17,18] In most other regions, relatively low proportions of preschool children were underweight or wasted and the prevalence decreased further from 1999 to 2016.[10,17] More infants younger than 9 months than older children were generally overweight, with a consistent decrease in WHZ from infancy up to the age of 59 months.[10,42,43]

The best comparison of nutritional status changes over time can be made between different data collection waves in national surveys, using the same reference cut-points for similar age groups. Based on the IOTF cut-points, a comparison of overweight and obesity prevalence among children aged 1–6 years from the NFCS 2005[8] and children aged 2–5 years from the SANHANES 2012[11] showed that overweight prevalence increased from a range of 12%–16% to 18.1%, while obesity remained at a similar level. Based on the NCHS and WHO references, a combined overweight and obesity prevalence below 10% was reported in earlier studies,[8,44,45] while prevalence generally increased to more than 10% in most studies conducted after 2013.[11,40,47,48] A longitudinal study in Johannesburg showed that girls who were overweight or obese at the ages of 1–8 years had increased odds of being obese during late adolescence. Obesity was persistent among one-third of girls and among 17% of boys who became obese from the age of 1–2 years and should therefore not be ignored.[136]

Anthropometric nutritional status: Primary school-age children

The highest prevalence of stunting and underweight was reported in studies in low socio-economic communities in both rural[49] and urban settings.[50,51] The prevalence of stunting among primary school-age children in nationally representative studies did not improve after 1999,[8,11,17] but was markedly lower than among children aged 1–3 years.[8,17] In national studies, there was a trend of decreasing underweight prevalence from 1999 to 2012.[10,17] A comparison of overweight and obesity prevalence among children aged 7–9 years from national surveys in 1999 (overweight 6.5%, obesity 3%) and 2012 (overweight 8.3%, obesity 3.4%) showed a trend of increasing overweight, while obesity prevalence remained at similar levels.[11,17] A high prevalence of combined overweight and obesity was reported in regional studies in the Western Cape,[51,54,61] KwaZulu-Natal,[56,62] Gauteng (20.2–24.1%)[48,63] and North West province (22%).[64]

Global reviews have shown increases in the prevalence of overweight and obesity among school-age children over time since 1975, including South Africa.[137,138] However, in general, obesity prevalence decreases from the age of 1 up to the age of 14 years, with the lowest prevalence in the age group 10–14 years, and then increases throughout adolescence.[137] A longitudinal study in Johannesburg showed a low prevalence of overweight and obesity among school-age boys, declining from infancy throughout childhood. However, the incidence of obesity was highest from age 4–8 years to 11–12 years in boys. The same increased incidence occurred later among girls, namely during early adolescence (from 11–12 years to 13–15 years), although overweight and obesity increased throughout childhood in girls.[139]

A recent study in the USA showed that the food and physical activity environments in primary schools are significantly associated with adiposity measures among the children in those schools. The food environment variables included unhealthy items in school meals and vending machines, while the physical activity environment included facilities for active play and sports participation.[140]

Anthropometric nutritional status: Adolescents

A high prevalence of stunting and underweight was reported in studies in low socio-economic settings in Limpopo,[65] KwaZulu-Natal[66] and North West province.[67] The prevalence of stunting and underweight reported among adolescents in nationally representative studies decreased over time from 2002 to 2011,[19,20] but was similar to the prevalence among children aged 7–9 years.[8,17] In national studies, the overweight prevalence increased from 6.6% in 2002 to 23.1%, in 2011.[19,20] Regional studies have shown a high prevalence of overweight and obesity in the Western Cape,[72,73] KwaZulu-Natal,[66] Gauteng,[69] urban Free State[70] and Eastern Cape.[74]

Biochemical nutritional status

The vitamin A status of South African children has improved since the early 2000s and vitamin A deficiency has been lower when correcting for inflammation.[78] The improvement could likely be attributed to the NFFP (implemented in 2003) and the vitamin A supplementation (implemented in 2002) programmes. However, caution should be exercised in areas where children regularly consume organ meat (as is the case in most of the Northern Cape) because children from these areas may be at risk of hypervitaminosis.[141]

Infants up to the age of 12 months have been more affected by iron deficiency. Although data are scarce, there is some evidence of an improvement in the iron status of South African children.[47, 81] The anaemia prevalence in urban primary school children is generally lower, but a variety of deficiency profiles are evident and a targeted approach will be needed to address them. Since iron deficiency anaemia generally comprises less than 50% of anaemia cases in both age categories in rural and urban areas, other causes–such as folate deficiency in, for example, Limpopo[94]–should also be considered and addressed. Among urban and rural primary school children from North West, iron deficiency seems to be the major contributor to anaemia.[87, 88,142]

Although data are limited and the most recent data were collected in 2014, the prevalence of zinc deficiency appears to be high in South African children, ranging from 39.3% to 47.8%. Data on other micronutrient deficiencies in South African children are scarce, but there are indications of iodine deficiency in the Eastern Cape,[8] vitamin D deficiency in Johannesburg[91] and folate deficiency in Limpopo.[94]

Dietary intakes

The lack of dietary intake data within similar age groups, provinces and locations (rural/urban) at different time points as well as the variability in dietary assessment methods and metrics that were used across the studies limit comparisons between study groups and thus observations of any changes in dietary intake that may have occurred between 1997 and 2019 (the time frame for this review). Two studies reported intake based on both a 24-hour recall and OFFQ, with the QFFQ reporting lower prevalence of inadequate intake compared to the 24-hour recall, but the magnitude of the difference between the two methods depended on the nutrient.[34,109] The variation in the prevalence of inadequate intake due to different dietary assessment methods and its dependence on the nutrient of interest hampers not only the comparison of studies but also reaching conclusions about the magnitude of inadequacy.[143] It should be noted further that different studies reported different components of dietary intake, depending on the aim of the study.

Energy, macro- and micronutrient intakes

Total protein intake in general seems to be adequate, although protein intake as a percentage of total energy is at the lower end of the AMDR. Intake of plant protein was more or less double that of animal protein in rural KwaZulu-Natal,[46,106] and between 1.5 and 3.5 times higher in Limpopo,[34,65] thus reflecting the lower quality of total protein intake. Legumes, a good source of plant protein, were among the top 10 foods in all the regional studies in KwaZulu-Natal, including those involving children under 2 years,[45,97] under 5 years,[46,78,131] Grade 6 and 7 learners,[131] and adolescents.[103] Although South Africa is experiencing a nutrition transition, fat intake did not exceed the upper limit of the AMDR in any of the studies. Low-fat (<25% TE) high-carbohydrate (>65% TE) diets were reported for Limpopo,[65,78] KwaZulu-Natal[78,106] and North West province,[106] while carbohydrate intake was just above 50% TE in Gauteng,[63] Western Cape[78] and Northern Cape.[78] In general, children in rural areas have higher carbohydrate and lower fat intake compared to those in urban areas, signalling more traditional diets. Calcium intake is low. Calcium is not included in the mandatory fortification of maize meal and wheat flour, and milk and dairy products are not consumed frequently. Data from children aged 2–5 years in the Northern Cape suggest that low milk intake may contribute to stunting.[101]

Despite mandatory fortification of the staple foods, maize meal and wheat flour (bread), studies reported high percentages of inadequate intakes for vitamin A, iron and zinc, although some variations were observed across the studies. Interpreting adequacy of intake for vitamin A, iron and zinc is challenging, as it is not known whether all the studies that were done after implementation of the NFFP used the nutrient values for fortified maize meal and bread, while few studies reported the percentage of children with intakes below the EAR. However, a recent study, published in 2020 and therefore not within the timeframe for this review, showed a low prevalence of inadequate intakes (<EAR) of nutrients, such as vitamin A, iron and zinc in 1-<10 year-old children in Gauteng and the Western Cape.[144] The authors attributed the improvement in intakes since the NFCS 1999 to the consumption of fortified maize meal and bread. The contribution of fortified maize meal and bread to micronutrient intakes may, however, vary across provinces and between rural and urban areas.[78]

Although fortified maize meal and to a lesser extent bread contribute to micronutrient intakes in children under the age of 2 years,[98] the nutrient density of the complementary diet was shown to be low for calcium, iron and zinc, respectively.[97,119] Improving the nutritional quality of the complementary diet, while promoting continuous breastfeeding up to the age of 2 years, therefore needs special attention.

Dietary diversity and foods consumed

Dietary diversity is a validated indicator for micronutrient adequacy of the diet both for infants and children.[129,145] Dietary diversity is generally low. Only 49.3% of children aged 6–23 months achieved the minimum dietary diversity,[10] while 37.5% to 55.7% of children older than 2 years consumed a diet with low diversity.[119,129,130] Although no information is available on dietary diversity for children older than 2 years in Limpopo, only 29.7% of children aged 6–23 months in the province achieved the minimum dietary diversity.[10]

The intake of vegetables and fruit is generally low, and results from the NYRBS indicated that vegetables and fruit were eaten often by fewer children in 2011 compared to 2008.[12,20] The inadequate intake of vegetables and fruit increases the risk of micronutrient deficiencies and dietary-related non-communicable diseases.[146] Cost[131,147] and children's low liking of vegetables[148] may contribute to the low intake of vegetables and fruit.

Unhealthy food options such as salty snacks, sweets and confectionery were not listed among the 10 most frequently consumed foods in the NFCS 1999.[109] In contrast, in the Northern Cape and Western Cape in 2011, salty snacks were consumed during the 24-hour recall period by at least 50% of preschool-age children, and both sugary foods (sweets, chocolates and confectionery) and cold drinks by at least one-third of the children.[78] It was further reported that unhealthy food options were introduced from a very young age (during the first two years of life).[10,119,125] Frequent consumption of fast foods, salty snacks, confectionery and sugar-sweetened beverages were also reported for adolescents in the Bt20 cohort in 2007, with these foods contributing substantial amounts of added sugar and salt to the diet.[149] Many schoolchildren have easy access to unhealthy food options. A study in Soweto, for example, showed that sugar-sweetened beverages are sold and advertised with increasing intensity within close proximity of schools.[150] In addition, foods sold through school tuckshops and food vendors, on or just outside the school premises, are mostly unhealthy options,[151] with the healthier options having a higher cost per energy (R/100kcal).[152]

4.5 LIMITATIONS OF THIS REVIEW

Population-based surveys collect crucial data on anthropometric measures in order to track trends in stunting, underweight and overweight prevalence among children. A recent study found that the quality of the anthropometric data varies between surveys, which may affect population-based estimates of malnutrition. South African HAZ and WHZ data for children aged 0–59 months from Demographic and Health Surveys (DHS) were also included in the analysis. A quality score was based on the completeness of the database, the percentage of implausible values, differences by month of birth, and standard deviation of the HAZ and WHZ.[153]

The results showed slightly higher values in recent DHS, suggesting potential improvements in quality of anthropometric data over time. However, the score for the SADHS was just above 0, compared to the maximum scores for Peru and Guatemala of 1.5. The lowest scores of between -1 and -5 included several west African countries.[153] The researchers excluded 21 publications considered for this review, based on small sample size and the failure to use correct age-appropriate anthropometric cut-points or dietary assessment methods. The researchers did not assess the quality of the data in more detail and so it is possible that some of the estimates were not accurate.

4.6 CONCLUSION

The double burden of malnutrition, with stunting among children younger than 5 years, underweight among primary school-age boys and obesity among infants and adolescent girls, is evident from the results of this review. The growing incidence of overweight and obesity among infants, preschool children and adolescents is of concern. Although household food security apparently improved over the past few years, the risk of increased food insecurity and all forms of malnutrition will grow due to the economic consequences of COVID-19 lockdown measures.

A recent comprehensive study with repeated measurements throughout childhood showed that high BMI at the age of 2 to 3 years tends to stay high, and that normal BMI occasionally increases to high BMI; yet the reverse is rarely true.[139] Early childhood and post-puberty may be important periods for intervention to prevent obesity, particularly among girls. An inadequate intake of vegetables and fruit increases the risk of micronutrient deficiencies, while the frequent consumption of unhealthy snacks and sugar-sweetened beverages (including sugar sweetened dairy products) is of concern. The improvement noted in vitamin A status could be attributed to the NFFP and vitamin A supplementation programme. In general, iron status appears to have improved, but limited data indicate that the prevalence of zinc deficiency is still high in South African children from low-income communities.

Limited success has been achieved in implementing interventions targeting the double burden of malnutrition in children. Appropriate interventions proposed to curb the increase in obesity among children include restricting advertisements of unhealthy foods to children, improving nutritional quality of school meals, taxing unhealthy foods, and providing subsidies on healthy foods and supply-chain incentives to produce more healthy foods.[154] Greater focus is needed on improving calcium intake across all age groups. Furthermore, appropriate interventions are needed to improve dietary diversity and increase the intake of vegetables and fruit as well as milk. An emphasis on appropriate interventions should always guide any food choices to avoid excessively processed foods and foods providing excessive amounts of nutrients of concern such as sugar, sodium and saturated fat.

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4.8 TABLES

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Table 4.1A: Percentage of Black or predominantly Black infants and children, 0 to 5 years old with malnutrition: Underweight, stunting, wasting and overweight/obesity

Province	Rural/ Urban	Represent-ative, race	Year	*n*	Age, years	Sex	Indicator	Cut-point reference	% (95%CI)	Reference
Infants 0 to 2 years old										
WC	U	N B	1998	60	0.5–1	n/a	Stunted	NCHS HAZ <-2	7.0	Oelofse *et al.*, 2002[28]
				60	0.5–1	n/a	Underweight	NCHS WAZ <-2	2.0	
				60	0.5–1	n/a	Wasted	NCHS WHZ <-2	0	
				60	0.5–1	n/a	Overweight	NCHS WHZ >2	-	
WC	U	N B	2000	113	<0.5	n/a	Stunted	NCHS HAZ <-2	1.8	Sibeko *et al.*, 2004[43]
							Underweight	NCHS WAZ <-2	0	
							Wasted	NCHS WHZ <-2	0	
							Overweight	NCHS WHZ >2	35.0	
WC KZN	R/U	N B	2006–2008	404	0.5	188 M 216 F	Stunted	WHO 2006 HAZ <-2	10.9	Engebretsen *et al.*, 2014[35]
							Underweight	WHO 2006 WAZ <-2	4.9	
							Wasted	WHO 2006 WHZ <-2	2.0	
WC	R	N BC 55%B	2012–2015	1076	<1	561 M 515 F	Overweight	WHO 2006 BMIZ >2	9.0	Budree *et al.*, 2017[125]
KZN	R	N B	1997	115	4mo-2	n/a	Stunted	NCHS HAZ <-2	15.3	Faber & Benadé, 1999[29]
							Underweight	NCHS WAZ <-2	3.6	
							Wasted	NCHS WHZ <-2	0.9	
							Overweight	NCHS WHZ >2	7.2	
KZN	R	N B	1998	97	6mo-2	50 M 47 F	Stunted	NCHS HAZ <-2	16.5	Faber & Benadé, 2000[32]
							Underweight	NCHS WAZ <-2	8.5	
							Wasted	NCHS WHZ <-2	3.8	
							Overweight	NCHS WHZ >2	14.8	
KZN	R	N B	2003	185	<0.5	95 M 90 F	Stunted	NCHS HAZ <-2	8.0	Schoeman *et al.*, 2010a[30]
							Underweight	NCHS WAZ <-2	1.0	
							Wasted	NCHS WHZ <-2	2.0	
KZN	R	N B	2003	194	0.5-1	97 M 97 F	Stunted	NCHS HAZ <-2	10.7	Smuts *et al.*, 2005[41]
							Underweight	NCHS WAZ <-2	1.6	
							Wasted	NCHS WHZ <-2	0	
KZN	R	N B	2008	413	<2	n/a	Stunted	WHO 2006 HAZ <-2	17.7	Schoeman *et al.*, 2010b[31]
							Underweight	WHO 2006 WAZ <-2	2.9	
							Wasted	WHO 2006 WHZ <-2	1.0	
							Overweight	WHO 2006 WHZ >2	8.7	

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Table 4.1A Continued

Province	Rural/ Urban	Represent-ative, race	Year	*n*	Age, years	Sex	Indicator	Cut-point reference	% (95%CI)	Reference
Infants 0 to 2 years old										
EC	R	N B	2003	190	<0.5	95 M 90F	Stunted	NCHS HAZ <-2	8.0	Schoeman *et al.*, 2010a[30]
							Underweight	NCHS WAZ <-2	1.0	
							Wasted	NCHS WHZ <-2	3.0	
EC	R	N B	2003	767	0.5–2	384 M 383 F	Overweight	NCHS WHZ >2	15.2	Smuts *et al.*, 2008[121]
EC	R	N B	2008	141	<2	n/a	Stunted	WHO 06 HAZ <-2	19.1	Schoeman *et al.*, 2010b[31]
							Underweight	WHO 06 WAZ <-2	1.4	
							Wasted	WHO 06 WHZ <-2	0	
EC	R	N B	2008	141	<2	n/a	Overweight	WHO 06 WHZ >2	6.4	
EC	U	N B	2015–2016	400	0–2	199 M 201 F	Stunted	WHO 06 HAZ <-2	9.0	McLaren, 2018[36]
							Underweight	WHO 06 WAZ <-2	n/a	
							Wasted	WHO 06 WHZ <-2	1.0	
							Overweight	WHO 06 WHZ >2	16.0	
GP	U	N B	2001	308	1–2	n/a	Stunted	NCHS HAZ <-2	19.0	Kleynhans *et al.*, 2006[38]
LP	R	N B	2001	156	1–2	n/a	Stunted	NCHS HAZ <-2	18.0	
LP	R	N B	2001	156	1	70 M 86 F	Stunted	NCHS/WHO HAZ <-2	34.0	Mamabolo *et al.*, 2007[67]
							Underweight	NCHS/WHO WAZ <-2	11.0	
							Wasted	NCHS/WHO WHZ <-2	11.8	
LP	R	N B	2006	185	<1	99 M 86 F	Stunted	NCHS/WHO	18.9	Mushaphi *et al.*, 2008[42]
				185	<1	99 M 86 F	Severely stunted	NCHS/WHO	7.0	
							Underweight	NCHS/WHO WAZ <-2	7.0	
							Severely underweight	NCHS/WHO WAZ <-3	7.0	
							Overweight	NCHS/WHO WHZ> 2	17.3	
LP	R	N B	2016	665	0.5	340 M 325 F	Stunted	WHO 2006 HAZ <-2	12.0	Huang *et al.*, 2018[33]
							Underweight	WHO 2006 WAZ <-2	4.0	
							Wasted	WHO 2006 WHZ <-2	2.0	
NWP	U	N B	2013–2015	750	0.5	387 M 363 F	Stunted	WHO 2006 HAZ <-2	26.7	Matsungo *et al.*, 2017[37]
							Underweight	WHO 2006 WAZ <-2	11.1	
							Wasted	WHO 2006 WLZ <-2	1.7	
							Overweight	WHO 2006 WLZ >2	10.1	
							MUACZ: mean ± SD	WHO 2006	0.25 ± 1.09	
							HCZ mean ± SD	WHO 2006	0.03 ± 1.0	

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Table 4.1A Continued

Province	Rural/ Urban	Represent-ative, race	Year	*n*	Age, years	Sex	Indicator	Cut-point reference	% (95%CI)	Reference
Infants 0 to 2 years old										
MP (Agincourt)	R	N	2007	671	1–4y	338 M 333 F	Stunted	WHO 2006 HAZ <-2	18	Kimani *et al.*, 2010[60]
							Underweight	WHO 2006 WAZ <-2	10	
							Wasted	WHO 2006 WLZ <-2	7	
							Overweight	IOTF	7	
							Obese	IOTF	1.0	
National NFCS	R/U	Y BWCI	1999	1198	1–3	n/a	Stunted	NCHS HAZ <-2	25.5 (23.0, 27.9)	Labadarios *et al.*, 2000[109]
							Severely stunted	NCHS HAZ <-3	8.2 (6.6, 9.7)	
							Underweight	NCHS WAZ <-2	12.4 (10.5, 14.2)	
							Severely underweight	NCHS WAZ <-3	2.2 (1.3, 3.0)	
							Wasted	NCHS WHZ <-2	4.0 (2.9, 5.1)	
							Severely wasted	NCHS WHZ <-3	0.8 (0.3, 1.4)	
							Overweight	NCHS WHZ >2	6.6 (5.2, 8.0)	
				795	1–3	n/a	Overweight	IOTF	16.0 (13.7,18.2)	Labadarios *et al.*, 2005[17]
							Obese	IOTF	7.8 (6.1, 9.5)	
National NFCS-FB	R/U	Y BWCI	2005	846	1–3	n/a	Stunted	CDC/WHO HAZ <-2	23.4	Labadarios *et al.*, 2007[8]
							Severely stunted	CDC/WHO HAZ <-3	6.4	
							Underweight	CDC/WHO WAZ <-2	11.0	
							Severely underweight	CDC/WHO WAZ <-3	1.2	
							Wasted	CDC/WHO WHZ <-2	5.1	
							Severely wasted	CDC/WHO WHZ <-3	0.9	
							Overweight	IOTF	19.3	
							Obese	IOTF	6.3	
National SANHANES	R/U	Y BCWI 76.6%B	2012	1090	0–3	537 M 553 F	Stunted	WHO 2006 HAZ <-2	26.9 M 25.9 F	Shisana *et al.*, 2013[11]
							Severely stunted	WHO 2006 HAZ <-3	9.9 M 9.1 F	
							Underweight	WHO 2006 WAZ <-2	8.2 M 3.6 F	
							Severely underweight	WHO 2006 WAZ <-3	2.6 M 0.7 F	
							Wasted	WHO 2006 BAZ <-2	3.8 M 1.5 F	
							Severely wasted	WHO 2006 BAZ <-3	1.9 M 0.3 F	

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Table 4.1A Continued

Province	Rural/ Urban	Represent-ative, race	Year	*n*	Age, years	Sex	Indicator	Cut-point reference	% (95%CI)	Reference
Infant/Child 0 to 6 years old										
EC	R	N B	2003	674	0.5–5	337 M 337 F	Stunted	NCHS HAZ <-2	22.0	Schoeman *et al.*, 2010a[30]
							Underweight	NCHS WAZ <-2	11.0	
							Wasted	NCHS WHZ <-2	5.0	
EC	R	N B	2003	765	2–5	383 M 382 F	Overweight	NCHS WHZ >2	5.0	Smuts *et al.*, 2008[121]
EC	R	N B	2008	166	2–5	n/a	Stunted	WHO06 HAZ <-2	26	Schoeman *et al.*, 2010b[31]
							Underweight	WHO 06 WAZ <-2	3.0	
							Wasted	WHO 06 WHZ <-2	0	
							Overweight	WHO 06 WHZ >2	1	
KZN	R/U	Y	1998	770	2–5	344 M 426 F	Stunted	NCHS HAZ <-2	34.3 M 33.1 F	Jinabhai *et al.*, 2005[62]
							Underweight	NCHS WAZ <-2	5.8 M 6.8 F	
							Overweight	IOTF	27.6 M 23.9 F	
							Obese	IOTF	13.9 M 12.4 F	
KZN	R B	N B	1999	164	2–5	77 M 87 F	Stunted	NCHS HAZ <-2	21.0	Faber *et al.*, 2001[46]
							Underweight	NCHS WAZ <-2	9.0	
							Wasted	NCHS WHZ <-2	0.9	
							Overweight	NCHS WHZ >2	3.0	
KZN	R	N B	2001	868	0.25–5	n/a	Stunted	CDC HAZ <-2	26.3 (23.3, 29.3)	Chopra, 2003[155]
							Underweight	CDC WAZ <-2	12.0 (9.8,14.2)	
							Wasted	CDC WHZ <-2	1.3	
							Overweight	CDC	-	
KZN	R	N B	2003	935	2–5	468 M 467 F	Overweight	NCHS WHZ >2	5.0	Smuts *et al.*, 2008[121]
KZN			2003	704	0.5–5	350 M 354 F	Stunted	NCHS HAZ <-2	24.0	Schoeman *et al.*, 2010a[30]
							Underweight	NCHS WAZ <-2	12.0	
							Wasted	NCHS WHZ <-2	4.0	
KZN	R	N B	2008	245	2–5	n/a	Stunted	WHO 2006 HAZ <-2	23.7	Schoeman *et al.*, 2010b[31]
							Underweight	WHO 2006 WAZ <-2	1.5	
							Wasted	WHO 2006 WHZ <-2	0	
							Overweight	WHO 2006 WHZ >2	0.9	

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Table 4.1A Continued

Province	Rural/ Urban	Represent-ative, race	Year	*n*	Age, years	Sex	Indicator	Cut-point reference	% (95%CI)	Reference
KZN FS	R/U	N B	2015	216	2–5	102 M 114 F	Stunted	WHO 06 HAZ <-2	35	Chakona *et al.*, 2018[156]
				216	2–5	102 M 114 F	MUAC <115 mm	FANTA II 2010 <115 mm	7.0	Chakona *et al.*, 2018[156]
Infant/Child 0 to 6 years old										
FS	R/U	N B	2007–2009	102	0–6	n/a	Stunted	WHO 06 HAZ <-2	17.6	Tydeman-Edwards., 2018[157]
				102	0–6	n/a	Underweight	WHO 06 WAZ <-2	29.4	
				102	0–6	n/a	Wasted	WHO 06 WHZ <-2	13.7	
FS	U	N B	2014	240	0–5	116 M 124 F	Underweight	WHO 06 WAZ <-2	7.7	Koetaan *et al.*,2018[158]
LP	R	N	1997	345	3–5y	175 M 170 F	Overweight	NCHS BAZ >85th	1.7	Monyeki *et al.*,1999[44]
LP	U	N B	2007	50	<5	n/a	Stunted	WHO 06 HAZ <-2	62.0	Heckman *et al.*, 2010[83]
							Underweight	WHO 06 WAZ <-2	24.0	
							Wasted	WHO 06 WHZ <-2	6.0	
LP	R	N B	2013	349	3–5	136 M 186 F	Stunted	WHO 06 HAZ <-2	18.6	Motadi *et al.*, 2015[80]
							Underweight	WHO 06 WAZ <-2	0.3	
							Wasted	WHO 06 WHZ <-2	1.4	
							Overweight	WHO 06 BAZ 2-3	20.9	
							Obese	WHO 06 BAZ >3	9.7	
NC	R	N BC	2010–1	150	2–5	77 M 73 F	Stunted	WHO 06 HAZ <-2	36.9	Van Stuijvenberg *et al.*, 2015[101]
							Underweight	WHO 06 WAZ <-2	25.5	
							Wasted	WHO 06 WHZ <-2	12.1	
GP	U	N B	2014	1254	1–5	633 M 621 F	Stunted	WHO 06 HAZ <-2	35.8	Madiba *et al.*, 2019[40]
							Severely stunted	WHO 06 HAZ <-3	22.4	
							Underweight	WHO 06 WAZ <-2	20.5	
							Severely underweight	WHO 06 WAZ <-3	11	
							Wasted	WHO 06 WHZ <-2	17.2	
							Severely wasted	WHO 06 WHZ <-3	9.5	
							Overweight	WHO 06 BAZ>2	14.0	
GP WC	R/U R/U	Y BC Y BC	2018 2018	674 674	0–5 0–5	n/a n/a	Stunted	WHO 06 HAZ <-2	21.6	Senekal *et al.*, 2019[48]
							Underweight	WHO 06 WAZ <-2	5.6	
							Wasted	WHO 2006 WHZ <-2	4.0	
							MUACZ <-2	WHO 2006	4.1	
							Overweight	WHO 06 BAZ 2-3	10.3	
							Obese	WHO 06 BAZ >3	7	

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Table 4.1A Continued

Province	Rural/ Urban	Represent-ative, race	Year	*n*	Age, years	Sex	Indicator	Cut-point reference	% (95%CI)	Reference
WC	R/U	N BC	2009	179	<5	n/a	Stunted	WHO 2006 HAZ <-2	10.7	Iverson *et al.*, 2011[159]
							Severely stunted	WHO 2006 HAZ <-3	2.8	
							Underweight	WHO 2006 WAZ <-2	8.5	
Infant/Child 0 to 6 years old										
							Wasted	WHO 2006 BAZ <-2	5.1	
							Severely wasted	WHO 2006 BAZ <-3	1.1	
							Overweight	WHO 2006 WHZ >2	6.3	
National SADHS	R/U	Y BCWI 81%B	2003	1159	<5	574 M 585 F	Stunted	NCHS/WHO HAZ <-2	27.4	DoH, MRC, OrcMacro, 2007[18]
							Severely stunted	NCHS/WHO HAZ <-3	11.9	
							Underweight	NCHS/WHO WAZ <-2	11.5	
							Severely underweight	NCHS/WHO WAZ <-3	2.9	
							Wasted	NCHS/WHO WHZ <-2	5.2	
							Severely wasted	NCHS/WHO WHZ <-3	1.8	
National SANHANES	R/U	Y BCWI 76.6%B	2012	1291	2–5	651 M 640 F	Overweight	IOTF	17.5 M 18.9 F	Shisana *et al.*, 2013[11]
							Obese		4.4 M 4.9 F	
National SADHS	R/U	Y BCWI 87%B	2016	1416	1–5	721 M 695 F	Stunted	WHO 2006 HAZ <-2	27.4	NDoH, StatsSA & ICF 2019[10]
							Severely stunted	WHO 2006 HAZ <-3	9.8	
							Underweight	WHO 2006 WAZ <-2	5.9	
							Severely underweight	WHO 2006 WAZ <-3	1.1	
							Wasted	WHO 2006 WHZ <-2	2.5	
							Severely wasted	WHO 2006 WHZ <-3	0.6	
							Overweight	WHO 2006 WHZ >2	13.3	
Preschool children 4 to 7 years old										
National	R/U	Y BWCI	1999	975	4–6	n/a	Stunted	NCHS HAZ <-2	20.7 (18.2, 23.3)	Labadarios *et al.*, 2000[109]
							Severely stunted	NCHS HAZ <-3	5.4 (4.0, 6.9)	
							Underweight	NCHS WAZ <-2	8.8 (7.0, 10.6)	
							Severely underweight	NCHS WAZ <-3	0.8 (0.3, 1.4)	
							Wasted	NCHS WHZ <-2	3.4 (2.2, 4.5)	
							Severely wasted	NCHS WHZ <-3	0.9 (0.3, 1.5)	
							Overweight	NCHS WHZ >2	5.2 (3.8, 6.6)	

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Table 4.1A Continued

Province	Rural/ Urban	Represent-ative, race	Year	*n*	Age, years	Sex	Indicator	Cut-point reference	% (95%CI)	Reference
Preschool children 4 to 7 years old										
				861	4–6	n/a	Overweight	IOTF	12.0 (9.6,14.4)	Labadarios *et al.*, 2005[17]
							Obese	IOTF	3.8 (2.5, 5.1)	
National	R/U	Y BWCI	2005	745	4–6	n/a	Stunted	CDC/WHO HAZ <-2	16.4	Labadarios *et al.*, 2007[8]
							Severely stunted	CDC/WHO HAZ <-3	5.1	
							Underweight	CDC/WHO WAZ <-2	8.6	
							Severely underweight	CDC/WHO WAZ <-3	0.8	
							Wasted	CDC/WHO WHZ <-2	5.0	
							Severely wasted	CDC/WHO WHZ <-3	1.5	
							Overweight	IOTF	10.9	
							Obese	IOTF	2.6	
National SANHANES	R/U	Y BCWI 76.6%B	2012	954	4–6	503 M 451 F	Stunted	WHO 06 HAZ <-2	13.5 M 9.5 F	Shisana *et al.*, 2013[11]
							Severely stunted	WHO 06 HAZ <-3	2.6 M 1.6 F	
							Underweight	WHO 06 WAZ <-2	5.4 M 3.2 F	
							Severely underweight	WHO 06 WAZ <-3	0.9 M 0.2 F	
							Wasted	WHO 06 BAZ <-2	2.6 M 1.0 F	
							Severely wasted	WHO 06 BAZ <-3	1.0 M 0.6 F	
MP	R	N B	2012	131	3–6	n/a	Stunted	WHO06 HAZ <-2	4.9	Draper *et al.*, 2018[160]
							Underweight	WHO 06 WAZ <-2	3.3	
							Wasted	WHO 06 BAZ <-2	3.3	
							Overweight	IOTF	2.5	
							Obese	IOTF	2.5	
WC	U	N BCW	2012	137	3–6	n/a	Stunted	WHO 06 HAZ <-2	3.6	
							Underweight	WHO 06 WAZ <-2	0	
							Wasted	WHO 06 BAZ <-2	3.6	
							Overweight	IOTF	8.8	
							Obese	IOTF	3.6	

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Table 4.1A Continued

Province	Rural/ Urban	Represent-ative, race	Year	*n*	Age, years	Sex	Indicator	Cut-point reference	% (95%CI)	Reference
KZN	U	N BC	2011	207	1–6	n/a	Stunted	WHO 06 HAZ <-2	23.5	Faber *et al.*, 2015[78]
WC	U	N BC	2011	194	1–6	n/a	Underweight	WHO 06 WAZ <-2	9.8	
NC	R	N B	2011	206	1–6	n/a	Wasted	WHO 06 BAZ <-2	0.6	
LP	R	N B	2011	140	1–6	n/a	Overweight	WHO 06 WHZ >2	6.1	
NC	R	N BC	2008	243	1–6	119 M 124 F	Stunted	WHO 06 HAZ <-2	40.5 (34.2, 46.8)	Van Stuijvenberg *et al.*, 2012[39]
							Underweight	WHO 06 WAZ <-2	23.1 (17.8, 28.5)	
							Wasted	WHO 06 WHZ <-2	8.4 (4.5, 12.3)	
							Overweight	WHO 06 WHZ >2	-	
NC	R	N BC	2016	95	3–5	46 M 49 F	Stunted	WHO 06 HAZ <-2	31.9	Van Stuijvenberg *et al.*, 2019[141]
							Underweight	WHO 06 WAZ <-2	24.5	
							Wasted	WHO 06 WHZ <-2	8.5	
Preschool children 4 to 7 years old										
FS	U	N B	1998	348	<6	171 M 177 F	Stunted	NCHS HAZ <-2	25.0	Dannhauser *et al.*, 2000[100]
							Underweight	NCHS WAZ <-2	19.2	
							Wasted	NCHS WHZ <-2	5.2	
							Overweight	NCHS <2	-	
KZN	R	N B	2003	50	>5–6	26 M 24 F	Stunted	NCHS HAZ <-2	31.0	Schoeman *et al.*, 2010a[30]
							Underweight	NCHS WAZ <-2	7.0	
							Wasted	NCHS WHZ <-2	2.0	
EC	R	N B	2003	40	>5–6	20 M 20 F	Stunted	NCHS HAZ <-2	26.0	
							Underweight	NCHS WAZ <-2	14.0	
							Wasted	NCHS WHZ <-2	3.0	
EC	U	N B	2014	105	6–7	62 M 43 F	Stunted	WHO 2006 HAZ <-2	10.5	Ronaasen *et al.*, 2016[161]

B, Black; BAZ, body mass index Z-score; C, Coloured; CDC, Center for Disease Control; EC, Eastern Cape; F, female; FS, Free State; GP, Gauteng Province; HAZ, height for age Z-score; HC, head circumference; I, Indian; IOTF, International Obesity Task Force; KZN, KwaZulu-Natal; LAZ, length for age Z-score; LP, Limpopo Province; M, male; MUAC, mid-upper arm circumference; N, no; n/a, not available; NC, Northern Cape; NCHS, National Center for Health Statistics; NFCS, National Food Consumption Survey; NFCS-FB, National Food Consumption Survey - Fortification Baseline; NW, North West; R, rural; SADHS, South African Department of Health Survey; SANHANES, South African National Health and Nutrition Examination Survey; W, White; WAZ, weight for age Z-score; WC, Western Cape; WHZ, weight for height Z-score; U, urban; Y, yes.

8 10 11 12 17 18 19 20 27 28 29 32 34 35 39 41 42 43 45 46 50 51 53 57 58 60 63 65 66 67 68 69 70 71 72 73 74 75 78 80 81 82 83 87 88 92 95 97 98 99 100 101 102 103 104 105 106 107 108 109 116 118 119 120 121 122 123 124 125 126 127 129 130 131 132 134 135 136 139 141 142 160 163 164 175 176 177 178

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Table 4.1B: Percentage of Coloured infants and children, 0 to 5 years old with malnutrition: Underweight, stunting, wasting and overweight/obesity

Province	Rural/ Urban	Represent-ative, Race	Year	*n*	Age, Years	Sex	Indicator	Cut-Point Reference	% (All; M, F)	Reference
FS/NC	R	N C	1997	536	2–5	270 M 266 F	Stunted	NCHS HAZ -2 to -3	33.6; 35.9, 31.6	Walsh *et al.*, 2002[27]
							Severely stunted	NCHS HAZ <-3	13.9; 14.8, 12.8	
							Underweight	NCHS WAZ -2 to -3	22.0; 27.0, 22.9	
							Severely underweight	NCHS WAZ <-3	10.2; 9.2, 11.3	
							Severely wasted	NCHS WHZ <-3	10.2; 9.2, 11.3	
							Wasted	NCHS WHZ <-2	14.9; 17.0, 9.8	
WC	U	N C	1998	60	0.5–1	n/a	Stunted	NCHS HAZ <-2	18.0	Oelofse *et al.*, 2002[28]
							Underweight	NCHS WAZ <-2	8.0	
							Wasted	NCHS WHZ <-2	0	
							Overweight	NCHS	-	

Table 4.1C: Percentage of Indian infants and children, 0 to 5 years old with malnutrition: Underweight, stunting, wasting and overweight/obesity

No data

Table 4.1D: Percentage of White infants and children, 0 to 5 years old with malnutrition: Underweight, stunting, wasting and overweight/obesity

Province	Rural/ Urban	Represent-ative, race	Year	*n*	Age, years	Sex	Indicator	Cut-point reference	%	Reference
NW	U	N W	2001	120	3–4	58 M 62 F	Overweight	NCHS BMI 85-95th	9.2	Du Toit & Pienaar, 2003[26]
							Obese	NCHS BMI p>95th	6.7	

BMI, Body mass index; F, female; N, national; NCHS, National Center for Health Statistics; NW, North West; P, percentile; W, white; U, urban.

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Table 4.1E: Summary of data on infants and children, 0 to 6 years old with malnutrition: Underweight, stunting, wasting and overweight/obesity

Group, R/U, Race, Year	Province Survey	Representa-tive Y/N Cut-point reference	*n*	Weight-for-age z Underweight		Height-for-age z Stunted		Weight-for-height z Wasted		Overweight Obese, % (95% CI) WHZ/BAZ	Reference
				% (95%CI)	Mean ± SD /(95%CI)	% (95% CI)	Mean ± SD /(95%CI)	% (95%CI)	Mean ± SD /(95%CI)		
Infants 0 to 2 years old											
0.5–1 U B 1998	WC	N NCHS	60	2.0	0.31 ± 1.12	7.0	-0.73 ± 0.84	0	1.10 ± 1.01	-	Oelofse *et al.*, 2002[28]
0.5–1 U C 1998	WC	N NCHS	60	7.0	-0.16 ± 1.42	18.0	-0.95 ± 1.30	0	0.76 ± 1.12	-	Oelofse *et al.*, 2002[28]
<0.5 U BC 2000	WC	N WHO 06	113	0	0.89 ±1.01	1.8	-0.69 ± 0.81	0	1.78 ± 0.83	35.0	Sibeko *et al.*, 2004[43]
0.5 RU B 2006–8	WC&KZN	N WHO 06	404	4.9	0.14 (-0.02; 0.30)	10.9	-0.08 (–0.23; 0.07)	1.99	0.41 (0.26,0.56)	-	Engebretsen *et al.*, 2014[35]
1.5 U B 2009–10	WC	N WHO 06	496	-	0.26 ± 1.17	-		-	0.72 ± 1.32	-	Le Roux *et al.*, 2014[162]
<1 R BC 2012–15	WC	N WHO 06	1071	-		-		-		9.0	Budree *et al.*, 2017[125]
4mo–2y R B 1997	KZN	N NCHS	115	3.6		15.3		0.9		7.2	Faber & Benadé, 1999[29]
0.5–2 R B 1998	KZN	N NCHS	97	8.5	-0.12±1.07	16.5	-0.97±0.97	3.8	0.74±1.01	14.8	Faber & Benadé, 2000[32]
0.5–1 R B 2003	KZN	N NCHS	194	1.6	0.39 ±1.13	10.7	-0.73 ±1.0	0	1.20 ±1.1	-	Smuts *et al.*, 2005[41]
0<1 R B 2003	KZN	N NCHS	290	6.0		13		1.0		16.0	Schoeman *et al.*, 2010a[30]
1–<2 R B 2003	KZN	N NCHS	385	9.0		25		4.0		11.0	Schoeman *et al.*, 2010a[30]
<2 R B 2008	KZN	N WHO 06	413	2.9		17.7		1		8.7	Schoeman *et al.*, 2010b[31]
1–2 U B 2001	GP	N NCHS	308	-		19.0		-		-	Kleynhans *et al.*, 2006[38]
1 R B 2001	LP	N NCHS	156	11.0	-0.67 ± 1.24	34.0	-1.36 ± 1.36	11.8	0.40 ± 1.36	-	Mamabolo *et al.*, 2007[67]
1–2 R B 2001	LP	N NCHS	156	-		18.0		-		-	Kleynhans *et al.*, 2006[38]
<1 R B 2006	LP	N NCHS	185	7.0	-0.19 ±1.18	18.9	-0.84 ± 1.43	7.0	0.76 ± 1.12	17.3 (WHZ)	Mushaphi *et al.*, 2008[42]
0.5 R B 2016	LP	N WHO 06	665	-	-0.6 ± 0.9	-	-1.06 ± 0.9	-	0.02 ± 0.9	-	Huang *et al.*, 2018[33]
0<1 R B 2003	EC	N NCHS	404	3.0		12		3.0		18.0	Smuts *et al.*, 2008[121]
1–<2 R B 2003	EC	N NCHS	363	12		29		4.0		12.0	Schoeman *et al.*, 2010a[30]
<2 R B 2008	EC	N WHO 06	141	1.4		19.1		0		6.4	Schoeman *et al.*, 2010b[31]
0–2 U B 2015–6	EC	N WHO 06	400	n/a	0.44 ±1.26	9.0	-0.24 ± 1.26	1.0	0.83 ± 1.28	16.0	McLaren *et al.*,2018[36]
0.5 U B 2013–5	NW	N WHO 06	750	11.1	-0.57 ± 1.21	26.7	-1.44 ± 1.07	1.7	0.54 ±1.15	10.1	Matsungo *et al.*, 2017[37]
1–3 RU BWCI 1999	National NFCS	Y NCHS	1198	12.4		25.5		4.0		6.6 WHZ	Labadarios *et al.*, 2000[109]
0–5 RU BCWI 2003	National DHS	Y NCHS	1159	11.5	-0.49 ± 0.05	27.4	-1.16 ± 0.05	5.2	0.34 ±0.06	-	DoH, MRC,OrcMacro, 2007[18]
1–3 RU BWCI 2005	National NFCS	Y NCHS	836	6.5	-0.33 (-0.42, -0.26)	28.8	-1.01 (-1.12, -0.89)	6.2	0.27 (0.17, 0.36)	9.8 WHZ (7.8,11.8)	Labadarios *et al.*, 2005[17]
0–3 RU BCWI 2012	National SANHANES	Y WHO 06	1090	5.9		26.5		2.6BAZ		-	Shisana *et al.*, 2013[11]
2–5 RU BC 2012	National BCWI	Y IOTF	1291	-		-		-		18.2, 4.6	Shisana *et al.*, 2013[11]

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Table 4.1E Continued

Group, R/U, Race, Year	Province Survey	Representative Y/N Cut-point reference	n	Weight-for-age z Underweight		Height-for-age z Stunted		Weight-for-height z Wasted		Overweight Obese, % (95% CI) WHZ/BAZ	Reference
				% (95%CI)	Mean ± SD /(95%CI)	% (95% CI)	Mean ± SD /(95%CI)	% (95%CI)	Mean ± SD /(95%CI)		
Infants 0 to 2 years old											
1-5 RU BCWI 2016	National DHS	Y WHO 06	1416	5.9		27.4		2.5		13.3 WHZ	NDoH, StatsSA, ICF, 2019[10]
3–4 W U 2001	NW	N NHCS	120	-		-		-		9.2, 6.7	Du Toit & Pienaar, 2003[26]
1–4 B R 2007	MP	N WHO 06	671	10		18		7		7.0, 1.0	Kimani *et al.*, 2010[60]
3–6 B R 2009	MP	N WHO 06	131	3.3	-0.30 ± 0.94	4.9	-0.39 ± 0.98	3.3	– 0.10 ± 1.02	2.5, 2.5 IOTF	Draper *et al.*, 2018[160]
3–5 B R 1997	LP	N NCHS	345	-		-				1.7, 0	Monyeki *et al.*, 1999[44]
<5 U B 2007	LP	N WHO 06	50	24.0		62.0		6.0		-	Heckman *et al.*, 2010[83]
3–5 R B 2013	LP	N WHO 06	349	0.3	-0.23 ±4.83	18.6	-1.02 ±1.33	1.4	0.58 ±1.4	20.9, 9.7	Motadi *et al.*, 2015[80]
2–5 RU C 1997	FS/NC	N NCHS	536	22.0		33.6		14.9		-	Walsh *et al.*, 2002[27]
2–5 R BC 2010–1	NC	N WHO 06	150	25.5	-1.15 (-1.34; -0.96)	36.9	-1.56 (-1.75; -1.38)	12.1	-0.37 (-0.60; -0.14)	-	Van Stuijvenberg *et al.*, 2015[101]
3–5 R BC 2016	NC	N WHO 06	95	24.5	–1.22 ± 1.09	31.9	-1.57 ± 0.98	8.5	–0.55 ± 1.09	-	Van Stuijvenberg *et al.*, 2019[141]
2–5 RU B 1998	KZN	N CHS IOTF	700	7.0		33.7				28.1, 14.4	Jinabhai *et al.*, 2005[62]
2–5 R B 1999	KZN	N NCHS	164	9.0	-0.60 ±1.15	21.0	-1.30 ± 1.02	0.9	0.25 ± 1.10	3.0 WHZ	Faber *et al.*, 2001[46]
<5 R B 2001	KZN	N CDC	868	12.0 (9.8-14.2)	-0.52 (-0.44, -0.60)	26.3 (23.3-29.3)	-1.25 (-1.15, -1.35)	1.3	-	-	Chopra *et al.*, 2003[155]
2–5 R B 2003	KZN	N NCHS	935	9.0		22		4.0		5.0	Schoeman *et al.*, 2010a[30]
2–5 R B 2008	KZN	N WHO 06	245	1.5		23.7		0		1.0	Schoeman *et al.*, 2010b[31]
2–5 R B 2015	KZN FS	N WHO 06	216	-		35	-0.93 ± 4.94			-	Chakona *et al.*, 2018[156]
<6 U B 1998	FS	N NCHS	348	19.2		25.0		5.2		-	Dannhauser *et al.*, 2000[100]
<5 U B 2014	FS	N WHO 06	240	7.7		-		-		-	Koetaan *et al.*, 2019[158]
2–5 R B 2003	EC	N NCHS	765	12		30		4.0		5.0	Schoeman *et al.*, 2010a[30]
2–5 R B 2008	EC	N WHO 06	166	3.0		26.0		0		1.0	Schoeman *et al.*, 2010b[31]
6–7 U B 2014	EC	N WHO 06	105	-		10.5		-		-	Ronaasen *et al.*, 2016[161]
1–5 U B 2014	GP	N WHO 06	1254	20.5		35.8	-0.25 ± 1.02	17.2		14.0 BMIZ	Madiba *et al.*, 2019[40]
0–5 RU 2018	GP	Y WHO 06	674	5.6		21.6		4.0		10.3, 7.0	Senekal *et al.*, 2019[48]
<5 RU BC 2009	WC	N WHO 06	179	8.5		10.7		5.1		6.3 WHZ	Iverson *et al.*, 2011[159]
3–6 U BCW 2012	WC	N WHO 06	137	0	–0.12 ± 1.01	3.6	-0.25 ± 1.02	3.6	-0.04 ± 1.03	8.8, 3.6 IOTF	Draper *et al.*, 2018[160]
4–5 U BCW 2014	WC	N WHO 06	80	-	0.09 ± 1.16	-	- 0.17± 1.10	-	0.29 ± 1.13	-	Jones *et al.*, 2014[163]
1–6 RU BC 2011	NC WC KZN LP	N WHO 06	734	9.8		23.5		0.6		6.1	Faber *et al.*, 2015[78]

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Table 4.1E Continued

Group, R/U, Race, Year	Province Survey	Representa-tive Y/N Cut-point reference	*n*	Weight-for-age z Underweight		Height-for-age z Stunted		Weight-for-height z Wasted		Overweight Obese, % (95% CI) WHZ/BAZ	Reference
				% (95%CI)	Mean ± SD /(95%CI)	% (95% CI)	Mean ± SD /(95%CI)	% (95%CI)	Mean ± SD /(95%CI)		
Infants/Children 0 to 6 years old											
1–6 R C 2008	NC	N WHO 06	243	23.1		40.5		8.4		-	Van Stuijvenberg *et al.*, 2012[39]
4–6 RU BWCI 1999	National NFCS	Y NCHS	975	8.8		20.7		3.4		5.2 WHZ	Labadarios *et al.*, 2000[109]
4–6 RU BWCI 2005	National NFCS-FB	Y NCHS	739	8.0	-0.61 (-0.69, -0.52)	16.8	-0.98 (-1.08, -0.88)	6.0	0.00 (-0.10, 0.09)	4.2 WHZ	Labadarios *et al.*, 2005[17]
4-6 RU BCWI 2012	National SANHANES	Y WHO 06	954	4.3		11.9		1.8BAZ		IOTF 18.2, 4.6	Shisana *et al.*, 2013[11]

B, Black; C, Coloured; CDC, Center for Disease Control; DHS, Department of Health survey; EC, Eastern Cape; F, female; FS, Free State; GP, Gauteng Province; HAZ, height for age Z-score; HC, head circumference; I, Indian; IOTF, International Obesity Task Force; KZN, KwaZulu-Natal; LP, Limpopo Province; M, male; N, national; NC, Northern Cape; NCHS, National Center for Health Statistics; NFCS, National Food Consumption Survey; NW, North West; R, rural; SANHANES, South African National Health and Nutrition Examination Survey; W, White; WAZ, weight for age; WC, Western Cape; WHZ, weight for height Z-score; U, urban; Y, yes.

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Table 4.2A: Percentage of Black (or predominantly Black) primary school-age children with malnutrition: Underweight, stunting, wasting and overweight/obesity

Province Survey	Rural/ Urban	Represen-tative	Year	*n*	Age, years	Sex	Indicator	Cut-point reference	% / 95% CI All/ M, F	Reference
LP	R	N	1997	991	6–10	477M	Overweight	NCHS WA <85th	1.9	Monyeki *et al*., 1999[44]
						514F	Obese	NCHS WA <95th	0	
LP	R/U	N	1997	50	10	25M 25F	Underweight	NCHS WA <80%	18.0	MacIntyre *et al*., 2006[65]
				50	10	25M 25F	Stunted	NCHS HAZ <95%	16.0	
LP	R/U	N	2007	602	9–13	381M221F	Underweight	CDC WAZ <-2	3.6, 4.2	Malongane *et al*., 2017[132]
				602	9–13	381M221F	Stunted	CDC HAZ <-2	11.3, 7.4	
				602	9–13	381M221F	Overweight	CDC BAZ >2	8.1, 11.3	
				602	9–13	381M221F	Obese	CDC BAZ >3	0.5, 1.0	
LP	R	N	2010	964	10–13	419M545F	Underweight	CDC < WA 5th p	5.7, 6.0	Toriola *et al*., 2012[164]
				964	10–13	419M545F	Overweight	CDC 85-95th	10.0, 13.2	
				964	10–13	419M545F	Obese	CDC >95th	6.0, 4.6	
LP	U	N	2011	269	7–13	134M135F	Overweight, Obese	IOTF	3.9, 4.7	Goon *et al*., 2013[165]
LP&MP	R	N	2016	1361	9–13	678M683F	Underweight	CDC <5th p	4.68, 4.54	Moselakgomo *et al*., 2017[166]
				1361	9–13	678M683F	Overweight	CDC 85-95	9.9, 10.4	
				1361	9–13	678M683F	Obese	CDC >95th	5.5, 5.3	
LP	R	N B	2017	254	6–9	104M150F	Stunted	WHO 07 HAZ <-2	14.0	Modjadji *et al*., 2019[49]
				254	6–9	104M150F	Underweight	WHO 07 WAZ <-2	27.0	
				254	6–9	104M150F	Overweight	WHO 07	-	
				253	10–15	104M149F	Stunted	WHO 07 HAZ <-2	30.0	
				253	10–15	104M149F	Underweight	WHO 07 WAZ <-2	35.0	
				253	10–15	104M149F	Overweight		-	
KZN	R/U	Y	1998	942	6–11	426M516F	Stunted	NCHS HAZ <-2	39.7, 33.9	Jinabhai *et al*., 2005[62]
				942	6–11	426M516F	Underweight	NCHS WAZ <-2	7.0, 6.6	
				942	6–11	426M 516F	Overweight	NCHS BAZ >2	20.2, 20.5	
				942	6–11	426M516F	Obese	NCHS BAZa >3	6.8, 7.2	
KZN	RU	Y BI	2004	1758	2–12	n/a	Stunted	WHO 2007 HAZ <-2	9.6	Timaeus *et al*., 2012[55]
				1758	2–12	n/a	Underweight	WHO 2007 WAZ <-2	2.1	
				1758	2–12	n/a	Overweight	WHO 2007 BAZ >1	19.0	

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Table 4.2A Continued

Province Survey	Rural/ Urban	Represen-tative	Year	*n*	Age, years	Sex	Indicator	Cut-point reference	% / 95% CI All; M, F	Reference
				1758	2–12	n/a	Obese	WHO 07 BAZ >2	3.5	
KZN	R	N	2009	321	6–11	163B 158G	Stunted	WHO 07	6.2	Baumgartner *et al.*, 2012[56]
				321	6–11	163B 158G	Underweight	WHO 07	2.2	
				321	6–11	163B 158G	Overweight	WHO 07	21.5	
				321	6–11	163B 158G	Obese	WHO 07	7.2	
KZN	R	Y	2010	264M	7	264M	Overweight, Obese	IOTF	3.0, 0.4	Craig E *et al.*, 2013[57]
				234M	11	234M	Overweight, Obese	WHO 07 BAZ >1, >2	8.4, 0.8	
				264M	7	264M	Excess BF% Obese	McCarthy 06	13.7, 3.1	
				234M	11	234M	Excess BF% Obese	McCarthy 06	2.1, 3.4	
				250F	7	250F	Excess BF% Obese	McCarthy 06	14.1, 5.2	
				269F	11	269F	Excess BF% Obese	McCarthy 06	6.3, 2.2	
				264M	7	264M	Underweight	IOTF	16.0	
				234M	11	234M	Underweight	WHO 07 BAZ <-2	3.4	
				264M	7	264M	Underweight	IOTF	12.9	
				234M	11	234M	Underweight	WHO 07 BAZ <-2	3.9	
				250F	7	250F	Overweight, Obese	IOTF	7.2, 2.0	
				269F	11	269F	Overweight, Obese	IOTF	8.6, 1.1	
				250F	7	250F	Overweight, Obese	WHO 07 BAZ >1, >2	11.6, 2.0	
				269F	11	269F	Overweight, Obese	WHO 07 BAZ >1, .2	11.9, 1.5	
				250F	7	250F	Underweight	IOTF	15.1	
				269F	11	269F	Underweight	IOTF	12.3	
				250F	7	250F	Underweight	WHO 07 BAZ <-2	1.2	
				269F	11	269F	Underweight	WHO 07 BAZ <-2	1.9	
KZN	R	N	2011	959	7–14	959F	Stunted	WHO 07 HAZ <-2	9.2	Tathiah *et al.*, 2013[167]
							Underweight	WHO 07 WAZ<-2	4.0	
							Overweight	IOTF	9.0	
							Obese	IOTF	3.8	
KZN	R/U	B	2012	1386	6–8y	698M688F	Stunted	WHO 07 HAZ <-2	14.7	Ajayi *et al.*, 2017[58]
							Underweight	WHO 07 WAZ<-2	3.0	

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Table 4.2A Continued

Province Survey	Rural/ Urban	Represen-tative	Year	*n*	Age, years	Sex	Indicator	Cut-point reference	% / 95% CI All; M, F	Reference
KZN	R	N	2012	1532	7–11	664M872F	Stunted	WHO07 HAZ <-2	2.9	Houle *et al.*, 2019[168]
							Overweight	WHO07 BAZ>2	13.2	
							Overfat BIA	McCarthy06 > 85th p	7.0	
NW	R	N	1998	396	10–12	188M208F	Underweight	WHO07 WAZ<-2	31.8	Walker & Walker, 2001[176]
NW	R/U	Y BCWI 73%B	2000	1257	10–15	608M649F	Overweight	WHO07 WHZ >2	4.1, 8.3	Kruger *et al.*, 2006[99]
							Obese	IOTF	1.5, 1.7	
				1257	10–15	608M649F	Stunted	CDC HAZ < 5th	19.1	Mukkudem-Petersen *et al.*, 2004[169]
NWP	U	N	2007	277	11–13y	127M150F	Overweight	IOTF	15.7, 15.3	Monyeki *et al.*, 2009[64]
							Obese	IOTF	5.5, 7.3	
NW	R/U	Y BCWI 69%B	2010	816	6–7	419M397F	Overweight	IOTF	6.4, 9.3	Kemp *et al.*, 2011[170]
NW		NW Child		816	6–7	419M397F	Obese	IOTF	3.3, 4.3	Kruger *et al.*, 2014[171]
							Stunted	WHO07 HAZ <-2	4.1, 4.5	
							Thinness BMIZ	WHO07 BAZ<-2	8.4, 6.3	
NW	U	N B	2010	408	6–11	213M 195F	Stunted	WHO07 HAZ <-2	12.4	Taljaard *et al.*, 2013[87]
							Underweight	WHO07 WAZ<-2	14.4	
							Wasted	WHO07 BAZ <-2	8.7	
							Overweight	WHO 07 BAZ >2	-	
NW	R	N	2012	167	6–12	84M 83F	Stunted	WHO07 HAZ <-2	13.2	Van der Hoeven *et al.*, 2016[88]
				167	6–12	84M 83F	Underweight	WHO07 WAZ<-2	5.4	
				167	6–12	84M 83F	Overweight	WHO 07 BAZ >1	3.0	
				167	6–12	84M 83F	Obese	WHO 07 BAZ >2	0.6	
MP	R	N	2007	970	5–9y	483M 487F	Stunted	WHO 07 HAZ <-2	5	Kimani *et al.*, 2010[60]
							Underweight	WHO 07 WAZ<-2	6	
							Wasted	WHO 07 WHZ<-2	6	
				970	1–4y	338M 333F	Overweight	IOTF	4	
MP	R	N	2007	970	5–9y	483M 487F	Obese	IOTF	1	
	R	N	2007	944	10–14y	471M 473F	Stunted	WHO 06 HAZ <-2	7	
				944	10–14y	471M 473F	Underweight	WHO 06 WAZ <-2	7	
				944	10–14y	471M 473F	Overweight	IOTF	6	
				944	10–14y	471M 473F	Obese	IOTF	2	
WC	U	N BCW	2011	306	9–11y	122M184F	Overweight/Obese	WHO 2007 BAZ >2	26.1	LeBlanc *et al.*, 2015[61]

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Table 4.2A Continued

Province Survey	Rural/ Urban	Represen-tative	Year	*n*	Age, years	Sex	Indicator	Cut-point reference	% / 95% CI All; M, F	Reference
WC	R/U	N BC	2008	717	10–12y	n/a	Stunted	WHO07 HAZ <-2	19.3	Abrahams *et al.*, 2011[51]
							Underweight	WHO07 BAZ <-2	2.0	
							Overweight	WHO 07 BAZ >1-2	14.3	
							Obese	WHO 07 BAZ >2	6.7	
WC	R/U	N	2009	1002	9–13	474M528F	Thinness	WHO 07 BAZ <-2	3.0, 3.0	De Villiers *et al.*, 2016[54]
							Overweight	WHO 07 BAZ >1	7.6, 11.0	
							Obese	WHO 07 BAZ >2	21.1, 15.9	
EC	R	N B	2013	234	6–18	116M118F	Stunted	WHO07 HAZ <-2	2.3, 5.6	Oldewage-Theron & Kruger, 2017[104]
							Underweight	WHO07 WAZ<-2	0, 8.3	
							Wasted	WHO07 BAZ <-2	4.3, 2.5	
							Overweight	WHO 07 BAZ >2	4.3, 4.2	
							Obese	WHO 07 BAZ >3	0, 0	
EC	U	N	2015	801	8–12	402M399F	Thinness	WHO07 BAZ <-2	4.9	Gerber *et al.*, 2018[59]
							Overweight	WHO 07 BAZ >1	13.2	
							Obese	WHO 07 BAZ >2	5.1	
EC	R	N	2015	1390	6–12	709M681F	Stunted	WHO07 HAZ <-2	9.1	Graham *et al.*, 2018[172]
							Overweight	WHO 2007	14.9	
							Obese	BAZ >1/ BAZ >2		
EC	U	N BC	2015	835	8–12y	418M417F	Stunted	WHO07 HAZ <-2	12.0, 12.7	Gall *et al.*, 2017[173]
GP	U	N	2004	149	9–13	66M83F	Stunted	n/a	31.2, 30.3	Oldewage-Theron *et al.*, 2006[50]
							Wasted	n/a	31.0, 22.9	
GP	U	N	2006	113	7–11	50M63F	Stunted	WHO07 HAZ <-2	18.0, 15.9	Samuel *et al.*, 2010[102]
							Thinness	WHO07 BAZ <-2	20.0, 0	
							Overweight	WHO 2007	10.0, 2.0	
							Obese	BAZ >1/ BAZ >2	11.1, 4.8	
GP	U	N	2015	220	5–9	120M100F	Stunted	WHO07 HAZ <-2	8.6	Shiau *et al.*, 2017[63]
							Underweight	WHO07 WAZ<-2	2.7	
							Overweight	WHO 07 BAZ >1	24.1	
				1220	6–9	626M594F	Obese	IOTF	4.1, 2.7	Shisana *et al.*, 2013[11]
GP&WC	R/U	Y BCWI	2018	626	5–9	n/a	Stunted	WHO07 HAZ <-2	6.7	Senekal *et al.*, 2019[48]
							Underweight	WHO07 WAZ<-2	6.8	
							Overweight	WHO 07 BAZ >2	13.4	
							Obese	WHO 07 BAZ >3	6.8	

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Table 4.2A Continued

Province Survey	Rural/ Urban	Represen-tative	Year	*n*	Age, years	Sex	Indicator	Cut-point reference	% / 95% CI All; M, F	Reference
WC	U	N BCW	2011	638	6–13	n/a	Overweight, Obese	IOTF	9.0, 4.0	Kirsten *et al.*, 2013[174]
FS	R	N B	2008	73	7–15	35M 38F	Stunted	WHO07 HAZ <-2	13.7	Egal *et al.*, 2018[53]
							Underweight	WHO07 WAZ<-2	19.8	
							Wasted	WHO07 BAZ <-2	11.4	
National NFCS	R/U	Y BWCI	1999	440	7–9	n/a	Stunted	NCHS HAZ <-2	13.0	Labadarios *et al.*, 2000[109]
							Underweight	NCHS WAZ <-2	7.7	
							Wasted	NCHS WHZ <-2	3.4	
							Overweight	NCHS WHZ >2	6.1	
				544	7–9	n/a	Overweight	IOTF	6.5 (4.2,8.9)#	Labadarios *et al.*, 2005[17]
							Obese	IOTF	3.0 (1.1, 4.8)#	
SA 5 prov	R/U	Y BCWI	2001	4833	6–13	2411M	Overweight	IOTF	7.6, 12.3	Armstrong *et al.*, 2006[136]
						2422F	Obese	IOTF	2.1, 4.7	
National NFCS-FB	R/U	Y BCWI	2005	582	7–9	n/a	Stunted	NCHS HAZ <-2	13.9 (11, 16.8)#	Labadarios *et al.*, 2005[17]
							Underweight	NCHS WAZ <-2	10.7 (8, 13.3)#	
							Wasted	IOTF	5.2 (3.3,7.0)#	
				566	7–9	n/a	Overweight	IOTF	7.8 (5.6,10)#	
							Obese	IOTF	2.5 (0.9, 4)#	
National SANHANES	R/U	YBCWI 77%B	2012	929	7–9	463M466F	Stunted	WHO 06 HAZ <-2	10.0, 8.7	Shisana *et al.*, 2013[11]
							Severely stunted	WHO 06 HAZ <-3	1.5, 1.9	
							Underweight	WHO 06 WAZ<-2	8.6, 4.0	
							Severely underweight	WHO 06 WAZ<-3	0.7, 1.2	
							Wasted	WHO 06 BAZ<-2	2.4, 1.2	
							Severely wasted	WHO 06 BAZ<-3	0.8, 0.1	
				1220	6–9	626M594F	Overweight	IOTF	8.3; 4.5, 12.3	
							Obese	IOTF	3.4; 2.7, 4.1	
				1305	10–14	620M685F	Stunted	WHO 06 HAZ<-2	15.2, 10.1	
							Severely stunted	WHO 06 HAZ <-3	1.8, 1.7	
							Underweight	WHO 06 WAZ<-2	0, 3.2	
				1305	10–14	620M685F	Severely underweight	WHO 06 WAZ<-3	0.7, 3.2	Shisana *et al.*, 2013[11]
							Wasted	WHO 06 BAZ<-2	5.6, 2.5	

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Table 4.2A Continued

Province Survey	Rural/ Urban	Represen-tative	Year	*n*	Age, years	Sex	Indicator	Cut-point reference	% / 95% CI All; M, F	Reference
							Severely wasted	WHO 06 BAZ<-3	0.5, 0.9	
				1319	10–14	628M691F	Overweight	IOTF	7.5, 16.7	
							Obese	IOTF	2.7, 5.6	

B, Black; BF, body fat; BIA, Body Impedance Assessment; C, Coloured; CDC, Center for Disease Control; DHS, Department of Health Survey; EC, Eastern Cape; F, female; FS, Free State; GP, Gauteng Province; HAZ, height for age Z-score; HC, head circumference; I, Indian; IOTF, International Obesity Task Force; KZN, KwaZulu-Natal; LP, Limpopo Province; M, male; N, no; n/a, not available; NC, Northern Cape; NCHS, National Center for Health Statistics; NFCS, National Food Consumption Survey; NW, North West; R, rural; SANHANES, South African National Health and Nutrition Examination Survey; W, White; WAZ, weight for age Z-score; WC, Western Cape; WHZ, weight for height Z-score; U, urban; Y, yes.

Table 4.2B: Percentage of Coloured primary school-age children with malnutrition: Underweight, stunting, wasting and overweight/obesity

Province	Rural/ Urban	Represen-tative	Year	*n*	Age, years	Sex	Indicator	Cut-point reference	%	Reference
South Africa 5 provinces	R/U	Y	2001–2004	1811	6–13	931M880F	Overweight	IOTF	8.7, 10.7	Armstrong *et al.*, 2006[136]
							Obese	IOTF	3.0, 4.8	
National SANHANES	R/U	Y C	2012	854	2–14	433M421F	Stunted	WHO 06 HAZ<-2	18.6, 16.1	Shisana *et al.*, 2013[11]
							Severely stunted	WHO 06 HAZ<-3	4.5, 5.1	
							Underweight	WHO 06 WAZ<-2	11.5, 9.8	
							Severely Underweight	WHO 06 WAZ <-3	2.2, 2.8	
							Wasted	WHO 06 BAZ<-2	4.5, 4.2	
							Severely wasted	WHO 06 BAZ<-3	1.1, 2.0	
							Overweight	IOTF	8.0, 14.6	
							Obese	IOTF	3.8, 5.3	
WC	U CB	N 90%C	2005	172	10–13	79M 93F	Overweight	IOTF	8.9, 15.0	Somers *et al.*, 2006[72]
							Obese	IOTF	3.8, 10.8	
WC	U	N CB	2006	361	6–11	183B 178G	Stunted	NCHS HAZ <-2	8.1	Van Stuijvenberg *et al.*, 2008[175]
							Underweight	NCHS WAZ <-2	14.4	
							Wasted	NCHS BAZ <-2	1.5	

B, Black; BAZ, body mass index for age; C, Coloured; F, female; HAZ, height for age Z-score; IOTF, International Obesity Task Force; M, male; N, no; NCHS, National Center for Health Statistics; R, rural; SANHANES, South African National Health and Nutrition Examination Survey; WAZ, weight for age Z-score; WC, Western Cape; WHZ, weight for height Z-score; U, urban; Y, yes.

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Table 4.2C: Percentage of Indian primary school-age children with malnutrition: Underweight, stunting, wasting and overweight/obesity

No data

Table 4.2D: Percentage of White primary school-age children with malnutrition: Underweight, stunting, wasting and overweight/obesity

Province	Rural/ Urban	Represen-tative	Year	*n*	Age, years	Sex	Indicator	Cut-point reference	%	Reference
South Africa 5 provinces	R/U	Y	2001–2004	3310	6–13	2062M	Overweight	IOTF	15.4, 15.5	Armstrong *et al.*, 2006[136]
						1248F	Obese	IOTF	4.3, 7.8	
NW	R/U	Y	2000–1	191	10–15	n/a	Overweight	IOTF	11.6	Kruger *et al.*, 2006[99]
							Obese	IOTF	2.6	
NW	R/U	Y	2009	218	6–7	n/a	Overweight	IOTF	13.3	Kemp *et al.*, 2011[170]
							Obese	IOTF	6.4	
NW	R/U	Y	2009	218	6-7	n/a	Stunted	WHO 07 HAZ <-2	0	Kruger *et al.*, 2014[171]
GP	U WBI	N 64%W,	2014	631	7–12y	n/a	Underweight	WHO 07 BAZ <-2	4.9	McVeigh & Meiring, 2014[69]
							Overweight	WHO 07 BAZ >1	11.9	
							Obese	WHO 07 BAZ >2	7.4	

B, Black; BAZ, body mass index for age Z-score; F, female; HAZ, height for age Z-score; IOTF, International Obesity Task Force; M, male; N, no; NCHS, National Center for Health Statistics; NW, North West; R, rural; WHZ, weight for height Z-score; W, White; U, urban; Y, yes, n/a, not available

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Table 4.2E: Summary of data of primary school-age children with malnutrition: Underweight, stunting, wasting and overweight/obesity

Group, Year	Province	Representa-tive	*n*	Weight-for-age z-score Underweight (BAZ<-2)		Height-for-age z-score Stunted (HAZ <-2)		Wasted WHZ<-2	Weight-for-height/BAZ Overweight, obese		Reference
				%	Mean SD*/ 95% CI#	%	Mean SD*/ 95% CI#	%	%	Mean ± SD/ Median (IQR)	
6–10 B R 1997	LP	N	991	-		-		-	1.9		Monyeki *et al.*, 1999[44]
10 RU B 1997	LP	N NCHS	50	18.0		16.0		-	-		MacIntyre *et al.*, 2006[65]
9–13 RU B 2007–8	LP	N CDC 2000	602	6.3		8.8		-	10.1 , 0.8		Malongane *et al.*, 2017[132]
10–13 B R 2010	LP	N CDC 2000	964	5.9		-		-	10.8 ,5.2		Toriola *et al.*, 2012[164]
7–13 B U 2011	LP	N IOTF	269	-		-		-	4.5 , 0		Goon *et al.*, 2013[165]
6–9 R B 2017	LP	N WHO 2007	254	27.0	–0.2 (–1.0, 0.4)	14.0	0.2 (–0.8, 0.8)#		-		Modjadji *et al.*, 2019[49]
9–13 RU B 2017	LP & MP	N CDC2000	1361	4.6		-		-	10.2 , 5.4		Moselakgomo *et al.*, 2017[166]
10–15 R B 2017	LP	N WHO 2007	253	-	-	30.0	–0.3 (–1.13, 0.5)#	-			Modjadji *et al.*, 2019[49]
5–9 B R 2007	MP	N WHO07 IOTF	970	6		5		-	4.0. 1.0		Kimani *et al.*, 2010[60]
10–14 B R 2007	MP	N WHO07 IOTF	944	7		7		-	6.0 , 2.0		Kimani *et al.*, 2010[60]
10–12 R B 1998	NW	NCHS	396	31.8		-		-	-		Walker & Walker., 2001[176]
10–15 RU BCWI 2001	NW	Y IOTF	1257	-		19.1		-	6.3 , 1.6		Kruger *et al.*, 2006[99] Mukkudem-Petersen *et al.*, 2004[169]
11–13 B U 2006	NW	N IOTF	277	-		-		-	15.5 , 6.5		Monyeki *et al.*, 2009[64]
6–7 RU BCWI 2009	NW	Y IOTF	816	4.3	-0.16	4.3	-0.14	-	7.8 , 3.8	-0.14*	Kemp *et al.*, 2011[170] Kruger *et al.*, 2014[171]
6–11 U B 2010	NW	N WHO 2007	404	14.4	-0.86 ± 1.10*	12.4	-0.87 ± 0.99*	-	-	-0.55 ± 1.42*	Taljaard *et al.*, 2013[87] Onanbanjo., 2013[142]
6–12 R B 2012	NW	N WHO 2007	167	5.4		13.2			3.0 , 0.6		Van der Hoeven *et al.*, 2015[88]
6–11 U CB 2006	WC	N NCHS	361	14.4		8.1		1.5	-		Van Stuijvenberg *et al.*, 2008[175]
10–12 BC RU 2008	WC	N WHO 2007	717	2.0		19.3	-1.04 ± 1.32	-	14.3 , 6.7	-0.09 ± 1.15*	Abrahams *et al.*, 2011[51]

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Table 4.2E Continued

Group, Year	Province	Representa-tive	*n*	Weight-for-age z-score Underweight (BAZ<-2)		Height-for-age z-score Stunted (HAZ <-2)		Wasted WHZ<-2	Weight-for-height/BAZ Overweight, obese		Reference
				%	Mean SD*/ 95% CI#	%	Mean SD*/ 95% CI#	%	%	Mean ± SD/ Median (IQR)	
9–13 RU BC 2009	WC	N WHO 2007	1002	3.0		-		-	9.5,18.6		De Villiers *et al.*, 2016[54]
10–13 R B 2011	WC	N IOTF	338	-		-		-	6.2, 3.8		Tathiah *et al.*, 2013[167]
9–11 BCW U 2011–13	WC	N WHO 2007	306	-		-		-	26.1		LeBlanc *et al.*, 2015[61]
6–18 R B 2013	EC	N WHO 2007	234	4.2		4.0		3.4	14.0, 0		Oldewage-Theron & Kruger, 2017[104]
8–12 U B 2015	EC	N WHO 2007	801	4.9		-		-	13.2,5.1		Gerber *et al.*, 2018[59]
6–12 R B 2015	EC	N WHO 2007	1390	-		9.1	-0.69 ± 1.03	-	14.9	-0.02 ± 1.03*	Graham *et al.*, 2018[172]
6–11 RU B 1998	KZN	N NCHS IOTF	942	6.8		25.9		-	20.4,7.0		Jinabhai *et al.*, 2005[62]
6–11 R B 2009	KZN	N WHO 2007	321	2.2		6.2			21.5, 7.2		Baumgartner *et al.*, 2012[56]
7y B R 2010	KZN	Y WHO07 IOTF	514	2.3		-	-0.86 (-1.61, -0.07)	-	9.9, 1.4	-0.18 (-0.77, 0.46)$	Craig E *et al.*, 2013[57]
11y B R 2010	KZN	Y WHO07 IOTF	503	3.4		-	-0.68 (-1.43, -0.01)	-	8.5, 2.4	-0.25 (-0.91, 0.41)$	Craig E *et al.*, 2013[57]
7–14 R B 2011	KZN	N WHO 07 IOTF	959	4.0	-0.22 (-0.31, -0.12)#	9.2	-0.22 (-0.35,-0.10)		9.0, 3.8	-0.44 (-0.53, -0.35)#	Timaeus *et al.*, 2012[55]
6–8 B RU 2012	KZN	N WHO 2007	1386	3.0		14.7		-	-		Ajayi *et al.*, 2017[58]
7–11 RU B 2012	KZN	IOTF	1532	-		2.9		-	13.2		Houle *et al.*, 2019[168]
9–13 U B 2004	GP	N WHO 2007	149	27.0		30.8		-	-		Oldewage-Theron *et al.*, 2006[50]
7–11 U B 2006	GP	N WHO 2007	113	8.9	-	16.8	-0.56 ± 1.23*	-	10.6, 3.5	-0.43 ± 1.23*	Samuel *et al.*, 2010[102]
5–9 U B 2015	GP	N WHO 2007	220	2.7	-0.29 ± 1.1*	8.6	-0.82 ± 0.9		24.1	0.28 ± 1.1*	Shiau *et al.*, 2017[63]
7–12 U B 2015	GP	N	835	4.9		9.6		-	-		Gall *et al.*, 2017[173]
5–9 RU BC 75%B 2018	GP & WC	R WHO 2007	626	6.8		6.7		-	13.4, 6.8		Senekal *et al.*, 2019[48]

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Table 4.2E Continued

Group, Year	Province	Representative	*n*	Weight-for-age z-score Underweight (BAZ<-2)		Height-for-age z-score Stunted (HAZ <-2)		Wasted WHZ<-2	Weight-for-height/BAZ Overweight, obese		Reference
				%	Mean SD*/ 95% CI#	%	Mean SD*/ 95% CI#	%	%	Mean ± SD/ Median (IQR)	
5–11 U CB 2009	NC	N WHO 2007	192	-	-1.45	-	-1.5	-	-	-	Troesch *et al*., 2011[177]
7–9 RU BWCI 1999	National	N NCHS IOTF	544	8.0		13.0		3.4	6.5, 3.0		Labadarios *et al*., 2000[109]
6–13 RU BWC 2001–4	5 provinces	Y IOTF	10195 5611M 4584F	-		-		-	13.8,3.5 10.9,2.4 17.5,4.8		Armstrong *et al*., 2006[136]
7–9 RU 2005 BCWI NFCS	National	N NCHS	582	10.7	-0.80 (-0.91, -0.69)#	13.9	-0.49 (-0.62, -0.37)	5.2	7.8, 2.5	-0.05 (-0.16, -0.07)#	Labadarios *et al*., 2005[17]
7–9 RU BC 2012	National BCWI	Y WHO 2007 IOTF	929	6.3		9.4			(6-9y): 8.3, 3.4		Shisana *et al*., 2013[11]
10–14 RU BC 2012	National BCWI	Y WHO 2007	1305	1.7		12.5			12.3, 4.2		Shisana *et al*., 2013[11]

B, Black; BMIZ, body mass index Z-score; C, Coloured; CDC, Center for Disease Control; DHS, Department of Health Survey; EC, Eastern Cape; F, female; FS, Free State; GP, Gauteng Province; HAZ, height for age Z-score; I, Indian; IOTF, International Obesity Task Force; KZN, KwaZulu-Natal; LP, Limpopo Province; M, male; N, national; NC, Northern Cape; NCHS, National Center for Health Statistics; NFCS, National Food Consumption Survey; NW, North West; R, rural; SANHANES, South African National Health and Nutrition Examination Survey; W, White; WAZ, weight for age Z-score; WC, Western Cape; WHZ, weight for height Z-score; U, urban; Y, yes.

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Table 4.3A: Percentage of Black adolescents, 13 to 18 years old with malnutrition: Underweight, stunting, wasting and overweight/obesity

Province	Rural/ Urban	Represen-tative	Year	*n*	Age, years	Sex	Indicator	Cut-point reference	% All; (95% CI) M, F	Reference
LP	R/U	N	1997	50	15	25M 25F	Underweight	NCHS WA <80th	18.0	MacIntyre *et al*., 2006[70]
							Stunted	NCHS WA <95th	30.0	
LP	R	N	2010	208	14–16	122M86F	Underweight	CDC BA < 5th	8.0, 0	Toriola *et al*., 2012[164]
							Overweight	CDC BA 85–95th	5.7, 8.1	
							Obese	CDC BA >95th	4.1, 3.5	
WC	U	N	2000	60	15–18	60F	Underweight	NCHS WA <15th	0	Caradas *et al*., 2001[73]
							Overweight	NCHS WA 85–95th	30.9	
							Obese	NCHS WA > 95th	7.3	
WC	U	N	2014	689	13–18	342M347F	Underweight	IOTF	35.4, 20.2	Van Niekerk *et al*., 2014[68]
							Overweight	IOTF	6.9, 15.5	
							Obese	IOTF	3.7, 5.3	
NW	U	N	2004	313	12–16	134M179F	Stunted	WHO 07 HAZ <-2	21.6, 12.3	Mamabolo *et al*., 2007[67]
							Overweight, Obese	IOTF	1.6, 13.4	
NW	U	N	2006	316	13–18	n/a	Stunted	WHO 07 HAZ <-2	20.1, 13.1	Kruger *et al*., 2012[107]
							Underweight	WHO 07 WAZ <-2	2.1, 2.0	
							Overweight	WHO 07 BAZ 1–2	8.0, 22.9	
							Obese	WHO 07 BAZ >2	0, 4.2	
KZN	R	Y	2010	502	15	182M	Underweight	IOTF	15.8	Craig E *et al*., 2013[57]
							Underweight	WHO 07 BAZ <-2	6.2	
							Overweight, Obese	IOTF	4.9, 1.2	
							Overweight, Obese	WHO 07 BAZ	5.7, 2.3	
							Excess BF% Obese	McCarthy 06	0.6, 2.8	
				502	15	320F	Underweight	IOTF	8.2	
							Underweight	WHO 07 BAZ <-2	1.9	
							Overweight, Obese	IOTF	15.4, 5.3	
							Overweight, Obese	WHO 07 BAZ >1, >2	17.8, 8.0	
							Excess BF% Obese	McCarthy 06	12.5, 11.3	
KZN	R/U	YBCWI	2016	564	16–20	204M360F	Overweight	CDC BA 85–95th	13.7, 17.2	Bhimma *et al*., 2018[66]
		84%B					Obese	CDC BA >95th	9.8, 15.3	
FS	U	N 81.7% B BWCAsian	2006	415	13–15	174M240F	Stunted	WHO 07 HAZ <-2	10.3, 4.2	Meko *et al*., 2015[70]
				415	13–15	174M240F	Underweight	WHO 07 BAZ <-2	27.6, 12.5	
							Overweight	WHO 07 BAZ >2	13.2, 28.8	
							Obese	WHO 07 BAZ >3	4.0, 7.5	

Table 4.3A Continued

Province	Rural/ Urban	Represen-tative	Year	*n*	Age, years	Sex	Indicator	Cut-point reference	% All; (95% CI) M, F	Reference
FS	U			415	13–15	174M240F	WCi $>90^{th}$	Fernandez *et al.* (black) 2004	2.3, 3.8	Meko *et al.*, 2015[70]
GP	U	N Bto20 Study	2007	1172	16–18	566M606F	Overweight	WHO 07 BAZ 1–2	5.7 (3.7,7.6) 2.5 (1.2,3.8)	Lundeen *et al.*, 2016[139]
							Obese	WHO 07 BAZ >2	19.1 (16.0,22.3) 7.9 (5.8,10.1)	
MP	R	N	2007	904	15–20	432M 472F	Stunted	WHO 06 HAZ <-2	6	Kimani *et al.*, 2010[60]
							Underweight	WHO 06 WAZ <-2	8	
							Overweight	IOTF	8	
							Obese	IOTF	4	
EC	R	N	2013	98	14–18	48M50F	Stunted	WHO 07 HAZ <-2	10.0, 6.3	Oldewage-Theron *et al.*, 2014[71]
							Underweight	WHO 07 BAZ <-2	2.1, 2.0	
							Overweight	WHO 07 BAZ >1	8.0, 22.9	
							Obese	WHO 07 BAZ >2	0, 4.2	
EC	U	N	n/a	392	13–17	116M276F	Underweight	CDC BA < 5^{th}	1.0, 0	Nkeh-Chungag *et al.*, 2015[74]
							Overweight	CDC BA 85^{th} – 95^{th}	11.9, 25.6	
							Obese	CDC BA > 95^{th}	10.2, 24.8	
National YRBS	R/U	Y	2002	6990	13–19	3285M	Underweight	NCHS BAZ <-2	17.0	Reddy *et al.*, 2009[19]
						3705F	Underweight	NCHS BAZ <-2	3.9	
						3285M	Overweight, Obese	IOTF	5.2, 1.9	
						3705F	Overweight, Obese	IOTF	25.1, 5.3	
National DHS	R/U	YBCWI	2003	1256	15–19	625M634F	Underweight	IOTF	29, 12.0	DoH, MRC, OrcMacro, 2007[18]
		81%B					Overweight	IOTF	8.2, 16.2	
							Obese	IOTF	0.4, 7.5	
National YRBS	R/U	Y NYRBS	2008	9442	13–19	4870M	Stunted	NHANES HAZ <-2	13.1; 15.3, 11.1	Reddy *et al.*, 2010[12]
		B 78.1%				4572F	Underweight	NHANESWAZ <-2	8.4; 12.0, 4.9	
		BCWI					Wasting	NHANES WHZ <-2	4.4; 6.7, 2.3	
							Overweight	IOTF	19.7; 11.2, 27.9	
							Obese	IOTF	5.3; 3.3, 7.2	
National YRBS	R/U	Y NYRBS	2011	9816	13–19	4614M	Stunted	NHANES HAZ <-2	12.9; 11.5, 14.4	Reddy *et al.*, 2013[20]
		BCWI				5202F	Underweight	NHANES WAZ <-2	7.0; 6.2, 8.0	
		B 81.4%					Wasting	NHANES WHZ <-2	3.5; 3.0, 4.0	
							Overweight	IOTF	23.1; 21.5, 24.9	
							Obese	IOTF	6.9; 5.8, 8.1	

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Province	Rural/ Urban	Represen-tative	Year	*n*	Age, years	Sex	Indicator	Cut-point reference	% All; (95% CI) M, F	Reference
National DHS	R/U	Y BCWI	2016	1043	15–19	499M	Stunted (girls)	Height < 145 cm	2.1	NDoH, StatsSA & ICF, 2019[10]
		87%B				544F	Underweight	BMI < 18.5 kg/m2	20.7, 6.7	
							Overweight	BMI 25–30 kg/m2	6.1, 15.8	
							Obese	BMI > 30 kg/m2	2.5, 11	

B, Black; BAZ, body mass index Z-score; Bto20, Birth to Twenty cohort; C, Coloured; CDC, Center for Disease Control; EC, Eastern Cape; F, female; FS, Free State; GP, Gauteng Province; HAZ, height for age Z-score; I, Indian; IOTF, International Obesity Task Force; KZN, KwaZulu-Natal; LAZ, length for age Z-score; LP, Limpopo Province; M, male; N, no; NC, Northern Cape; NCHS, National Center for Health Statistics; NFCS, National Food Consumption Survey; NFCS-FB, National Food Consumption Survey - Fortification Baseline; NHANES, National Nutrition and Health Survey (USA); NW, North West; R, rural; SADHS, South African Department of Health Survey; SANHANES, South African National Health and Nutrition Examination Survey; W, White; WA, weight for age; WAZ, weight for age Z-score; WC, Western Cape; WCi, waist circumference; WHZ, weight for height Z-score; U, urban; Y, yes; YRBS, Youth Risk Behaviour Survey.

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Table 4.3B: Percentage of Coloured adolescents, 13 to 18 years old with malnutrition: Underweight, stunting, wasting and overweight/obesity

Province	Rural/ Urban	Represen-tative	Year	*n*	Age, years	Sex	Indicator	Cut-point reference	% All; M, F	Reference
WC	U	N C	2000	83	15–18	83F	Underweight	NCHS <15th	6.0	Caradas *et al.*, 2001[73]
							Overweight, Obese	NCHS 85–95/ >95th	20.5, 4.8	
National YRBS	R/U	Y C	2002	1419	13–19	666 M 753 F	Underweight	NCHS WAZ <-2	15.5, 6.2	Reddy *et al.*, 2009[19]
		YRBS					Overweight	IOTF	8.5, 16.9	
							Obese	IOTF	3.8, 1.1	
WC	U	N CB74%C	2005	166	14–16	64 M 102 F	Overweight	IOTF	7.8, 26.5	Somers *et al.*, 2006[72]
							Obese	IOTF	3.1, 4.9	
National YRBS	R/U	Y C	2008	1428	13–19	670 M 758 F	Stunted	NHANES HAZ <-2	13.6; 15.2, 12.0	Reddy *et al.*, 2009[19]
		YRBS					Underweight	NHANES WAZ <-2	9.4; 13.3, 5.9	
							Wasted	NHANES WHZ <-2	6.6; 10.7, 2.9	
							Overweight	IOTF	17.5; 12.9, 21.6	
							Obese	IOTF	4.9; 2.9, 6.7	
National YRBS	R/U	Y C	2011	1009	13–19	670 M 758 F	Stunted	NHANES HAZ <-2	13.9; 10.5, 18.3	Reddy *et al.*, 2013[20]
		YRBS				476 M 533 F	Underweight	NHANES WAZ <-2	9.7; 7.1, 13.1	
							Wasted	NHANES WHZ <-2	6.6; 10.7, 2.9	
							Overweight	IOTF	21.3; 15.8, 28.0	
							Obese	IOTF	9.1; 5.3, 15.3	

C, Coloured; F, female; HAZ, height for age Z-score; IOTF, International Obesity Task Force; M, male; N, no; NC, Northern Cape; NCHS, National Center for Health Statistics; NHANES, National Nutrition and Health Survey (USA); R, rural; SANHANES, South African National Health and Nutrition Examination Survey; WA, weight for age; WAZ, weight for age Z-score; WC, Western Cape; WHZ, weight for height Z-score; U, urban; Y, yes; YRBS, Youth Risk Behaviour Survey.

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Table 4.3C: Percentage of Indian adolescents, 13 to 18 years old with malnutrition: Underweight, stunting, wasting and overweight/obesity

Province	Rural/ Urban	Represen-tative	Year	*n*	Age, years	Sex	Indicator	Cut-point reference	% All; M, F	Reference
National YRBS	R/U	Y I	2008	515	13–19	223M292F	Stunted	NHANES HAZ <-2	10.3; 7.6, 12.4	Reddy *et al.*, 2009[19]
							Underweight	NHANES WAZ <-2	11.5; 9.9, 12.7	
							Wasted	NHANES WHZ <-2	7.0; 9.0, 5.5	
							Overweight	IOTF	22.9; 23.4, 22.4	
							Obese	IOTF	7.2; 9.9, 5.2	
National YRBS	R/U	Y I	2011	509	13–19	237M272F	Stunted	NHANES HAZ <-2	8.8; 6.6, 11.8	Reddy *et al.*, 2013[20]
							Underweight	NHANES WAZ <-2	11.0; 7.5, 15.9	
							Wasted	NHANES WHZ <-2	8.8; 6.0, 12.8	
							Overweight	IOTF	20.6; 17.3, 24.4	
							Obese	IOTF	6.6; 4.0, 10.8	

F, female; HAZ, height for age Z-score; I, Indian; IOTF, International Obesity Task Force; M, male; N, no; R, rural; NHANES, National Health and Nutrition Examination Survey (USA); WAZ, weight for age Z-score; WHZ, weight for height Z-score; U, urban; Y, yes; YRBS, Youth Risk Behaviour Survey.

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Table 4.3D: Percentage of White adolescents, 13 to 19 years old with malnutrition: Underweight, stunting, wasting and overweight/obesity

Province	Rural/ Urban	Represen-tative	Year	*n*	Age, years	Sex	Indicator	Cut-point reference	% All; M, F	Reference
WC	U	N	2000	83	15–18	85 F	Underweight	NCHS <15th	7.1	Caradas *et al*., 2001[73]
							Overweight	NCHS >85th	11.8	
							Obese	NCHS >95th	1.2	
National YRBS	R/U	Y	2002	384M	13–19	384 M 431 F	Stunted	NCHS HAZ <-2	1.5	Reddy *et al*., 2009[19]
			2002	431F	13–19	384 M 431 F	Underweight	NCHS BAZ <-2	1.3	
			2002	384M	13–19	384 M 431 F	Overweight	IOTF	20.2, 4.8	
							Obese			
			2002	431F	13–19	384 M 431 F	Overweight	IOTF	26.0, 7.7	
							Obese			
National YRBS	R/U	Y W	2008	519	13–19	294 M 225 F	Stunted	NCHS HAZ <-2	4.6; 3.2, 6.4	Reddy *et al*., 2009[19]
							Underweight	NCHS BAZ <-2	4.5; 1.8, 7.8	
							Wasted	NCHS WHZ<-2	1.1; 0.4, 1.7	
							Overweight	IOTF	25.8; 24.8, 27.0	
							Obese	IOTF	9.7; 9.3, 10.3	
GP	U WBI 63.5% W	N 63.5% W, 14.5% B,22%I	2014	136	13–18	n/a	Underweight Overweight	WHO 07 BMI <5th WHO 07 BMI 85th –95th	3.7 13.2	McVeigh & Meiring, 2014[69]
							Obese	WHO 2007 BMI >95th	8.1	
National YRBS	R/U	Y W	2011	510	13–19	222M288F	Stunted	NCHS HAZ <-2	3.3; 1.5, 6.8	Reddy *et al*., 2013[20]
							Underweight	NCHS BAZ <-2	2.0; 0.6, 6.3	
							Wasted	NCHS WHZ<-2	1.5; 0.5, 4.6	
							Overweight	IOTF	30.4; 24.8, 36.6	
							Obese	IOTF	9.0; 5.9, 13.5	

BAZ, BMI for age Z-score; BMI, Body mass index; F, female; GP, Gauteng Province; HAZ, height for age Z-score; IOTF, International Obesity Task Force; M, male; N, no; NCHS, National Center for Health Statistics; R, rural; WC, Western Cape; WHZ, weight for height Z-score; U, urban; Y, yes; YRBS, Youth Risk Behaviour Survey.

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Table 4.3E: Summary of data of adolescents, 13 to 18 years old with malnutrition: Underweight, stunting, wasting and overweight/obesity

Age, years Group, Year	Province	Representa-tive Reference	*n*	Weight-for-age Underweight BAZ <-2		Height-for-age Stunted, HAZ <-2		Weight-for-height/BAZ Overweight, obese		Reference
				%	Mean (SD)	%	Mean (SD)*/ median (IQR)$	%	Mean±SD /95%CI/ median (IQR)	
15 RU B 1997	LP	N NCHS	50	18.0		30.0		-		MacIntyre *et al.*, 2006[65]
14–16 R B 2010	LP	N CDC	208	0.4		-		6.7, 3.8		Toriola *et al.*, 2012[164]
15–18 U BWC 2000	WC	N NCHS	228 F	4.8		-		19.7, 2.2		Caradas *et al.*, 2001[73]
14–16 U BC 2005	WC	N IOTF	166	-		-		19.3, 4.2		Somers *et al.*, 2006[72]
13–18 U WBCI 2014	WC	N IOTF	687	27.1		-		11.2, 4.8		Van Niekerk *et al.*, 2014[68]
15 R B 2013	KZN	Y IOTF Ob WHO2007	502	3.4		-	-0.66 (-1.31, 0.06)$	13.1, 5.8	-0.03 IQR -0.68, 0.73	Craig *et al.*, 2013[57]
16–20 RU BCWI 2016	KZN	Y CDC	564	9.6		23.2		15.9, 13.3		Bhimma *et al.*, 2018[66]
16–18 BtT B U 2007	GP	N WHO2007	1172	-		-		12.6, 5.3	M -0.6 (–0.7, –0.5), F 0.3 (0.2, 0.4)	Lundeen *et al.*, 2016[139]
13–18 U WBI 2014	GP	N WHO 2007	136	3.7		-		13.2, 8.1		McVeigh & Meiring, 2014[69]
15–20 B R 2007	MP Agincourt	N WHO 2007 IOTF	904	8		6		8.0, 4.0		Kimani *et al.*, 2010[60]
12–16 B U 2004	NW	N WHO 2007	313	-		16.3	M -1.23 ± 0.99, F -1.01 ± 0.93*	7.3, 1.3		Mamabolo *et al.*, 2007[67]
13–18 U B 2006	NW	N WHO 2007	316				-1.09 ±1.0			Kruger *et al.*, 2012[107]
13–15 U BWCI 2006	FS	N WHO 2007	414	3.4		6.8		16.2, 6.0		Meko *et al.*, 2015[70]
14–18 R B 2013	EC	N WHO 2007	98	2.1		8.2		15.3, 2.0		Oldewage-Theron *et al.*, 2014[71]
13–17 B U 2015	EC	N CDC	388	-		-		21.7, 20.6		Nkeh-Chungag *et al.*, 2015[74]
13–19 RU 2002 YRBS	National BWCI	Y NCHS IOTF	9224	9.0 (7.8, 10.2)		11.4 (10.1,12.7)		16.9, 4.0		Reddy *et al.*, 2009[19]
13–19 RU 2002 YRBS	National C	Y NCHS IOTF	1466	10.6		13.8		13.0, 3.3		
13-19 RU 2002 YRBS	National I	Y NCHS IOTF	118	4.8		6.9		25.3, 10.2		

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Table 4.3E Continued

Age, years Group, Year	Province	Representa-tive Reference	*n*	Weight-for-age Underweight BMIZ <-2		Height-for-age Stunted, HAZ <-2		Weight-for-height/BMIZ Overweight, obese BMIZ		Reference
				%	Mean (SD)	%	Mean (SD)*/ median (IQR)$^{\$}$	%	Mean±SD /95%CI/ median (IQR)	
13–19 RU 2002 YRBS	National W	Y NCHS IOTF	802	1.9		3.9		23.4, 6.4		
15–19 RU 2003	National 81%B	Y IOTF	1256	20.5	-0.49 ± 0.05	-	-1.16 ± 0.06	12.2, 4.0	0.34 ± 0.06	DoH, MRC, 2007[18]
13–19 RU 2008 YRBS	National BWCI	Y NCHS IOTF	9965	8.4		13.1		19.7, 5.3		Reddy *et al.*, 2009[19]
13–19 RU 2008 YRBS	National C	Y NCHS IOTF	1434	9.4		13.6		17.5, 4.9		
13–19 RU 2008 YRBS	National I	Y NCHS IOTF	515	11.5		10.3		22.9, 7.2		
13–19 RU 2008 YRBS	National W	Y NCHS IOTF	519	4.5		4.6		25.8, 9.7		
13–19 RU 2011 YRBS	National BWCI81.4%	Y NCHS IOTF	9816	7.0		12.9		23.1, 6.9		Reddy *et al.*, 2013[20]
13–19 RU 2011 YRBS	National C	Y NCHS	1434	9.7		13.9		21.3, 7.1		
13–19 RU 2011 YRBS	National I	Y NCHS IOTF	515	11.0		8.8		20.6, 7.3		
13–19 RU 2011 YRBS	National W	Y NCHS IOTF	519	2.0		3.3		30.4, 9.0		
15–19 RU 2016 DHS	National BWCI	Y SA WHO adult BMI	1043	13.6		2.1		11.0, 6.8		NDoH, StatsSA & ICF 2019[10]

B, Black; BMIZ, body mass index Z-score; C, Coloured; CDC, Center for Disease Control; EC, Eastern Cape; F, female; FS, Free State; GP, Gauteng Province; HAZ, height for age Z-score; I, Indian; IOTF, International Obesity Task Force; IQR, Inter quartile range; KZN, KwaZulu-Natal; LAZ, length for age Z-score; LP, Limpopo Province; M, male; N, no; NCHS, National Center for Health Statistics; NW, North West; R, rural; SADHS, South African Department of Health Survey; SANHANES, South African National Health and Nutrition Examination Survey; W, White; WAZ, weight for age Z-score ; WC, Western Cape; WHZ, weight for height Z-score; U, urban; Y, yes; YRBS, Youth Risk Behaviour Survey.

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Table 4.4: Vitamin A status of infants and children

Province	Represen-tative	Publication date (Data collection)	Age, years†	Sex	Ethnicity	Sample size, n	Retinol ug/dL) Mean ± SD Median (25th, 75th) Mean (95% CI)*	Vitamin A deficiency (%) Serum retinol <20 ug/dL	Reference
0 to 6 years old, rural and urban									
National SANHANES	Yes	2012	<5	221M, 217F	All	438	21.5 (20.1–22.6)*	43.6	Shisana *et al.*, 2013[11]
National NFCS-FB	Yes	2005	1–9	Both	All	1388	17.8 (17.2–18.4)* 18.4 (17.8–19.0)*[1]	63.6	Labadarios *et al.*, 2007[8]
0 to 6 years old, rural									
National NFCS-FB	Yes	2005	1–9	Both	All	600	17.4 (16.4–18.3)* 17.8 (16.8–18.9)*[2]	67.3	Labadarios *et al.*, 2007[8]
KZN	Yes	2015	<5	Both	NS	140	26.0 (25.0, 27.1)	13.6 6.6[5]	Faber *et al.*, 2015[78]
KZN	No	2005	6m–1	99M, 95F	NS	194	27.4 ± 7.8	16.1[6]	Smuts *et al.*, 2005[41]
KZN	No	2001	2–5	77M, 87F	NS	164	-	50.0	Faber *et al.*, 2001[46]
KZN	Yes	2000	6m–2	50M, 47F	Black	97	22.1 ± 6.5	39.2	Faber & Benadé, 2000[32]
LP	No	2017 (2009–2014)	2	Both	NS	314	20.2 ± 6.2	57.0	MAL-ED Network Investigators, 2017[75]
LP	Yes	2015	<5	Both	NS	206	28.8 (27.8, 29.8)	11.2 5.5[5]	Faber *et al.*, 2015[78]
0 to 6 years old, urban									
National NFCS-FB	Yes	2005	1–9	Both	All	688	18.1 (17.4–18.9)* 18.8 (18.0–19.6)*[3]	60.7	Labadarios *et al.*, 2007[8]
FS	No	2000 (1998)	<1–5	171M ,197F	NS	368	21.6 ± 6.2	18.8	Dannhauser *et al.*, 2000[100]
NC	No	2019	3–5	43M, 52F	NS	95	32.1 ± 9.5	6.7	Van Stuijvenberg *et al.*, 2019[141]
NC	Yes	2015	<5	Both	NS	194	29.7 (28.7, 30.8)	9.8 2.2[5]	Faber *et al.*, 2015[78]
NC	No	2012	1–6	119M, 124F	NS	243	31.3 (31.3, 32.3)	8.5	Van Stuijvenberg *et al.*, 2012[39]
WC	Yes	2015	<5	Both	NS	207	29.8 (28.8, 30.8)	8.2 3.1[5]	Faber *et al.*, 2015[78]
WC	No	2004	1–6m	51M, 62F	NS	113	26.9 ± 7.2	10.0	Sibeko *et al.*, 2004[43]
WC	No	2003	6m	NS	Black	46	30.5 ± 7.4 28.8 ± 6.6	-	Oelofse *et al.*, 2003[180]

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Table 4.4 Continued

Province	Representative	Publication date (Data collection)	Age, years†	Sex	Ethnicity	Sample size, n	Retinol ug/dL) Mean ± SD Median (25th, 75th) Mean (95% CI)*	Vitamin A deficiency (%) Serum retinol <20 ug/dL	Reference
Primary school, rural									
FS[7]	No	2018	7–15	35M, 38F	NS	73	35.1 ± 8.5	1.4	Egal *et al.*, 2018[53]
KZN	No	2001	6–11	NS	NS	108	22.1 ± 5.3	38.9	Van Stuijvenberg *et al.*, 2001[178]
NW	No	2016	6–12	87M, 80F	NS	167	-	4.8	Van der Hoeven *et al.*, 2016[88]
Primary school, urban									
NW	No	2013	6–11	213M, F195	NS	408	30.2 ± 6.4 30.0 ± 6.14 28.4 ± 5.3 30.0 ± 6.0	3.5	Taljaard *et al.*, 2013[87]

CRP, C-reactive protein; F, female; FS, Free State; GP, Gauteng Province; KZN, KwaZulu-Natal; LP, Limpopo Province; M, male; NC, Northern Cape; NFCS-FB, National Food Consumption Survey Fortification Baseline; NW, North West; NS, not specified; WC, Western Cape.
† Age of children reported in years, unless indicated differently in months (m).
[1] Only participants with CRP<10 mg/L were included, n=1020.
[2] Only participants with CRP<10 mg/L were included, n=436.
[3] Only participants with CRP<10 mg/L were included, n=584.
[4] Participants were divided randomly into four groups.
[5] Corrected for inflammation according to Kongsbak *et al.*, 2006.
[6] Only participants with CRP <12 mg/L were included.
[7] Ages up to 15 years included.

Table 4.5: Anaemia and iron status of infants and children

Province	Repre-senta-tive	Publi-cation date	Age, years†	Sex	Eth-nicity	Sample size, n	Hb (g/dL) Mean ± SD Mean (95% CI)* Median (25^{th}, 75^{th}) Median (IQR)#	Ferritin (ug/L) Mean ± SD Mean (95% CI)* Median (25^{th}, 75^{th}) Median (IQR)#	TfR (mg/L) Mean ± SD Median (IQR)#	Anaemia (%) (g/dL)	ID (%) (ug/L)	IDA (%)	Reference
										Hb<11 Hb<11.5* Hb<12#	SF<10[$] SF<12 SF<15* SF<20#		
National	Yes	2012	<5	249M, 262F	All	511	12.2 (12.0–12.3)	40.7 (33.9 - 47.6)*		10.7	8.1	1.9[10]	SANHANES, 2012[11]
National NFCS-FB	Yes	2005	1–9	Both	All	1730	11.8 (11.7 - 11.8)*	38.0 (35.9 - 40.1)* 37.3 (35.3 - 39.4)*[1] 33.4 (31.0 - 35.8)*[2]		27.9	19.7[2]	7.6[9]	Labadarios *et al.*, 2007[8]
0 to 6 years old, rural													
National NFCS-FB	Yes	2005	1–9	Both	All	706	11.8 (11.7 - 11.9)*	41.5 (37.8 - 45.1)* 40.4 (36.7 - 44.0)*[3] 36.2 (32.7 - 39.7)*[2]		24.6	16.2[2]	5.6[9]	Labadarios *et al.*, 2007[8]
KZN	No	2005	6m–1	99M, 95F	NS	194	11.3 ± 1.0	-		40.2	18.3[8]	-	Smuts *et al.*, 2005[41]
KZN	No	2001	2–5	77M, 87F	NS	164	10.6 ± 1.3	17.7 ± 14.2		54.0	33.0[$]	-	Faber *et al.*, 2001[46]
LP	No	2017 (2009–2014)	2	Both	NS	314	11.0 ± 1.1	31.2 ± 31.2		42.0	-	-	MAL-ED Network Investigators, 2017[75]
LP	Yes	2015	3–5	136M, 186F	NS	349	11.4 ± 1.1	25.0 ± 18		28.0	7.2	-	Motadi *et al.*, 2015[80]
LP	No	2014	1	Both	Black	127	10.7 ± 1.4	25.1 ± 25.1		52.0	39.4	-	Mamabolo & Alberts, 2014[95]
LP	No	2014	3	Both	Black	143	11.9 ± 1.2	20.8 ± 14.1		21.7	32.9	-	Mamabolo & Alberts, 2014[95]
0 to 6 years old, urban													
National NFCS-FB	Yes	2005	1–9	Both	All	1024	11.7 (11.6 - 11.8)*	35.4 (33.0 - 37.9)* 35.1 (32.7 - 37.4)*[4] 31.2 (27.9 - 34.5)*[2]		30.1	22.4[2]	8.9	Labadarios *et al.*, 2007[8]
FS	No	2000 (1998)	<1–5	171M, 197F	NS	368	-	-		50.5	18.1	-	Dannhauser *et al.*, 2000[100]
LP	No	2010	<5	32M, 20F	NS	52	9.7 ± 2.6	-		-	-	-	Heckman *et al.*, 2010[83]
NW[5]	No	2019	6–9mo	378M, 363F	NS	750	11.2 (10.5, 12.1) 11.5 (10.5, 12.3) 11.3 (10.5, 12.1)	24.9 (16.0, 40.6) 25.3 (16.4, 40.2) 25.4 (15.3, 39.8)		36.5	16.0	10.4[10]	Smuts *et al.*, 2019[81]
WC	No	2004	1–6m	51M,62F	NS	113	10.9 ± 1.1	-		50.0	-	-	Sibeko *et al.*, 2004[43]
WC	No	2003	6m	NS	Black	46	10.8 ± 1.0	-		-	-	-	Oelofse *et al.*, 2003[180]

Table 4.5 Continued

Province	Representative	Publication date	Age, years†	Sex	Ethnicity	Sample size, n	Hb (g/dL) Mean ± SD Mean (95% CI)* Median (25th, 75th) Median (IQR)#	Ferritin (ug/L) Mean ± SD Mean (95% CI)* Median (25th, 75th) Median (IQR)#	TfR (mg/L) Mean ± SD Median (IQR)#	Anaemia (%) (g/dL)	ID (%) (ug/L)	IDA (%)	Reference
										Hb<11 Hb<11.5* Hb<12#	SF<10$ SF<12 SF<15* SF<20#		
FS[7]	No	2018	7–15	35M, 38F	NS	73	13.2 ± 1.3	-		3.9*	-	-	Egal *et al.*, 2018[53]
KZN	No	2017	6–8	698M, 688F	NS	1386	-	-		48.3*	-		Ajayi *et al.*, 2017[58]
KZN	No	2015	6–8	109M, 72F	NS	181	-	-		56.9*	-	-	Gwetu *et al.*, 2015[82]
KZN	No	2013	6–11	Both	NS	926	-	-		11.5*	7.3	-	Taljaard *et al.*, 2013b[179]
KZN	No	2001	6–11	NS	NS	108	12.6 ± 0.81	28.6 (13.1, 58.5)		30.0#	28.7#	-	Van Stuijvenberg *et al.*, 2001[178]
NW	No	2016	6–12	87M, 80F	NS	167	-	-		13.2*	17.4*	1.8[11]	Van der Hoeven *et al.*, 2016[88]
Primary school, urban													
NC	No	2013	5–11	111M, 86F	NS	200[13]	-	-		5.4*	3.3	-	Taljaard *et al.*, 2013b[179]
NW	No	2013	6–11	265M, 301F	Black	566	12.6 (1.2)# M 12.8 (1.2)# F	24.7 (21.7) M 26.9 (28.3) F	5.8 (1.7)# M 5.7 (1.7)# F	6.8*	13.9	5.6[12]	Onabanjo *et al.*, 2012[142]

CRP, C-reactive protein; F, female; FS, Free State; Hb, haemoglobin; ID, iron deficiency; IDA, iron deficiency anaemia; IQR, inter quartile range; KZN, KwaZulu-Natal; LP, Limpopo Province; M, male; NFCS-FB, National Food Consumption Survey Fortification Baseline; NW, North West; NS, not specified; TfR, transferrin; WC, Western Cape.

† Age of children reported in years, unless indicated differently in months (m).

[1] Only participants with CRP <10 mg/L were included, n 1116.

[2] Only participants 1 to 5 years old were included.

[3] Only participants with CRP <10 mg/L were included, n 477.

[4] Only participants with CRP <10 mg/L were included, n 639.

[5] Participants were divided randomly into more than one group.

[7] Children up to age 15 years included.

[8] Ferritin of participants with CRP >5 was adjusted with 0.65 as correction factor.

[9] Hb < 11 g/dL (0- to 4-years old) or Hb <11.5 g/dL (5- to 11-years old) and Ferritin <12 ug/L.

[10] Hb < 11 g/dL and Fer <12 ug/L.

[11] Hb < 11.5 g/dL and Fer <15 ug/L.

[12] Hb < 11.5 g/dL and Fer <12 ug/L.

[13] Number of children after exclusion before starting with intervention.

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Table 4.6: Zinc and iodine status of infants and children

Province	Represen-tative	Publica-tion date	Age, years†	Sex	Ethnicity	Sample size, n	Zinc and iodine status		Reference
							Zinc (ug/dL) Mean ± SD Mean (95% CI)*	Zinc deficiency (%) <65ug/dL	
0 to 6 years old, rural and urban									
National NFCS-FB	Yes	2005	1–9	Both	All	1730	68.7 (66.5 - 70.8)*	45.3	Labadarios *et al.*, 2007[8]
0 to 6 years old, rural									
National NFCS-FB	Yes	2005	1–9	Both	All	706	69.3 (65.6 - 73.0)*	39.3	Labadarios *et al.*, 2007[8]
KZN	No	2005	6m–1	99M, 95F	NS	194	73.9 ± 15.0[1]	46.8	Smuts *et al.*, 2005[41]
LP	Yes	2015	3–5	136M, 186F	NS	349	66.3 ± 28.8	42.6	Motadi *et al.*, 2015[80]
National NFCS-FB	Yes	2005	1–9	Both	All		68.4 (65.7 - 71.0)*	47.8	Labadarios *et al.*, 2007[8]
WC	No	2003	6m	NS	Black	46	79.3 ± 12.1[2] 69.1 ± 15.8	-	Oelofse *et al.*, 2003[28]
Primary school, rural									
FS	No	2018	7–15	35M, 38F	NS	73	83.0 ± 1.24	25.0	Egal *et al.*, 2018[53]
NW	No	2016	6–12	87M, 80F	NS	167	-	75.5	Van der Hoeven *et al.*, 2016[88]
Primary school, urban									
NW	No	2013	6–11	213M, F195	NS	408	80.5 ± 13.8 80.4 ± 12.3[2] 77.7 ± 15.8 81.6 ± 12.9	12.1	Taljaard *et al.*, 2013[87]
							Urinary iodine (ug/L) Median (25^{th}, 75^{th})	Low urinary iodine (%) (<100 ug/L)	
0 to 6 years old, rural and urban									
National NFCS-FB	Yes	2005	1–9	Both	All	1730	214.8 (118.2, 367.4)	26.8	Labadarios *et al.*, 2007[8]
EC							204.2 (92.9, 361.3)	28.8	
FS							321.0 (180.5, 512.7)	10.8	
GP							192.6 (114.4, 304.1)	21.3	
KZN							263.0 (160.3, 430.4)	11.7	
MP							180.5 (110.4, 298.5)	20.3	
NC							777.7 (507.4, 836.6)	0.0	
LP							210.2 (127.7, 361.3)	15.8	
NW							161.2 (91.9, 309.5)	25.2	
WC							213.0 (126.7, 389.4)	17.7	

Table 4.6 Continued									
Province	**Represen-tative**	**Publica-tion date**	**Age, years†**	**Sex**	**Ethnicity**	**Sample size, n**	**Zinc and iodine status**		**Reference**
							Zinc (ug/dL) Mean ± SD Mean (95% CI)*	Zinc deficiency (%) <65ug/dL	
National NFCS-FB	Yes	2005	1–9	M F	All	706	197.5 (107.8, 349.0)	-	Labadarios *et al*., 2007[8]
0 to 6 years old, urban									
National NFCS-FB	Yes	2005	1–9	M F	All	1024	230.3 (131.4, 376.4)	-	Labadarios *et al*., 2007[8]
Primary school, rural									
KZN	No	2001	6–11	NS	NS	108	20.0 (8.0, 47.0)	97.1	Van Stuijvenberg *et al*., 2001[178]

EC, Eastern Cape; F, female; FS, Free State; GP, Gauteng Province; KZN, KwaZulu-Natal; LP, Limpopo Province; M, male; MP, Mpumalanga Province; NC, Northern Cape; NFCS-FB, National Food Consumption Survey Fortification Baseline; NS, not specified; NW, North West; WC, Western Cape.

† Age of children reported in years, unless indicated differently in months (m).

[1] Participants with CRP >12 mg/L were excluded.

[2] Participants were divided randomly into more than one group.

Table 4.7: Vitamin D, vitamin B and folate status of infants and children*

Province	Represen-tative	Publica-tion date	Age, group	Sex M F	Ethnicity	Sample size, (n)	25-OH Vit D (nmol/L) Mean ± SD		Vit D deficiency (%) (<50 nmol/L)	Vit D insufficiency (%) (50–74 nmol/L)	Reference
Primary school, urban											
GP	Yes	2015	11y	Both	B W	99	58.6 ± 5.8		5.0	35.0	Poopedi *et al.*, 2015[92]
GP	Yes	2015	13y	Both	B W	82	58.6 ± 7.7				Poopedi *et al.*, 2015[92]
GP	Yes	2015	15y	Both	B W	76	55.6 ± 7.7				Poopedi *et al.*, 2015[92]
GP	Yes	2015	17y	Both	B W	90	60.6 ± 7.7				Poopedi *et al.*, 2015[92]
GP	Yes	2010	10y	198 M, 187 F	B W	385	M: B 100 ± 34.4; W 129 ± 37.1 F: B 86 ± 31.1; W 112 ± 34.8				Poopedi *et al.*, 2015[92]
Province	**Represen-tative**	**Publica-tion date**	**Age, group**	**Sex M F**	**Ethnicity**	**Sample size, (n)**	**RBC and serum folate (nmol/L) Mean (95 % CI)**	**Folate deficiency (%) (< 5 ng/mL)**	**Vit B12 (pg/mL)**	**Vit B12 deficiency (%) (<145 pg/mL)**	**Reference**
0 to 6 years old, rural and urban											
National NFCS-FB	Yes	2005	1-9y	Both	All	1502	1397 (1338 – 1456)[1] 39.1 (38.0 – 40.1)[2]	0.2[1]	-	-	Labadarios et al., 2007[8]
0 to 6 years old, rural											
National NFCS-FB	Yes	2005	1-9y	Both	All	576	1263 (1199 – 1327)[1] 38.8 (37.0 – 40.5)[2]	0.4[1]	-	-	Labadarios et al., 2007[8]
Limpopo	No	2014	1y	Both	B	127	8.1 ± 4.0[2]	22.8[2]	362.4 ± 219.4	10.2	Mamabolo & Alberts 2014[95]
Limpopo	No	2014	3y	Both	Black	143	6.7 ± 2.1[2]	19.6[1]	448.7 ± 206.4	0.0	Mamabolo & Alberts 2014[95]
0 to 6 years old, urban											
National NFCS-FB	Yes	2005	1-9y	Both	All	926	1481 (1393 – 1569)[1] 39.3 (38.0 – 40.5)[2]	0.1[1]	-	-	Labadarios et al., 2007[8]

B, Black; F Female; FS, Free State; GP, Gauteng Province; KZN, KwaZulu-Natal; LP, Limpopo Province; M, Male; MP, Mpumalanga Province; NC, Northern Cape; NFCS-FB, National Food Consumption Survey Fortification Baseline; NS, not specified; NW, North-West; W, White; WC, Western Cape * The same children longitudinally assessed [1] Red blood cell ; [2] Serum

Table 4.8: Inflammatory status of infants and children*

Province	Represen-tative	Publica-tion date	Age, years†	Sex M F	Ethnicity	Sample size, *n*	CRP (mg/L) Mean (95% CI)* Median# Median (IQR)$	CRP>3mg/L (%)$ CRP>5mg/L (%) CRP>10mg/L (%)* CRP>12mg/L (%)#	AGP>1g/L (%)	Reference
0 to 6 years old, rural and urban										
National	Yes	2005	1–9	Both	All	1422	3.2 (2.7–3.7)*	6.9*	-	Labadarios *et al.*, 2007[8]
0 to 6 years old, rural										
National	Yes	2005	1–9	Both	All	597	3.5 (2.8–4.2)*	7.7*	-	Labadarios *et al.*, 2007[8]
KZN	Yes	2015	<5	Both	NS	140	-	15.4	18.4	Faber *et al.*, 2015[78]
KZN	No	2005	6m–1	99M, 95F	NS	194	-	12.4#	41.8	Smuts *et al.*, 2005[41]
LP	Yes	2015	<5	Both	NS	206	-	16.1	17.6	Faber *et al.*, 2015[78]
0 to 6 years old, urban										
National	Yes	2005	1–9	Both	All	825	3.0 (2.3–3.7)*	6.3*	-	Labadarios *et al.*, 2007[8]
NC	Yes	2015	<5	Both	NS	194		16.4	10.4	Faber *et al.*, 2015[78]
NC	No	2012	1–6	119M, 124F	NS	243	-	6.4*	-	Van Stuijvenberg *et al.*, 2012[39]
NW	No	2019	6–9m	378M, 363F	NS	750	-	15.2	31.5	Smuts *et al.*, 2019[81]
WC	Yes	2015	<5	Both	NS	207		21.1	11.9	Faber *et al.*, 2015[78]
Primary school, rural										
EC[1]	No	2017	6–18	116M, 118F	NS	234	2.3#	19.0$	-	Oldewage-Theron & Kruger, 2017[104]
NW	No	2016	6–12	87M, 80F	NS	167	-	4.8	-	Van der Hoeven *et al.*, 2016[88]
Primary school, urban										
NW	No	2013	6–11	213M, 195F	NS	408	-	26.1	-	Taljaard *et al.*, 2013[87]
NW	No	2013	6–11	265M, 301F	African	566	3.70 (3.10) M$ 3.30 (2.70) F$	-	-	Onabanjo *et al.*, 2012[142]

CRP, C-reactive protein; IQR, inter quartile range; KZN, KwaZulu-Natal, LP, Limpopo Province; M, male; NC, Northern Cape; NW, North West; NS, not specified; NW, North West; W, white; WC, Western Cape.
† Age of children reported in years, unless indicated differently in months (m).
[1] Children up to 18 years included.

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Table 4.9: Energy intake for infants, children and adolescents

Province	Year	Age, years†	Ethnicity	*n*	Dietary assessment method	Energy intake, kJ[1]		Reference
						Mean ± SD Median (25th, 75th) Median[a] Mean (95% CI)*	Adequacy of intake[2]	
0 to 6 years old, rural and urban								
National	1999	1–3	All	1308 1249	24-hour recall QFFQ	3887 (2839, 5263) 5282 (3585, 7185)	45% <67% RDA[3] 26% <67% RDA[3]	Labadarios *et al.*, 2000[109]
National	1999	4–6	All	1083 1044	24-hour recall QFFQ	4988 (3545, 6508) 6529 (4676, 8870)	47% <67% RDA[3] 27% <67% RDA[3]	Labadarios *et al.*, 2000[109]
0 to 6 years old, rural								
National	1999	1–3	All	644 603	24-hour recall QFFQ	3678 (2743, 4832) 4898 (3316, 6728)	49% <67% RDA[3] 39% <67% RDA[3]	Labadarios *et al.*, 2000[109]
National	1999	4–6	All	570 547	24-hour recall QFFQ	4695 (3269, 6075) 6098 (4254, 8668)	53% <67% RDA[3] 32% <67% RDA[3]	Labadarios *et al.*, 2000[109]
KZN	2002	6–12m	Black	475	24-hour recall	3470 (3031, 4013)		Faber, 2005[97]
KZN	2000	4–24m	Black	50	24-hour recall	3691 (3267, 4431)	Median = 93% RDA[3]	Faber & Benadé, 2001[45]
KZN	1999	2–5		154	24-hour recall	5085 (3988, 6149)	Median = 81% RDA[3]	Faber *et al.*, 2001[46]
KZN	2011	1.5–6	Black	105	24-hour recall	4233 (3506, 5299)		Faber *et al.*, 2015[78]
LP	2000/01	1		156	QFFQ	4653 ± 2285		Mamabolo *et al.*, 2006[34]
LP	2002/03	3		162	24-hour recall QFFQ	3303 ± 1455 5779 ± 2570		Mamabolo *et al.*, 2006[34]
LP	2011	1.5–6	Black	166	24-hour recall	3869 (3204, 4758)		Faber *et al.*, 2015[78]
0 to 6 years old, urban								
National	1999	1–3	All	664 631	24-hour recall QFFQ	4209 (2933, 5571) 5878 (4078, 7555)	41% <67% RDA[3] 21% <67% RDA[3]	Labadarios *et al.*, 2000[109]
National	1999	4–6	All	513 490	24-hour recall QFFQ	5331 (3878, 6870) 6914 (5285, 9271)	41% <67% RDA[3] 20% <67% RDA[3]	Labadarios *et al.*, 2000[109]
FS	~1998	2–3.9		63	24-hour recall	3424 ± 1490 3245[a]		Dannhauser *et al.*, 2000[100]
FS	~1998	2–3.9		68	24-hour recall	4274 ± 1652 3994[a]		Dannhauser *et al.*, 2000[100]
FS	~1998	4–5.9		46	24-hour recall	3780 ± 1612 3534[a]		Dannhauser *et al.*, 2000[100]
FS	~1998	4–5.9		54	24-hour recall	4383 ± 1561 4183[a]		Dannhauser *et al.*, 2000[100]
NC	2011	1.5–6	Coloured	160	24-hour recall	4315 (3430, 5656)		Faber *et al.*, 2015[78]
NC	2010–11	2–5		149	24-hour recall	4533 (3575, 5721) 4713 (4498–4929)*	Median = 79.5% EER[4] Mean = 85.1% EER[4]	Van Stuijvenberg *et al.*, 2015[101]
NW	2013–15	6m[5]	Black	715	24-hour recall	2857 (2419, 3367)		Swanepoel *et al.*, 2019[98]
NW	2013-15	12m[5]	Black	446	24-hour recall	3779 (3079, 4498)		Swanepoel *et al.*, 2019[98]

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Table 4.9 Continued

Province	Year	Age, years†	Ethnicity	*n*	Dietary assessment method	Energy intake, kJ[1]		Reference
						Mean ± SD Median (25th, 75th) Median[a] Mean (95% CI)*	Adequacy of intake[2]	
0 to 6 years old, urban								
NW	2013–15	18m[5]	Black	213	24-hour recall	4402 (3551, 5463)		Swanepoel *et al.*, 2019[98]
WC	1998	6–12m	Coloured	48	3x 24-hour recall	3900 ± 900	2% <67% RDA[3]	Oelofse *et al.*, 2002[28]
WC	1998	6–12m	Black	62	3x 24-hour recall	3200 ± 800	13.4% <67% RDA[3]	Oelofse *et al.*, 2002[28]
WC	2011	1.5–6	Coloured	181	24-hour recall	4920 (4075, 6151)		Faber *et al.*, 2015[78]
Primary school age children, rural and urban								
National	1999	7–9	All	477 476	24-hour recall QFFQ	5614 (4066, 7183) 7257 (5025, 10213)	50.5% <67% RDA[3] 32% <67% RDA[3]	Labadarios *et al.*, 2000[109]
Primary school age children, rural								
National	1999	7–9	All	238 232	24-hour recall QFFQ	5100 (3766, 6912) 6426 (4250, 9257)	56% <67% RDA[3] 40% <67% RDA[3]	Labadarios *et al.*, 2000[109]
EC	~2013[6]	6–8		55	2x 24-hour recall	6149 (4476, 7614)		Oldewage-Theron & Kruger, 2017[104]
EC	~2013[6]	9–13		82	2x 24-hour recall	7172 (6083, 8599)		Oldewage-Theron & Kruger, 2017[104]
FS		9–13		142	3x 24-hour recall	4309 ± 1410		Oldewage-Theron & Egal, 2010[105]
KZN	2009	6–11	Black	102	3x 24-hour recall	6940 (5776, 7988)		Visser *et al.*, 2019[106]
LP		10		25	4x 24-hour recall	9302 ± 2014		MacIntyre & du Plessis, 2006[65]
NW	2012	6–12		100	3x 24-hour recall	5753 (4548, 7066)		Visser *et al.*, 2019[106]
Primary school age children, urban								
National	1999	7–9	All	239 239	24-hour recall QFFQ	5840 (4414, 7482) 8324 (5786, 11273)	45% <67% RDA[3] 25% <67% RDA[3]	Labadarios *et al.*, 2000[109]
GP		5–9		216[7]	24-hour recall	5006 ± (1850)	85.2% <WHO ref[8]	Shiau *et al.*, 2017[63]
GP	1997	7[9]	Black	163	QFFQ	7915 (7706–8125)*		MacKeown *et al.*, 2003[108]
GP	1999	9[9]	Black	163	QFFQ	7882 (7534–8225)*		MacKeown *et al.*, 2003[108]
GP	2000	10[9]	Black	163	QFFQ	7333 (7053–7610)*		MacKeown *et al.*, 2003[108]
GP		7–11		149	2x 24-hour recall	5121 ± 2399	M 66% EER[4] F 72% EER[4]	Samuel *et al.*, 2010[102]
GP		9–13		149	QFFQ	5990 ± 391		Oldewage-Theron *et al.*, 2006[50]
LP		10		25	4x 24-hour recall	9333 ± 2016		MacIntyre & Du Plessis, 2006[65]
NW	2009	6–11		376	3x 24-hour recall	6455 (5175, 7577)		Visser *et al.*, 2019[106]
Adolescents, rural and urban								
NW		10–15	All	604M 642F	24-hour recall 24-hour recall	8013 ± 3022 7397 ± 2763		Kruger *et al.*, 2006[99]

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Table 4.9 Continued

Province	Year	Age, years†	Ethnicity	*n*	Dietary assessment method	Energy intake, kJ[1]		Reference
						Mean ± SD Median (25th, 75th) Median[a] Mean (95% CI)*	Adequacy of intake[2]	
Adolescents, rural								
EC	~2013[6]	14–18		97	2x 24-hour recall	7141 (5700, 9370)		Oldewage-Theron & Kruger, 2017[104]
LP		15		25	2x 24-hour recall	9508 ± 1710		MacIntyre & du Plessis, 2006[65]
Adolescents, urban								
GP	2003	13[9]	Black	143	QFFQ	8903 (8346–9460)*		MacKeown *et al.*, 2007[116]
KZN		14–18		61F	2x 24-hour recall	7503 ± 1985[10]	75.4% EER[4]	Napier & Hlambelo, 2014[103]
LP		15		25	4x 24-hour recall	10030 ± 1980		MacIntyre & Du Plessis, 2006[65]
NW	2004	14.8 ± 1.4	Black	250[11]	24-hour recall	8461 ± 3520		Kruger *et al.*, 2012[107]
NW	2004	13.8 ± 1.0	Black	66[12]	24-hour recall	8568 ± 2641		Kruger *et al.*, 2012[107]

EC, Eastern Cape; EER, Estimated Energy Requirements (DRIs); F, female; FS, Free State; GP, Gauteng Province; KZN, KwaZulu-Natal; LP, Limpopo Province; M, male; NC, Northern Cape; NW, North West; QFFQ, Quantified Food Frequency Questionnaire; RDA, Recommended Dietary Allowance; WC, Western Cape.

† Age of children reported in years, unless indicated differently in months (m).

1 Energy intake values as reported in the papers. Energy intake reported as kcal were converted to kJ (multiply by 4.186). Decimals were dropped.

2 Percentage individuals with a kJ intake below 67%RDA, or intake as %EER.

3 Food and Nutrition Board. Recommended Dietary Allowances, 10th edn, 1989.

4 Institute of Medicine (2006) Dietary Reference Intakes: The Essential Guide to Nutrient Requirements. Washington, DC: The National Academies Press.

5 Cohort, 6 to 18 months old.

6 Date based on ethical clearance certificate.

7 HIV-uninfected group.

8 WHO recommendation 1650 kcal for 6- to 9-year-old children.

9 Birth-to-Twenty cohort.

10 Lunchbox contributed 40.2% of total energy intake.

11 Intervention group (physical activity intervention).

12 Control group (physical activity intervention).

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Table 4.10: Protein intake for infants, children, and adolescents

Province	Year	Age, years†	Ethnicity	*n*	Dietary assessment method	Protein intake (g) Mean ± SD Median (25th, 75th) Median[a] Mean (95% CI)*	Protein intake (g) Adequacy of intake[1]	Reference
0 to 6 years old, rural and urban								
National	1999	1–3	All	1308 1249	24-hour recall QFFQ	28 (18.3, 40.5) 37 (25, 51)	8.5% <67% RDA[2] 3% <67% RDA[2]	Labadarios *et al*., 2000[109]
National	1999	4–6	All	1083 1044	24-hour recall QFFQ	35.5 (23.4, 51) 47 (31, 65)	10% <67% RDA[2] 4.5% <67% RDA[2]	Labadarios *et al*., 2000[109]
0 to 6 years old, rural								
National	1999	1–3	All	644 603	24-hour recall QFFQ	25.5 (17, 36) 33 (22, 46)	8% <67% RDA[2] 3% <67% RDA[2]	Labadarios *et al*., 2000[109]
National	1999	4–6	All	570 547	24-hour recall QFFQ	32 (21, 46) 42 (28, 60)	13.5% <67% RDA[2] 6% <67% RDA[2]	Labadarios *et al*., 2000[109]
KZN	2002	6–12m	Black	475	24-hour recall	17 (13, 23)		Faber, 2005[97]
KZN	2000	4–24m	Black	50	24-hour recall	19 (16, 25)	Median = 132% RDA[2]	Faber & Benadé, 2001[45]
LP	2000/01	1		156	QFFQ	35.96 ± 20.09	0% <67% RDA[3]	Mamabolo *et al*., 2006[34]
LP	2002/03	3		162	24-hour recall QFFQ	26.27 ± 10.65 43.04 ± 16.18	0% <67% RDA[3] 0% <67% RDA[3]	Mamabolo *et al*., 2006[34]
0 to 6 years old, urban								
National	1999	1–3	All	664 631	24-hour recall QFFQ	30 (20, 44) 44 (55, 46)	8.5% <67% RDA[2] 3% <67% RDA[2]	Labadarios *et al*., 2000[109]
National	1999	4–6	All	513 490	24-hour recall QFFQ	41 (27, 57) 51 (36, 70)	6.5% <67% RDA[2] 3% <67% RDA[2]	Labadarios *et al*., 2000[109]
FS	~1998	2–3.9		63	24-hour recall	29.6 ± 14.6 26.5[a]		Dannhauser *et al*., 2000[100]
FS	~1998	2–3.9		68	24-hour recall	34.1 ± 15.4 31.8[a]		Dannhauser *et al*., 2000[100]
FS	~1998	4–5.9		46	24-hour recall	31.7 ± 16.1 31.4[a]		Dannhauser *et al*., 2000[100]
FS	~1998	4–5.9		54	24-hour recall	33.9 ± 15.4 31.1[a]		Dannhauser *et al*., 2000[100]
NC	2010–11	2–5		149	24-hour recall	40.5 (28.9, 52.7) 42.9 (40–46)*		Van Stuijvenberg *et al*., 2015[101]
NW	2013–15	6m[4]	Black	715	24-hour recall	12.5 (9.7, 16.8)		Swanepoel *et al*., 2019[98]
NW	2013–15	12m[4]	Black	446	24-hour recall	21.9 (15.1, 28.6)	3.6% <0.87 g/kg	Swanepoel *et al*., 2019[98]
NW	2013–15	18m[4]	Black	213	24-hour recall	29.0 (21.0, 38.5)	2.8% <0.87 g/kg	Swanepoel *et al*., 2019[98]
WC	1998	6–12m	Coloured	48	3x 24-hour recall	32 ± 13	4% <67% RDA[2]	Oelofse *et al*., 2002[28]
WC	1998	6–12m	Black	62	3x 24-hour recall	19 ± 7	21% <67% RDA[2]	Oelofse *et al*., 2002[28]

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Table 4.10 Continued

Province	Year	Age, years†	Ethnicity	*n*	Dietary assessment method	Protein intake (g)		Reference
						Mean ± SD Median (25th, 75th) Median[a] Mean (95% CI)*	Adequacy of intake[1]	
Primary school age children, rural and urban								
National	1999	7–9	All	477 476	24-hour recall QFFQ	39 (27, 56.4) 53 (35, 74)	7.5% <67% RDA[2] 5% <67% RDA[2]	Labadarios *et al.*, 2000[109]
Primary school age children, rural								
National	1999	7–9	All	238 232	24-hour recall QFFQ	35 (23, 52) 44 (30, 66)	15.5 % <67% RDA[2] 5% <67% RDA[2]	Labadarios *et al.*, 2000[109]
FS		9–13		142	3x 24-hour recall	37 ± 13	53.6% <EAR[5]	Oldewage-Theron & Egal, 2010[105]
KZN	2009	6–11	Black	102	3x 24-hour recall	42.1 (30.6, 52.9)	27.4% <EAR[5]	Visser *et al.*, 2019[106]
LP		10		25	4x 24-hour recall	69 ± 17		MacIntyre & Du Plessis, 2006[65]
NW	2012	6–12		100	3x 24-hour recall	49 (37.6, 67.4)	5% <EAR[5]	Visser *et al.*, 2019[106]
Primary school age children, urban								
National	1999	7–9	All	239 239	24-hour recall QFFQ	43.5 (31, 61) 58 (42, 81)	7.5% <67% RDA[2] 5% <67% RDA[2]	Labadarios *et al.*, 2000[109]
GP	1997	7[6]	Black	163	QFFQ	57 (53.9–60.3)*		MacKeown *et al.*, 2003[108]
GP	1999	9[6]	Black	163	QFFQ	59 (56.5–61.5)*		MacKeown *et al.*, 2003[108]
GP	2000	10[6]	Black	163	QFFQ	55 (53.2–57.6)*		MacKeown *et al.*, 2003[108]
GP		7–11		149	2x 24-hour recall	37.8 ± 19		Samuel *et al.*, 2010[102]
GP		9–13		149	QFFQ	39.6 ± 20.4		Oldewage-Theron *et al.*, 2006[50]
LP		10		25	4x 24-hour recall	73 ± 16		MacIntyre & Du Plessis, 2006[65]
NW	2009	6–11		376	3x 24-hour recall	47.5 (39.2, 58.2)	3.3% <EAR[5]	Visser *et al.*, 2019[106]
Adolescents, rural								
LP		15		25	4x 24-hour recall	67 ± 16		MacIntyre & Du Plessis, 2006[65]
Adolescents, urban								
GP	2003	13[6]		143	QFFQ	59 (55.21–62.79)*		MacKeown *et al.*, 2007[116]
KZN		14–18		61F	2x 24-hour recall	61.86 ± 22.30		Napier & Hlambelo, 2014[103]
LP		15		25	4x 24-hour recall	74 ± 14		MacIntyre & Du Plessis, 2006[65]
NW	2004	14.8 ± 1.4		250[7]	24-hour recall	63.5 ± 27.2		Kruger *et al.*, 2012[107]
NW	2004	13.8 ± 1.0		66[8]	24-hour recall	63.6 ± 19.4		Kruger *et al.*, 2012[107]

EAR, Estimated Average Requirement; F, female; FS, Free State; GP, Gauteng Province; KZN, KwaZulu-Natal; LP, Limpopo Province; NC, Northern Cape; NW, North West; QFFQ, Quantified Food Frequency Questionnaire; RDA, Recommended Dietary Allowance; WC, Western Cape.
† Age of children reported in years, unless indicated differently in months (m).
[1] Percentage individuals with a protein intake below the reference, unless indicated differently.
[2] Food and Nutrition Board. Recommended Dietary Allowances, 10th edn, 1989.
[3] Nutrition Information Centre, University of Stellenbosch (NICUS). The Dietary Reference Intakes. Tygerberg: University of Stellenbosch, 2003.
[4] Cohort, 6 to 18 months old.
[5] Institute of Medicine (2006) Dietary Reference Intakes: The Essential Guide to Nutrient Requirements. Washington, DC: The National Academies Press.
[6] Birth-to-Twenty cohort.
[7] Intervention group (physical activity intervention).
[8] Control group (physical activity intervention).

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Table 4.11: Animal and plant protein intake for infants, children and adolescents

Province	Year	Age, years†	Ethnicity	*n*	Animal protein (g) Mean ± SD Median (25th, 75th) Median[a]	Plant protein (g) Mean ± SD Median (25th, 75th) Median[a]	Reference
0 to 6 years old, rural and urban							
National	1999	1–9	All	1308	6 ± 5.5 %TE	7 ± 2.5 %TE	Labadarios *et al.*, 2000[109]
0 to 6 years old, rural							
National	1999	1–9	All	644	5 ± 5.5 %TE	8 ± 2.5 %TE	Labadarios *et al.*, 2000[109]
KZN	2000	4–24m	Black	50	3 (2, 4) %TE	5 (4, 7) %TE	Faber & Benadé, 2001[45]
KZN	1999	2–5	Black	154	0 (0, 3)	9 (7, 11)	Faber *et al.*, 2001[46]
LP	2000/01	1		156	12.47 ± 9.26	23.43 ± 11.09	Mamabolo *et al.*, 2006[34]
LP	2002/03	3		162	9.78 ± 9.09	15.16 ± 6.57	Mamabolo *et al.*, 2006[34]
0 to 6 years old, urban							
National	1999	1–9	All	664	7 ± 5 %TE	6.5 ± 2.5 %TE	Labadarios *et al.*, 2000[109]
FS	~1998	2–3.9		63	16.0 ± 12.3 11.9[a]	13.9 ± 8.2 11.9[a]	Dannhauser *et al.*, 2000[100]
FS	~1998	2–3.9		68	17.3 ± 12.6 16.5[a]	16.8 ± 8.2 15.7[a]	Dannhauser *et al.*, 2000[100]
FS	~1998	4–5.9		46	16.7 ± 12.8 16.4[a]	15.0 ± 8.1 14.1[a]	Dannhauser *et al.*, 2000[100]
FS	~1998	4–5.9		54	15.9 ± 12.4 13.0[a]	18.0 ± 7.0 17.3[a]	Dannhauser *et al.*, 2000[100]
Primary school age children, rural							
FS		9–13		142	15 ± 11	22 ± 8	Oldewage-Theron & Egal, 2010[105]
KZN	2009	6–11	Black	102	12.3 (5, 23.5)	24.9 (21.4, 31.1)	Visser *et al.*, 2019[106]
LP		10		25	17.4 ± 9.0	51.9 ± 12.3	MacIntyre & Du Plessis, 2006[65]
NW	2012	6–12		100	23.3 (13.4, 35.3)	25 (19, 30.9)	Visser *et al.*, 2019[106]
Primary school age children, urban							
GP		5–9		216[1]	50.5 ± 20.6 %TP	46.8 ± 19.2 %TP	Shiau *et al.*, 2017[63]
NW	2009	6–11		376	18.4 (12.3, 35.3)	27.9 (23.1, 33.4)	Visser *et al.*, 2019[106]
GP		7–11		149	15.4 ± 13	22.4 ± 11	Samuel *et al.*, 2010[102]
LP		10		25	25.1± 9.8	48.1 ± 10.1	MacIntyre & Du Plessis, 2006[65]
Adolescents, rural							
LP		15		25	15.0 ± 11.2	52.5 ± 52.5	MacIntyre & Du Plessis, 2006[65]
Adolescents, urban							
LP		15		25	19.7± 8.1	53.8 ± 10.7	MacIntyre & Du Plessis, 2006[65]

FS, Free State; GP, Gauteng Province; KZN, KwaZulu-Natal; LP, Limpopo Province; NC; NW, North West; TE, total energy; TP, total protein.
† Age of children reported in years, unless indicated differently in months (m).
[1] HIV-uninfected group.

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Table 4.12: Macronutrient distribution, expressed as a percentage of total energy (%TE), for infants, children and adolescents

Province	Year	Age, years†	Ethnicity	*n*	% TE Protein Mean ± SD Median (25th, 75th) Median[a]	% TE Fat Mean ± SD Mean[b] Median (25th, 75th) Median[a]	% TE Carbohydrate Mean ± SD Median (25th, 75th) Median[a]	Reference
Infants and 1 to 3 years old, rural								
KZN	2000	4–24m	Black	50	8 (7, 10)	37 (26, 43)	57 (52, 67)	Faber & Benadé, 2001[45]
LP	2000–01	1		156	12.94 ± 2.61	**21.77** ± 6.79[1]	65.06 ± 7.91	Mamabolo *et al*., 2006[34]
LP	2002–03	3		162	12.18 ± 1.67	**22.07** ± 5.68[1]	**65.74** ± 5.98[1]	Mamabolo *et al*., 2006[34]
Infants and 1 to 3 years old, urban								
NW	2013–15	6m[2]	Black	715	7.4 (6.2, 8.9)	42.4 (37.2, 47.4)	49.5 (45.7, 54.4)	Swanepoel *et al*., 2019[98]
NW	2013–15	12m[2]	Black	446	9.6 (7.8, 11.9)	35.2 (28.0, 40.1)	53.5 (48.1, 59.3)	Swanepoel *et al*., 2019[98]
NW	2013–15	18m[2]	Black	213	11.7 (9.0, 13.2)	**28.6** (21.0, 34.0)[1]	57.4 (52.4, 63.4)	Swanepoel *et al*., 2019[98]
WC	1998	6–12m	Coloured	48	14 ± 4	38 ± 6	48 ± 6	Oelofse *et al*., 2002[28]
WC	1998	6–12m	Black	62	10 ± 3	38 ± 8	53 ± 8	Oelofse *et al*., 2002[28]
4 to 18 years old, rural and urban								
National	1999	1–9	All	2868	13 ± 4.5	**22.5** ± 11[1]	**71** ± 14[3]	Labadarios *et al*., 2000[109]
4 to 18 years old, rural								
National	1999	1–9	All	1452	13 ± 5	**19.5** ±10.5[1]	**74** ±14[3]	Labadarios *et al*., 2000[109]
EC	~2013[4]	6–8		55		25.8[b]		Oldewage-Theron & Kruger, 2017[104]
EC	~2013[4]	9–13		82		25.3[b]		Oldewage-Theron & Kruger, 2017[104]
EC	~2013[4]	14–18		97		26.5[b]		Oldewage-Theron & Kruger, 2017[104]
KZN	1999	2–5	Black	154	11 (9, 12)	27 (20, 34)	**67** (62, 74)[3]	Faber *et al*., 2001[46]
KZN	2011	1.5–6	Black	105	10.6 (8.6, 13.4)	**23.1** (18.1, 28.7)[1]	63.1 (56.7, 67.6)	Faber *et al*., 2015[78]
KZN	2009	6–11	Black	102	10.3	**23**[1]	**66.7**[3]	Visser *et al*., 2109[106]
LP	2011	1.5–6	Black	166	13.0 (11.4, 14.9)	**19.7** (14.8, 24.9)[1]	**66.4** (61.7, 73.0)[3]	Faber *et al*., 2015[78]
LP		10		25	12 ± 1.2	**16** ± 5.1[1]	**76** ± 6.5[3]	MacIntyre & Du Plessis, 2006[65]
LP		15		25	12 ± 1.6	**16** ± 4.4[1]	**73** ± 5.6[3]	MacIntyre & Du Plessis, 2006[65]
NW	2012	6–12		100	14.5	**21.9**[1]	63.6	Visser *et al*., 2019[106]
4 to 18 years old, urban								
National	1999	1–9	All	1416	13.5 ± 4	25 ± 10.5	**66.5** ± 13.5[3]	Labadarios *et al*., 2000[109]
GP		5–9		216[5]	13.5 ± 4.0	31.8 ± 11.4	50.6 ± 10.7	Shiau *et al*., 2017[63]
KZN		14–18		61F	14.0[a]	29.0[a]	56.9[a]	Napier & Hlambelo, 2014[103]
LP		10		25	13 ± 1.1	**22** ± 4.1[1]	**66** ± 4.5[3]	MacIntyre & Du Plessis, 2006[65]
LP		15		25	12 ± 1.2	**20** ± 4.1[1]	**69** ± 4.4[3]	MacIntyre & Du Plessis, 2006[65]
NC	2011	1.5–6	Coloured	160	13.7 (11.2, 16.6)	32.6 (27.0, 39.0)	52.2 (43.9, 58.0)	Faber *et al*., 2015[78]
NW	2009	6–11		376	12.5	**22.1**[1]	**65.4**[3]	Visser *et al*., 2019[106]
WC	2011	1.5–6	Coloured	181	13.2 (11.2, 16.7)	32.7 (26.7, 36.7)	51.3 (45.1, 56.3)	Faber *et al*., 2015[78]

EC, Eastern Cape; F, Female; GP, Gauteng Province; KZN, KwaZulu-Natal; LP, Limpopo Province; NC, Northern Cape; NW, North West; TE, total energy; WC, Western Cape.
Acceptable Macronutrient Distribution Range (AMDR) expressed as percentage of TE:
Children 1- to 3-years old: Protein 5–20%, Fat 30–40%, Carbohydrate 45–65%
Children 4- to 18-years old: Protein 10–30%, Fat 25–35%, Carbohydrate 45–65%
Reference for the AMDR: Institute of Medicine (2006) Dietary Reference Intakes: The Essential Guide to Nutrient Requirements. Washington, DC: The National Academies Press.
† Age of children reported in years, unless indicated differently in months (m).
[1] Below minimum AMDR.
[2] Cohort, 6 to 18 months old.
[3] Above maximum AMDR.
[4] Date based on ethical clearance certificate.
[5] HIV-uninfected group.

Table 4.13: Dietary calcium intake for infants, children and adolescents

Province	Year	Age, years†	Ethnicity	*n*	Dietary assessment method	EAR[1] (mg)	Calcium intake[§] (mg)		Reference
							Mean ± SD Median (25th, 75th) Median[a] Mean (95% CI)*	Adequacy of intake[2]	
0 to 6 years old, rural and urban									
National	1999	1–3	All	1308 1249	24-hour recall QFFQ	500	235 (105, 436) 290 (165, 492)	65% <67% RDA[3] 57% <67% RDA[3]	Labadarios *et al.*, 2000[109]
National	1999	4–6	All	1083 1044	24-hour recall QFFQ	800	224 (109, 415) 316 (185, 552)	85% <67% RDA[3] 74% <67% RDA[3]	Labadarios *et al.*, 2000[109]
0 to 6 years old, rural									
National	1999	1–3	All	644 603	24-hour recall QFFQ	500	214 (93, 405) 235 (136, 415)	68% <67% RDA[3] 68% <67% RDA[3]	Labadarios *et al.*, 2000[109]
National	1999	4–6	All	570 547	24-hour recall QFFQ	800	195 (90, 364) 270 (162, 487)	88% <67% RDA[3] 80% <67% RDA[3]	Labadarios *et al.*, 2000[109]
KZN	2002	6–12m	Black	475	24-hour recall	AI 260	337 (252, 477)		Faber, 2005[97]
KZN	2000	4–24m	Black	50	24-hour recall	6–12m: AI 260 1–2y: 500	303 (249, 423)		Faber & Benadé, 2001[45]
KZN	1999	2–5	Black	154	24-hour recall	2–3y: 500 4–5y: 800	217 (165, 333)		Faber *et al.*, 2001[46]
LP	2000/01	1		156	QFFQ	500	243 ± 201	67.3% <67% RDA[4]	Mamabolo *et al.*, 2006[34]
LP	2002/03	3		162	24-hour recall QFFQ	500	122 ± 130 257 ± 155	93.8% <67% RDA[4] 72.8% <67% RDA[4]	Mamabolo *et al.*, 2006[34]
0 to 6 years old, urban									
National	1999	1–3	All	664 631	24-hour recall QFFQ	500	253 (129, 472) 351 (212, 560)	62% <67% RDA[3] 48% <67% RDA[3]	Labadarios *et al.*, 2000[109]
National	1999	4–6	All	513 490	24-hour recall QFFQ	800	266 (143, 457) 385 (225, 638)	81% <67% RDA[3] 67% <67% RDA[3]	Labadarios *et al.*, 2000[109]
FS	~1998	2–3.9		63	24-hour recall	500	328 ± 206 318[a]		Dannhauser *et al.*, 2000[100]

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Table 4.13 Continued

Province	Year	Age, years†	Ethnicity	*n*	Dietary assessment method	EAR[1] (mg)	Calcium intake[§] (mg)		Reference
							Mean ± SD Median (25th, 75th) Median[a] Mean (95% CI)*	Adequacy of intake[2]	
0 to 6 years old, urban									
FS	~1998	2–3.9		68	24-hour recall	500	340 ± 256 373[a]		Dannhauser *et al.*, 2000[100]
FS	~1998	4–5.9		46	24-hour recall	800	380 ± 238 328[a]		Dannhauser *et al.*, 2000[100]
FS	~1998	4–5.9		54	24-hour recall	800	340 ± 215 349[a]		Dannhauser *et al.*, 2000[100]
KZN	2007	2–5	Black	73	2x 24-hour recall	2–3y: 500 4–5y: 800	276 ± 149		Faber *et al.*, 2013[131]
NC	2010–11	2–5		149	24-hour recall	2–3y: 500 4–5y: 800	126 (64, 332) 215 (182–247)*		Van Stuijvenberg *et al.*, 2015[101]
NW	2013–15	6m[5]	Black	715	24-hour recall	AI 260	357 (276, 468)		Swanepoel *et al.*, 2019[98]
NW	2013–15	12m[5]	Black	446	24-hour recall	500	368 (276, 494)	75.8% <EAR[1]	Swanepoel *et al.*, 2019[98]
NW	2013–15	18m[5]	Black	213	24-hour recall	500	346 (239, 497)	75.1% <EAR[1]	Swanepoel *et al.*, 2019[98]
WC	1998	6–12m	Coloured	48	3x 24-hour recall	AI 260	768 ± 349	0% <67% RDA[3]	Oelofse *et al.*, 2002[28]
WC	1998	6–12m	Black	62	3x 24-hour recall	AI 260	522 ± 231	8% <67% RDA[3]	Oelofse *et al.*, 2002[28]
Primary school age children, rural and urban									
National	1999	7–9	All	477 476	24-hour recall QFFQ	7–8y: 800 9y: 1100	225 (118, 438) 361 (200, 570)	84% <67% RDA[3] 73% <67% RDA[3]	Labadarios *et al.*, 2000[109]
Primary school age children, rural									
National	1999	7–9	All	238 232	24-hour recall QFFQ	7–8y: 800 9y: 1100	186 (92, 375) 318 (180, 485)	87% <67% RDA[3] 80% <67% RDA[3]	Labadarios *et al.*, 2000[109]
FS		9–13		142	3x 24-hour recall	1100	166 ± 139		Oldewage-Theron & Egal, 2010[105]
KZN	2009	6–11	Black	102	3x 24-hour recall	6–8y: 800 9–11y: 1100	172 (125, 256)	100% <EAR[1]	Visser *et al.*, 2019[106]
LP		10		25	4x 24-hour recall	1100	280 ± 87		MacIntyre & Du Plessis, 2006[65]
NW	2012	6–12		100	3x 24-hour recall	1100	298 (120, 319)	97% <EAR[1]	Visser *et al.*, 2019[106]
Primary school age children, urban									
National	1999	7–9	All	239 239	24-hour recall QFFQ	7–8y: 800 9y: 1100	273 (152, 482) 420 (237, 686)	81% <67% RDA[3] 63% <67% RDA[3]	Labadarios *et al.*, 2000[109]
GP		5–9		216[6]	24-hour recall	5–8y: 800 9y: 1100	295 ± 212	96.3% <EAR[1]	Shiau *et al.*, 2017[63]
GP	1997	7[7]	Black	163	QFFQ	800	583 (559–605)*		MacKeown *et al.*, 2003[108]
GP	1999	9[7]	Black	163	QFFQ	1100	606 (557–654)*		MacKeown *et al.*, 2003[108]
GP	2000	10[7]	Black	163	QFFQ	1100	494 (460–526)*		MacKeown *et al.*, 2003[108]

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Table 4.13 Continued

Province	Year	Age, years†	Ethnicity	*n*	Dietary assessment method	EAR[1] (mg)	Calcium intake[§] (mg)		Reference
							Mean ± SD Median (25th, 75th) Median[a] Mean (95% CI)*	Adequacy of intake[2]	
Primary school age children, urban									
GP		9–13		149	QFFQ	1100	219 ± 200		Oldewage-Theron *et al.*, 2006[50]
KZN	2007	Grade 6&7 12.7 ± 1.2	Black	399	2x 24-hour recall	1100	246 ± 134		Faber *et al.*, 2013[131]
LP		10		25	4x 24-hour recall	1100	382 ± 116		MacIntyre & Du Plessis, 2006[65]
NW	2009	6–11		376	3x 24-hour recall	6–8y: 800 9–11y: 1100	217 (139, 300)	98% <EAR[1]	Visser *et al.*, 2019[106]
Adolescents, rural									
LP		15		25	4x 24-hour recall	1100	313 ± 113		MacIntyre & Du Plessis, 2006[65]
Adolescents, urban									
GP	2003	13[7]	Black	143	QFFQ	1100	642 (585–699)*		MacKeown *et al.*, 2007[116]
KZN		14–18		61F	24-hour recall	1100	383 ± 231		Napier & Hlambelo, 2014[103]
LP		15		25	4x 24-hour recall	1100	347 ± 117		MacIntyre & Du Plessis, 2006[65]
NW	2004	14.8 ± 1.4		250[8]	24-hour recall	1100	318 ± 170		Kruger *et al.*, 2012[107]
NW	2004	13.8 ± 1.0		66[9]	24-hour recall	1100	303 ± 135		Kruger *et al.*, 2012[107]

AI, Adequate Intake; EAR, Estimated Average Requirement; F, Female; FS, Free State; GP, Gauteng Province; KZN, KwaZulu-Natal; LP, Limpopo Province; NC, Northern Cape; NW, North West; QFFQ, Quantified Food Frequency Questionnaire; RDA, Recommended Dietary Allowance; WC, Western Cape.

§ Calcium intake values as reported in the papers; decimals were dropped.

† Age of children reported in years, unless indicated differently in months (m).

1 IOM (Institute of Medicine). 2011. Dietary Reference Intakes for Calcium and Vitamin D. Washington, DC: The National Academies Press. There is no EAR set for infants, and AI is used as indicator of requirement.

2 Percentage individuals with a calcium intake below the reference.

3 Food and Nutrition Board. Recommended Dietary Allowances, 10th edn, 1989.

4 Nutrition Information Centre, University of Stellenbosch (NICUS). The Dietary Reference Intakes. Tygerberg: University of Stellenbosch, 2003.

5 Cohort, 6 to 18 months old.

6 HIV-uninfected group.

7 Birth-to-Twenty cohort.

8 Intervention group (physical activity intervention).

9 Control group (physical activity intervention)

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Table 4.14: Vitamin A intake for infants, children and adolescents; data collected before 2003 or published before 2005

Province	Year	Age, years†	Ethnicity	*n*	Method	EAR[1] (µg RAE)	Vitamin A intake[5] (µg RE)		Reference
							Mean ± SD Median (25th, 75th) Median[a] Mean (95% CI)*	Adequacy of intake[2]	
0 to 6 years old, rural and urban									
National	1999	1–3	All	1308 1249	24-hour recall QFFQ	210	176 (71, 384) 345 (168, 640)	65% <67% RDA[3] 40% <67% RDA[3]	Labadarios *et al.*, 2000[109]
National	1999	4–6	All	1083 1044	24-hour recall QFFQ	275	181 (78, 400) 372 (182, 685)	69% <67% RDA[3] 46% <67% RDA[3]	Labadarios *et al.*, 2000[109]
0 to 6 years old, rural									
National	1999	1–3	All	644 603	24-hour recall QFFQ	210	133 (51, 322) 262 (123, 462)	70% <67% RDA[3] 51% <67% RDA[3]	Labadarios *et al.*, 2000[109]
National	1999	4–6	All	570 547	24-hour recall QFFQ	275	155 (51, 362) 310 (136, 580)	73% <67% RDA[3] 54% <67% RDA[3]	Labadarios *et al.*, 2000[109]
KZN	2002	6–12m	Black	475	24-hour recall	AI 500	524 (458, 719)		Faber, 2005[97]
KZN	2000	4–24m	Black	50	24-hour recall	6–12m: AI 500 1–2y: 210	630 (375, 815)		Faber & Benadé, 2001[45]
KZN	1999	2–5	Black	154	24-hour recall	2–3y: 210	150 (56, 579)		Faber *et al.*, 2001[46]
LP	2000/01	1		156	QFFQ	210	255 ± 379	39.7% <67% RDA[4]	Mamabolo *et al.*, 2006[34]
LP	2002/03	3		162	24-hour recall QFFQ	210	99 ± 140 206 ± 237	79.6% <67% RDA[4] 49.4% <67% RDA[4]	Mamabolo *et al.*, 2006[34]
0 to 6 years old, urban									
National	1999	1–3	All	664 631	24-hour recall QFFQ	210	204 (95, 425) 459 (244, 833)	60% <67% RDA[3] 29% <67% RDA[3]	Labadarios *et al.*, 2000[109]
National	1999	4–6	All	513 490	24-hour recall QFFQ	275	209 (109, 461) 456 (249, 803)	64% <67% RDA[3] 36% <67% RDA[3]	Labadarios *et al.*, 2000[109]
FS	~1998	2–3.9		63	24-hour recall	210	254 ± 424 120[a]		Dannhauser *et al.*, 2000[100]
FS	~1998	2–3.9		68	24-hour recall	210	426 ± 542 273[a]		Dannhauser *et al.*, 2000[100]
FS	~1998	4–5.9		46	24-hour recall	275	298 ± 279 197[a]		Dannhauser *et al.*, 2000[100]
FS	~1998	4–5.9		54	24-hour recall	275	446 ± 532 347[a]		Dannhauser *et al.*, 2000[100]
WC	1998	6–12m	Coloured	48	3x 24-hour recall	AI 500	942 ± 410	0% <67% RDA[3]	Oelofse *et al.*, 2002[28]
WC	1998	6–12m	Black	62	3x 24-hour recall	AI 500	713 ± 351	6% <67% RDA[3]	Oelofse *et al.*, 2002[28]
Primary school age children, rural and urban									
National	1999	7–9	All	477 476	24-hour recall QFFQ	7–8y: 275 9y: 445M, 420F	188 (71, 419) 410 (187, 775)	79% <67% RDA[3] 56% <67% RDA[3]	Labadarios *et al.*, 2000[109]

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Table 4.14 Continued

Province	Year	Age, years†	Ethnicity	*n*	Method	EAR[1] (µg RAE)	Vitamin A intake[§] (µg RE): Mean ± SD / Median (25th, 75th) / Median[a] / Mean (95% CI)*	Vitamin A intake[§] (µg RE): Adequacy of intake[2]	Reference
National	1999	7–9	All	238 232	24-hour recall QFFQ	7–8y: 275 9y: 445M, 420F	145 (47, 357) 333 (152, 622)	85% <67% RDA[3] 65% <67% RDA[3]	Labadarios *et al.*, 2000[109]
Primary school age children, urban									
National	1999	7–9	All	239 239	24-hour recall QFFQ	7–8y: 275 9y: 445M, 420F	236 (107, 510) 497 (284, 857)	72% <67% RDA[3] 47% <67% RDA[3]	Labadarios *et al.*, 2000[109]
GP	1997[5]	7	Black	163	QFFQ	275	565 (518–610)*		MacKeown *et al.*, 2003[108]
GP	1999[5]	9	Black	163	QFFQ	445M, 420F	425 (385–463)*		MacKeown *et al.*, 2003[108]
GP	2000[5]	10	Black	163	QFFQ	445M, 420F	324 (300–348)*		MacKeown *et al.*, 2003[108]
Adolescents, urban									
GP	2003[5]	13	Black	143	QFFQ	445M, 420F	642 (585–699)*		MacKeown *et al.*, 2007[116]

AI, Adequate Intake; EAR, Estimated Average Requirement; F, female; FS, Free State; GP, Gauteng Province; KZN, KwaZulu-Natal; LP, Limpopo Province; M, male; QFFQ, Quantified Food Frequency Questionnaire; RAE, Retinol Activity Equivalents; RDA, Recommended Dietary Allowance; RE, Retinol Equivalents; WC, Western Cape.
† Age of children reported in years, unless indicated differently in months (m).
§ Vitamin A values as reported in the papers; decimals were dropped.
[1] Institute of Medicine (2006) Dietary Reference Intakes: The Essential Guide to Nutrient Requirements. Washington, DC: The National Academies Press.
[2] Percentage individuals with a vitamin A intake below the reference
[3] Food and Nutrition Board. Recommended Dietary Allowances, 10th edn, 1989.
[4] Nutrition Information Centre, University of Stellenbosch (NICUS). The Dietary Reference Intakes. Tygerberg: University of Stellenbosch, 2003.
[5] Birth-to-Twenty cohort.

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Table 4.15: Vitamin A intake for infants, children and adolescents; data collected after 2003 or published after 2005

Province	Year	Age, years†	Ethnicity	*n*	Dietary assessment method, Software	EAR[1] (µg RAE)	Vitamin A intake[§] (µg RE) Mean ± SD Median (25th, 75th) Median[a] Mean (95% CI)*	Vitamin A intake[§] (µg RE) Adequacy of intake[2]	Reference
0 to 6 years old, rural									
KZN	2011	1.5–6	Black	105	24-hour recall SAS & FCT	1–3y: 210 4–6y: 275	200 (157, 297)[3]		Faber *et al.*, 2015[78]
LP	2011	1.5–6	Black	166	24-hour recall SAS & FCT	1–3y: 210 4–6y: 275	289 (205, 412)[3]		Faber *et al.*, 2015[78]
0 to 6 years old, urban									
KZN	2007	2–5	Black	73	2x 24-hour recall SAS & FCT	2–3y: 210 4–5y: 275	378 ± 212		Faber *et al.*, 2013[131]
NC	2011	1.5–6	Coloured	160	24-hour recall SAS & FCT	1–3y: 210 4–6y: 275	208 (145, 322)[3]		Faber *et al.*, 2015[78]
NC	2010–11	2–5		149	24-hour recall SAS & FCT	2–3y: 210 4–5y: 275	269 (180, 450) 947 (530–1364)*		Van Stuijvenberg *et al.*, 2015[101]
NW	2013–15	6m[4]	Black	715	24-hour recall SAS & FCT	AI 400	640 (505, 825)[3]		Swanepoel *et al.*, 2019[98]
NW	2013–15	12m[4]	Black	446	24-hour recall SAS & FCT	AI 500	592 (453, 809)[3]	6.5% <EAR[1]	Swanepoel *et al.*, 2019[98]
NW	2013–15	18m[4]	Black	213	24-hour recall SAS & FCT	210	489 (304, 723)[3]	13.1% <EAR[1]	Swanepoel *et al.*, 2019[98]
WC	2011	1.5–6	Coloured	181	24-hour recall SAS & FCT	1–3y: 210 4–6y: 275	265 (172, 380)[3]		Faber *et al.*, 2015[78]
Primary school age children, rural									
FS		9–13		142	3x 24-hour recall FoodFinder	445M, 420F	220 ± 416	87.1% <EAR[1]	Oldewage-Theron & Egal, 2010[105]
KZN	2009	6–11		102	3x 24-hour recall FoodFinder[5]	6–8y: 275 9–11y: 445M, 420F	334 (210, 432)	91.2% <EAR[1]	Visser *et al.*, 2019[106]
LP		10		25	4x 24-hour recall FoodFinder	445M, 420F	565 ± 641		MacIntyre & Du Plessis, 2006[65]
NW	2012	6–12		100	3x 24-hour recall FoodFinder[5]	6–8y: 275 9–12y: 445M, 420F	499 (341, 803)	46% <EAR[1]	Visser *et al.*, 2019[106]
Primary school age children, urban									
GP		5–9		216[6]	24-hour recall FoodFinder	4–8y: 275 9y: 445M, 420F	400 ± 1285	72.2% <EAR[1]	Shiau *et al.*, 2017[63]
GP		9–13		149	QFFQ Dietary Manager	445M, 420F	460 ± 430		Oldewage-Theron *et al.*, 2006[50]
KZN	2007	Grade 6&7 12.7 ± 1.2	Black	399	2x 24-hour recall SAS & FCT	9–13y: 445M, 429F	511 ± 317		Faber *et al.*, 2013[131]
LP		10		25	4x 24-hour recall FoodFinder	445M, 420F	320 ± 386		MacIntyre & Du Plessis, 2006[65]

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Table 4.15 Continued

Province	Year	Age, years†	Ethnicity	*n*	Dietary assessment method, Software	EAR[1] (µg RAE)	Vitamin A intake[§] (µg RE)		Reference
							Mean ± SD Median (25th, 75th) Median[a] Mean (95% CI)*	Adequacy of intake[2]	
Primary school age children, urban									
NW	2009	6–11		376	3x 24-hour recall FoodFinder[5]	6–8y: 275 9–11y: 445M, 420F	496 (367, 862)	36.4% <EAR[1]	Visser *et al.*, 2019[106]
Adolescents, rural									
LP		15		25	4x 24-hour recall FoodFinder	630M, 485F	355 ± 297		MacIntyre & Du Plessis, 2006[65]
Adolescents, urban									
KZN		14–18		61F	2x 24-hour recall FoodFinder[3]	485	374 ± 391	78.6% <EAR[1]	Napier & Hlambelo, 2014[103]
LP		15		25	4x 24-hour recall FoodFinder	630M, 485F	407 ± 528		MacIntyre & Du Plessis, 2006[65]

AI, Adequate Intake; EAR, Estimated Average Requirement; F, female; FCT, Food Composition Tables; FS, Free State; GP, Gauteng Province; KZN, KwaZulu-Natal; LP, Limpopo Province; NC, Northern Cape; NW, North West; QFFQ, Quantified Food Frequency Questionnaire; RAE, Retinol Activity Equivalents; RDA, Recommended Dietary Allowance; RE, Retinol Equivalents; WC, Western Cape.

† Age of children reported in years, unless indicated differently in months (m).

§ Vitamin A values as reported in the papers; decimals were dropped.

[1] Institute of Medicine of the National Academies (2006). Dietary Reference Intakes: The Essential Guide to Nutrient Requirements. Washington, DC: The National Academies Press.

[2] Percentage individuals with a vitamin A intake below the reference.

[3] Vitamin A values for plant foods given as µg RE were divided by 2 to obtain µg RAE.

[4] Cohort, 6 to 18 months old.

[5] Values for fortified maize meal and bread added.

[6] HIV-uninfected group.

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FOODS PROCURED, NUTRITIONAL STATUS AND DIETARY INTAKE OF PEOPLE LIVING IN SOUTH AFRICA

Table 4.16: Iron intake for infants, children and adolescents; data collected before 2003 or published before 2005

Province	Year	Age, years†	Ethnicity	*n*	Dietary assessment method	EAR[1] (mg)	Iron intake[5] (mg)		Reference
							Mean ± SD Median (25th, 75th) Mediana Mean (95% CI)*	Adequacy of intake[2]	
0 to 6 years old, rural and urban									
National	1999	1–3	All	1308 1249	24-hour recall QFFQ	3.0	3.9 (2.4, 6.2) 6.2 (4.0, 8.7)	79% <67% RDA[3] 57% <67% RDA[3]	Labadarios *et al.*, 2000[109]
National	1999	4–6	All	1083 1044	24-hour recall QFFQ	4.1	5.4 (3.4, 8.2) 7.5 (5.1, 10.6)	63% <67% RDA[3] 41% <67% RDA[3]	Labadarios *et al.*, 2000[109]
0 to 6 years old, rural									
National	1999	1–3	All	644 603	24-hour recall QFFQ	3.0	3.7 (2.4, 6.0) 5.6 (3.6, 8.2)	80% <67% RDA[3] 62% <67% RDA[3]	Labadarios *et al.*, 2000[109]
National	1999	4–6	All	570 547	24-hour recall QFFQ	4.1	5.1 (2.9, 7.8) 7.3 (4.5, 9.9)	66% <67% RDA[3] 45% <67% RDA[3]	Labadarios *et al.*, 2000[109]
KZN	2002	6–12m	Black	475	24-hour recall	6–12m: 6.9	2.9 (1.2, 6.6)		Faber, 2005[97]
KZN	2000	4–24m	Black	50	24-hour recall	6–12m: 6.9 1y: 3.0	5 (2, 6)		Faber & Benadé, 2001[45]
KZN	1999	2–5	Black	154	24-hour recall	2–3y: 3.0 4–5y: 4.1	6 (4, 9)		Faber *et al.*, 2001[46]
LP	2000/01	1		156	QFFQ	3.0	7.34 ± 4.43	16.0% <67% RDA[4]	Mamabolo *et al.*, 2006[34]
LP	2002/03	3		162	24-hour recall QFFQ	3.0	4.07 ± 1.99 7.67 ± 3.85	69.7% <67% RDA[4] 8.0% <67% RDA[4]	Mamabolo *et al.*, 2006[34]
0 to 6 years old, urban									
National	1999	1–3	All	664 631	24-hour recall QFFQ	3.0	4.2 (2.4, 6.4) 6.6 (4.5, 9.2)	78% <67% RDA[3] 51% <67% RDA[3]	Labadarios *et al.*, 2000[109]
National	1999	4–6 4–6	All	513 490	24-hour recall QFFQ	4.1	5.8 (3.6, 8.9) 8.0 (5.7, 11.0)	59% <67% RDA[3] 36% <67% RDA[3]	Labadarios *et al.*, 2000[109]
FS	Urban	2–3.9		63	24-hour recall	3.0	3.6 ± 2.2 3.6[a]		Dannhauser *et al.*, 2000[100]
FS	Urban	2–3.9		68	24-hour recall	3.0	4.5 ± 2.6 4.1[a]		Dannhauser *et al.*, 2000[100]
FS	Urban	4–5.9		46	24-hour recall	4.1	4.0 ± 3.1 3.3[a]		Dannhauser *et al.*, 2000[100]
FS	Urban	4–5.9		54	24-hour recall	4.1	4.6 ± 2.4 4.0[a]		Dannhauser *et al.*, 2000[100]
WC	1998	6–12m	Coloured	48	3x 24-hour recall	6.9	9 ± 5	25% <67% RDA[3]	Oelofse *et al.*, 2002[28]
WC	1998	6–12m	Black	62	3x 24-hour recall	6.9	7 ± 5	47% <67% RDA[3]	Oelofse *et al.*, 2002[28]

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Table 4.16 Continued

Province	Year	Age, years†	Ethnicity	n	Dietary assessment method	EAR[1] (mg)	Iron intake[§] (mg)		Reference
							Mean ± SD Median (25th, 75th) Mediana Mean (95% CI)*	Adequacy of intake[2]	
Primary school age children, rural and urban									
National	1999	7–9 7–9		477 476	24-hour recall QFFQ	7–8y: 4.1 9y: 5.9M, 5.7F	5.8 (3.5, 8.6) 8.5 (5.4, 12.0)	58% <67% RDA[3] 36% <67% RDA[3]	Labadarios *et al.*, 2000[109]
Primary school age children, rural									
National	1999	7–9	All	238 232	24-hour recall QFFQ	7–8y: 4.1 9y: 5.9M, 5.7F	5.2 (3.4, 8.0) 7.9 (4.9, 11.3)	63% <67% RDA[3] 43% <67% RDA[3]	Labadarios *et al.*, 2000[109]
Primary school age children, urban									
National	1999	7–9 7–9	All	239 239	24-hour recall QFFQ	7–8y: 4.1 9y: 5.9M, 5.7F	6.2 (3.8, 9.1) 8.9 (6.4, 12.7)	53% <67% RDA[3] 30% <67% RDA[3]	Labadarios *et al.*, 2000[109]
GP	1997	7[5]	Black	163	QFFQ	4.1	8.7 (8.38–9.02)*		MacKeown *et al.*, 2003[108]
GP	1999	9[5]	Black	163	QFFQ	5.9M, 5.7F	9.1 (8.67– 9.53)*		MacKeown *et al.*, 2003[108]
GP	2000	10[5]	Black	163	QFFQ	5.9M, 5.7F	8.5 (8.12–8.88)*		MacKeown *et al.*, 2003[108]
Adolescents, urban									
GP	2003	13[5]	Black	143	QFFQ	5.9M, 5.7F	10.2 (9.45–10.95)*		MacKeown *et al.*, 2007[116]

EAR, Estimated Average Requirement; EC, Eastern Cape; F, female; FS, Free State; GP, Gauteng Province; KZN, KwaZulu-Natal; LP, Limpopo Province; QFFQ, Quantified Food Frequency Questionnaire; RDA, Recommended Dietary Allowance; WC, Western Cape.
† Age of children reported in years, unless indicated differently in months (m).
§ Iron intake values as reported in the papers.
[1] Institute of Medicine of the National Academies (2006). Dietary Reference Intakes: The Essential Guide to Nutrient Requirements. Washington, DC: The National Academies Press.
[2] Percentage individuals with an iron intake below the reference.
[3] Food and Nutrition Board. Recommended Dietary Allowances, 10th edn, 1989.
[4] Nutrition Information Centre, University of Stellenbosch (NICUS). The Dietary Reference Intakes. Tygerberg: University of Stellenbosch, 2003.
[5] Birth-to-Twenty cohort.

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Table 4.17: Iron intake for infants, children and adolescents; data collected after 2003 or published after 2005

Province	Year	Age, years†	Ethnicity	*n*	Dietary assessment method	EAR[1] (mg)	Iron intake[5] (mg) Mean ± SD / Median (25th, 75th) / Mean (95% CI)*	Iron intake[5] (mg) Adequacy of intake[2]	Reference
0 to 6 years old, rural and urban									
KZN	2007	2–5	Black	73	2x 24-hour recall SAS & FCT	2–3y: 3.0 4–5y: 4.1	8.2 ± 2.6		Faber *et al.*, 2013[131]
NC	2010–11	2–5		149	24-hour recall SAS & FCT	2–3y: 3.0 4–5y: 4.1	6.9 (5.3, 9.6) 8.1 (7.3–8.8)*		Van Stuijvenberg *et al.*, 2015[101]
NW	2013–15	6m[3]	Black	715	24-hour recall SAS & FCT	AI 0.27	5.4 (2.2, 9.5)		Swanepoel *et al.*, 2019[98]
NW	2013–15	12m[3]	Black	446	24-hour recall SAS & FCT	6.9	5.1 (3.4, 7.6)	18.6% <EAR[1]	Swanepoel *et al.*, 2019[98]
NW	2013-15	18m[3]	Black	213	24-hour recall SAS & FCT	3.0	5.9 (4.6, 7.8)	8.5% <EAR[1]	Swanepoel *et al.*, 2019[98]
Primary school age children, rural									
EC	~2013[4]	6–8		55	2x 24-hour recall FoodFinder	4.1	5.0 (4.0, 6.5)	46.4% <EAR[1]	Oldewage-Theron & Kruger, 2017[104]
EC	~2013[4]	9–13		82	2x 24-hour recall FoodFinder	5.9M, 5.7F	6.4 (4.9, 8.0)	50.6% <EAR[1]	Oldewage-Theron & Kruger, 2017[104]
FS		9–13		142	3x 24-hour recall FoodFinder	5.9M, 5.7F	5.3 ± 1.9	65.0% <EAR[1]	Oldewage-Theron & Egal, 2010[105]
KZN	2009	6– 11		102	3x 24-hour recall FoodFinder[5]	6–8y: 4.1 9–11y: 5.9M, 5.7F	10.2 (71.3, 11.6)	23.4% <EAR[1]	Visser *et al.*, 2019[106]
LP		10		25	4x 24-hour recall FoodFinder	5.9M, 5.7F	8.9 ± 2.3		MacIntyre & Du Plessis, 2006[65]
NW	2012	6–12		100	3x 24-hour recall FoodFinder[5]	6–8y: 4.1 9–12y: 5.9M, 5.7F	12.4 (9.1, 16.1)	19% <EAR[1]	Visser *et al.*, 2019[106]
Primary school age children, urban									
GP		5–9		216[6]	24-hour recall FoodFinder	5–8y: 4.1 9y: 5.9M, 5.7F	6.5 ± 2.9	19.4% <EAR[1]	Shiau *et al.*, 2017[63]
GP		9–13		149	QFFQ Dietary Manager	5.9M, 5.7F	5.8 ± 4.3		Oldewage-Theron *et al.*, 2006[50]
KZN	2007	Grade 6&7 12.7 ± 1.2	Black	399 216M, 183F	2x 24-hour recall SAS & FCT	5.9M, 5.7F	12.8 ± 3.6		Faber *et al.*, 2013[131]
LP		10		25	4x 24-hour recall FoodFinder	5.9M, 5.7F	9.8 ± 2.4		MacIntyre & Du Plessis, 2006[65]
NW	2009	6–11	Both	376	3x 24-hour recall FoodFinder[5]	6–8y: 4.1 9–11y: 5.9M, 5.7F	13.5 (11.3, 16.8)	12.8% <EAR[1]	Visser *et al.*, 2019[106]

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Table 4.17 Continued

Province	Year	Age, years†	Ethnicity	*n*	Dietary assessment method	EAR[1] (mg)	Iron intake[§] (mg)		Reference
							Mean ± SD Median (25th, 75th) Mean (95% CI)*	Adequacy of intake[2]	
EC	~2013[4]	14–18	Both	97	2x 24-hour recall FoofFinder	7.7M, 7.9F	6.5 (4.9, 8.4)	66.3% <EAR[1]	Oldewage-Theron & Kruger, 2017[104]
LP		15		25	4x 24-hour recall FoodFinder	7.7M, 7.9F	9.6 ± 2.0		MacIntyre & Du Plessis, 2006[65]
Adolescents, urban									
KZN		14–18		61F	2x 24-hour recall FoodFinder	7.9	8.85 ± 3.49	49.1% <EAR[1]	Napier & Hlambelo, 2014[103]
LP		15		25	4x 24-hour recall FoodFinder	7.7M, 7.9F	9.8 ± 1.8		MacIntyre & Du Plessis, 2006[65]
NW	2004	14.8 ± 1.4		250[7]	24-hour recall FoodFinder	7.7M, 7.9F	8.1 ± 4.0		Kruger *et al.*, 2012[107]
NW	2004	13.8 ± 1.0		66[8]	24-hour recall FoodFinder[5]	7.7M, 7.9F	8.8 ± 2.9		Kruger *et al.*, 2012[107]

AI, Adequate Intake; EAR, Estimated average requirements; EC, Eastern Cape; F, female; FCT, Food Composition Tables; FS, Free State; GP, Gauteng Province; KZN, KwaZulu-Natal; LP, Limpopo Province; NC, Northern Cape; NW, North West; QFFQ, Quantified Food Frequency Questionnaire; M, male; WC, Western Cape.

† Age of children reported in years, unless indicated differently in months (m).

§ Iron intake values as reported in the papers.

1 Institute of Medicine of the National Academies (2006). Dietary Reference Intakes: The Essential Guide to Nutrient Requirements. Washington, DC: The National Academies Press.

2 Percentage individuals with an iron intake below the reference.

3 Cohort, 6 to 18 months old.

4 Date based on ethical clearance certificate.

5 Values for fortified maize meal and bread added.

6 HIV-uninfected group.

7 Intervention group (physical activity intervention).

8 Control group (physical activity intervention).

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Table 4.18: Zinc intake for infants, children and adolescents; data collected before 2003 or published before 2005

Province	Year	Age, years†	Ethnicity	*n*	Dietary assessment method	EAR[1] (mg)	Zinc intake[§] (mg) Mean ± SD Median (25th, 75th) Median[a] Mean (95% CI)*	Zinc intake[§] (mg) Adequacy of intake[2]	Reference
0 to 6 years old, rural and urban									
National	1999	1–3	All	1308 1249	24-hour recall QFFQ	2.5	3.6 (2.3, 5.5) 4.9 (3.2, 6.8)	86% <67% RDA[3] 73% <67% RDA[3]	Labadarios *et al.*, 2000[109]
National	1999	4–6	All	1083 1044	24-hour recall QFFQ	4.0	4.5 (2.9, 6.8) 5.9 (8.3, 4.4)	74% <67% RDA[3] 60% <67% RDA[3]	Labadarios *et al.*, 2000[109]
0 to 6 years old, rural									
National	1999	1–3 1–3	All	644 603	24-hour recall QFFQ	2.5	3.3 (2.2, 4.9) 4.2 (2.7, 6.0)	90% <67% RDA[3] 80% <67% RDA[3]	Labadarios *et al.*, 2000[109]
National	1999	4–6 4–6	All	570 547	24-hour recall QFFQ	4.0	4.1 (2.6, 6.0) 5.3 (3.6, 7.7)	81% <67% RDA[3] 66% <67% RDA[3]	Labadarios *et al.*, 2000[109]
KZN	2002	6–12m	Black	475	24-hour recall	2.5	2.5 (1.9, 3.7)		Faber, 2005[97]
KZN	2000	4–24m	Black	50	24-hour recall	2.5	3 (2, 4)		Faber & Benadé, 2001[45]
KZN	1999	2–5	Black	154	24-hour recall	2–3y: 2.5 4–5y: 4.0	4 (3, 5)		Faber *et al.*, 2001[46]
LP	2000/01	1		156	QFFQ	2.5	4.67 ± 2.64	5.1% <67% RDA[4]	Mamabolo *et al.*, 2006[34]
LP	2002/03	3		162	24-hour recall QFFQ	2.5	3.11 ± 1.44 5.08 ± 2.26	17.9% <67% RDA[4] 0.6% <67% RDA[4]	Mamabolo *et al.*, 2006[34]
0 to 6 years old, urban									
National	1999	1–3	All	664 631	24-hour recall QFFQ	2.5	3.9 (2.4, 6.1) 5.4 (3.7, 7.5)	82% <67% RDA[3] 66% <67% RDA[3]	Labadarios *et al.*, 2000[109]
National	1999	4–6	All	513 490	24-hour recall QFFQ	4.0	5.2 (3.3, 7.6) 6.5 (4.6, 9.1)	66% <67% RDA[3] 52% <67% RDA[3]	Labadarios *et al.*, 2000[109]
FS	Urban	2–3.9		63	24-hour recall	2.5	3.9 ± 2.4 3.6[a]		Dannhauser *et al.*, 2000[100]
FS	Urban	2–3.9		68	24-hour recall	2.5	4.2 ± 2.2 3.9[a]		Dannhauser *et al.*, 2000[100]
FS	Urban	4–5.9		46	24-hour recall	4.0	4.3 ± 2.4 3.8[a]		Dannhauser *et al.*, 2000[100]
FS	Urban	4–5.9		54	24-hour recall	4.0	4.4 ± 2.5 3.6 [a]		Dannhauser *et al.*, 2000[100]
WC	1998	6–12m	Coloured	48	3x 24-hour recall	2.5	5 ± 2	8% <67% RDA[3]	Oelofse *et al.*, 2002[28]
WC	1998	6–12m	Black	62	3x 24-hour recall	2.5	4 ± 1	31% <67% RDA[3]	Oelofse *et al.*, 2002[28]
Primary school age children, rural and urban									
National	1999	7–9	All	477 476	24-hour recall QFFQ	7–8y: 4.0 9y: 7.0	4.9 (3.4, 7.2) 6.7 (4.3, 9.7)	72% <67% RDA[3] 50% <67% RDA[3]	Labadarios *et al.*, 2000[109]

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Table 4.18 Continued

Province	Year	Age, years†	Ethnicity	*n*	Dietary assessment method	EAR[1] (mg)	Zinc intake[§] (mg)		Reference
							Mean ± SD Median (25th, 75th) Median[a] Mean (95% CI)*	Adequacy of intake[2]	
Primary school age children, rural									
National	1999	7–9	All	238 232	24-hour recall QFFQ	7–8y: 4.0 9y: 7.0	4.4 (2.8, 6.2) 5.6 (3.8, 8.4)	81% <67% RDA[3] 80% <67% RDA[3]	Labadarios *et al.*, 2000[109]
Primary school age children, urban									
National	1999	7–9	All	239 239	24-hour recall QFFQ	7–8y: 4.0 9y: 7.0	5.7 (4.0, 8.0) 7.6 (5.2, 10.5)	63% <67% RDA[3] 43% <67% RDA[3]	Labadarios *et al.*, 2000[109]
GP	1997	7[5]	Black	163	QFFQ	4.0	8.2 (7.89–8.51)*		MacKeown *et al.*, 2003[108]
GP	1999	9[5]	Black	163	QFFQ	7.0	8.2 (7.83–8.57)*		MacKeown *et al.*, 2003[108]
GP	2000	10[5]	Black	163	QFFQ	7.0	7.7 (7.35–8.05)*		MacKeown *et al.*, 2003[108]
Adolescents, urban									
GP	2003	13[5]	Black	143	QFFQ	7.0	8.2 (7.64 - 8.76)*		MacKeown *et al.*, 2007[116]

EAR, Estimated Average Requirement; F, female; FS, Free State; GP, Gauteng Province; KZN, KwaZulu-Natal; LP, Limpopo Province; QFFQ, Quantified Food Frequency Questionnaire; RDA, Recommended Dietary Allowance; WC, Western Cape.
† Age of children reported in years, unless indicated differently in months (m).
§ Zinc intake values as reported in the papers.
[1] Institute of Medicine of the National Academies (2006). Dietary Reference Intakes: The Essential Guide to Nutrient Requirements. Washington, DC: The National Academies Press.
[2] Percentage individuals with a zinc intake below the reference.
[3] Food and Nutrition Board. Recommended Dietary Allowances, 10th edn, 1989.
[4] Nutrition Information Centre, University of Stellenbosch (NICUS). The Dietary Reference Intakes. Tygerberg: University of Stellenbosch, 2003.
[5] Birth-to-Twenty cohort.

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Table 4.19: Zinc intake for infants, children and adolescents; data collected after 2003 or published after 2005

Province	Year	Age, years†	Ethnicity	*n*	Dietary assessment method	EAR[1] (mg)	Zinc intake[§] (mg)		Reference
							Mean ± SD Median (25th, 75th) Median[a] Mean (95% CI)*	Adequacy of intake[2]	
0 to 6 years old, urban									
KZN	2007	2–5	Black	73	2x 24-hour recall SAS & FCT	2–3y: 2.5 4–5y: 4.0	6.5 ± 2.3		Faber *et al.*, 2013[131]
NC	2011	2–5		149	24-hour recall SAS & FCT	2–3y: 2.5 4–5y: 4.0	6.2 (4.5, 9.1) 7.2 (6.6–7.8)*		Van Stuijvenberg *et al.*, 2015[101]
NW	2013–15	6m[3]	Black	715	24-hour recall SAS & FCT	AI 2.0	2.65 (1.65, 4.33)	46.6% <EAR[1]	Swanepoel *et al.*, 2019[98]
NW	2013–15	12m[3]	Black	446	24-hour recall SAS & FCT	2.5	4.39 (3.12, 6.02)	13.7% <EAR[1]	Swanepoel *et al.*, 2019[98]
NW	2013–15	18m[3]	Black	213	24-hour recall SAS & FCT	2.5	5.81 (4.30, 7.26)	3.8 % <EAR[1]	Swanepoel *et al.*, 2019[98]
Primary school age children, rural									
EC	~2013[4]	6–8		55	2x 24-hour recall FoodFinder	4.0	5.0 (3.8–6.50)*	37.5% <EAR[1]	Oldewage-Theron & Kruger, 2017[104]
EC	~2013[4]	9–13		82	2x 24-hour recall FoodFinder	7.0	6.0 (5.0–7.4)*	74.7% <EAR[1]	Oldewage-Theron & Kruger, 2017[104]
FS		9–13		142	3x 24-hour recall FoodFinder	7.0	3.3 ± 1.5	97.9% <EAR[1]	Oldewage-Theron & Egal, 2010[105]
KZN	2009	6–11	Black	102	2x 24-hour recall FoodFinder3[5]	6–8y: 4.0 9–11y: 7.0	7.3 (5.5, 9.3)	51.9% <EAR[1]	Visser *et al.*, 2019[106]
LP		10		25	4x 24-hour recall FoodFinder	7.0	7.5 ± 3.2		MacIntyre & Du Plessis, 2006[65]
NW	2012	6–12		100	2x 24-hour recall FoodFinder3[5]	6–8y: 4.0 9–12y: 7.0	7.7 (5.9, 11.1)	25% <EAR[1]	Visser *et al.*, 2019[106]
Primary school age children, urban									
GP		5–9		216[6]	24-hour recall FoodFinder	5–8y: 4.0[5] 9y: 7.0	5.0 ± 2.4	37.5% <EAR[1]	Shiau *et al.*, 2017[63]
GP		7–11		149	2x 24-hour recall FoodFinder3		4.6 ± 2.2		Samuel *et al.*, 2010[102]
		7–8				7–8y: 4.0	4.8 ± 2.0	16.2 % <EAR[1]	
		9–11				9–11y: 7.0	4.5 ± 2.3	83.5% <EAR[1]	
GP		9–13		149	QFFQ Dietary Manager	7.0	4.9 ± 3.0		Oldewage-Theron *et al.*, 2006[50]
KZN	2007	Grade 6&7 12.7 ± 1.2	Black	399 216M 183F	2x 24-hour recall SAS & FCT	7.0	10.0 ± 3.3		Faber *et al.*, 2013[131]
LP		10		25	4x 24-hour recall	7.0	9.6 ± 2.5		MacIntyre & Du Plessis, 2006[65]

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Table 4.19 Continued

Province	Year	Age, years†	Ethnicity	*n*	Dietary assessment method	EAR[1] (mg)	Zinc intake[§] (mg)		Reference
							Mean ± SD Median (25th, 75th) Mediana Mean (95% CI)*	Adequacy of intake[2]	
Primary school age children, urban									
NW	2009	6–11		376	3x 24-hour recall FoodFinder[5]	6–8y: 4.0 9–11y: 7.0	10.5 (8.4, 12.9)	7.2% <EAR[1]	Visser *et al.*, 2019[106]
Adolescents, rural									
EC	~2013[4]	14–18		97	2x 24-hour recall FoodFinder	8.5M, 6.8F	6.4 (4.7, 7.6)	80.6% <EAR[1]	Oldewage-Theron & Kruger, 2017[104]
LP		15		25	4x 24-hour recall	8.5M, 6.8F	7.4 ± 2.1		MacIntyre & Du Plessis, 2006[65]
Adolescents, urban									
KZN		14–18		61F		8.5M, 7.3F	8.59 ± 2.93	37.7% <EAR[1]	Napier & Hlambelo, 2014[103]
LP		15		25	4x 24-hour recall		9.1 ± 2.5		MacIntyre & Du Plessis, 2006[65]
NW	2004	14.8±1.4		250[7]	24-hour recall FoodFinder[5]	8.5M, 7.3F	8.1 ± 3.7		Kruger *et al.*, 2012[107]
NW	2004	13.8±1.0		66[8]	24-hour recall Foodfinder[5]	8.5M, 7.3F	8.3 ± 2.9		Kruger *et al.*, 2012[107]

AI, Adequate Intake; EAR, Estimated Average Requirement; EC, Eastern Cape; F, female; FCT, food composition tables; FS, Free State; GP, Gauteng Province; KZN, KwaZulu-Natal; LP, Limpopo Province; NC, Northern Cape; NW, North West; M, male; WC, Western Cape.

† Age of children reported in years, unless indicated differently in months (m).

§ Zinc intake values as reported in the papers.

[1] Institute of Medicine of the National Academies (2006). Dietary Reference Intakes: The Essential Guide to Nutrient Requirements. Washington, DC: The National Academies Press.

[2] Percentage individuals with a zinc intake below the reference

[3] Cohort, 6 to 18 months old.

[4] Date based on ethical clearance certificate.

[5] Values for fortified maize meal and bread added.

[6] HIV-uninfected group.

[7] Intervention group (physical activity intervention).

[8] Control group (physical activity intervention).

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Table 4.20: Energy and micronutrient contribution of the National Food Fortification Programme (NFFP)

Reference	Province	Year	*n*	Age, years†	Energy and micronutrient contribution of fortified maize meal and bread[1]	
Faber *et al.*, 2015[78]	KwaZulu-Natal, rural Black	2011	105	1.5–6	Vitamin A, µg RAE % of vitamin A intake	122 (65, 182) 59 (38, 77)
	Limpopo, rural Black	2011	166	1.5–6	Vitamin A, µg RAE % of vitamin A intake	160 (113, 210) 57 (41, 76)
	Northern Cape, urban Coloured mostly	2011	160	1.5–6	Vitamin A, µg RAE % of vitamin A intake	76 (26, 130) 38 (12, 58)
	Western Cape, urban Coloured mostly	2011	181	1.5–6	Vitamin A, µg RAE % of vitamin A intake	65 (25, 107) 28 (5, 50)
Nel *et al.*, 2014[118]	Northern Cape, urban	2010/11	150	24–59m	Vitamin A, µg RE	65.4 (34.0, 100.8)
Swanepoel *et al.*, 2019[98]	North West, urban Black	2013-15	Cohort; data at age: 6m (*n* 715) 12m (*n* 446) 18m (*n* 213)		On the day of recall, fortified staples were consumed by 23% of children at 6 months, 81% at 12 months, and 96% at 18 months. For consumers thereof, fortified staples contributed 11% of energy intake at 6 months. At age 18 months, fortified stapes contributed 29% of energy, >30% of iron, zinc, vitamin A, thiamine, niacin, vitamin B6, and folate. At age 12 months, nutrient densities of the complementary diet were higher for zinc, folate, and vitamin B6 but lower for calcium, iron, vitamin A, niacin, and vitamin C for consumers compared to non-consumers. (consumers and non-consumers refer to those eating / not eating the food items on the day of recall) At age 12 months, 51.4% of consumers versus 25.0% (P=0.005) of non-consumers of fortified staples had intakes >EAR for all eight fortificant nutrients	

† Age of children reported in years, unless indicated differently in months (m).
RAE, Retinol Activity Equivalents; RE, Retinol Equivalents.
[1]reported as median (25th; 75th percentile), unless indicated differently.

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Table 4.21: Energy and micronutrient contribution of commercial infant products and the nutrient density of the complementary diet for children under 2 years

Reference	Province	Year	*n*	Age	Energy and micronutrient contribution of fortified maize meal and bread
Faber, 2005[97]	KwaZulu-Natal, rural	2002	475	6–12m	Energy and protein intakes from **complementary foods** were adequate. Infants who consumed **infant products** (n=260) (commercially available fortified infant cereals/ ready-to-eat canned baby foods/formula milk powder) had significantly higher intakes for calcium, iron, zinc, vitamin A, thiamine, riboflavin, niacin, vitamin B6, vitamin B12 and vitamin C than infants who did not consume any infant products. For infants who consumed **infant cereals** (n=142), these cereals provided 51% of total iron intake. Infant cereals provided more than 25% of total intake for magnesium, thiamine, niacin and vitamin B12. For infants consuming **ready-to-eat canned baby foods** (n=77), these products contributed less than 15% of total intake for all the micronutrients. The **nutrient density of the complementary diet** was less than half the desired density for calcium, iron and zinc. **Animal products** were consumed by 17% of infants, 26% consumed dairy products and 18% consumed vitamin-A-rich fruit and vegetables during the 24-hour recall period
Swanepoel *et al.*, 2019[98]	North West, urban		Cohort; data at age: 6m (*n* 715) 12m (*n* 446) 18m (*n* 213)		On the day of recall, commercial **infant products** were consumed by 83% of children at 6 months, 46% at 12 months, and 15% at 18 months. For consumers thereof, **commercial infant products** contributed 33% energy and 94% iron intakes at 6 months and 27% energy and 56% iron intakes at 12 months; nutrient densities of the complementary diet were higher than for non-consumers for most micronutrients.
Faber *et al.*, 2016[119]	KwaZulu-Natal, urban and rural	2011	158 rural 158 urban	6–24m	For breastfeeding children, **nutrient density of the complementary diet:** - adequate for protein, vitamin A and vitamin C; 100% of children - inadequate for zinc; 100% of children - inadequate for, calcium, iron and niacin; >80% of children - inadequate for vitamin B6 and riboflavin; 60% to 80% of children Children of age 18-24 months: urban diet had higher nutrient density for animal protein and cholesterol, and lower density for plant protein and fibre compared to the rural diet. Higher dietary diversity of the complementary diet was associated with higher nutrient density for protein and several of the micronutrients including calcium, iron and zinc.

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Table 4.22: Percentage of children who were initially breastfed, exclusively breastfed and breastfed at the time of data collection; as well as introduction and consumption of complementary foods

Province Reference	Year	n	Age	Breastfeeding Description	%	Age when first food was introduced	Complementary foods
National SADHS, 2003[18]	2003	194 150	<6m <6m 6–9m	Exclusively breastfed Not breastfeeding Currently breastfed	8.3 26.7 69.9		
National SANHANES IYCF, 2012[120]	2012	243 178 143	<6m <6m 12–15m 20–23m	Exclusively breastfed Never breastfed Currently breastfed Currently breastfed	7.4 17.5 35.8 13.4	**(Sample: age <24m n=843)** Mean: 4.5m (95% CI 4.2, 4.7) Infant cereal, 51.2% Homemade porridge, 29.0%	
National SADHS, 2016[10]	2016	1386 231 189	<24m <6m <6m 12–15m 20–23m	Initially breastfed Exclusively breastfed Currently breastfed Currently breastfed Currently breastfed	84 31.6 74.8 51.4 13.0		
WC & KZN[1] Rural & urban Engebretsen *et al.*, 2014[35]	2006–08	485	Cohort, 0–24wk	Exclusively breastfed at 12wk	6%		
EC, rural Black Smuts *et al.*, 2008[121]	2003	797	<24m	Initially breastfed Currently breastfed, <6m Currently breastfed, 6-<12m, Currently breastfed, 12-<18m Currently breastfed, 18-<24m	99 87 81 67 50		
FS, urban Dannhauser *et al.*, 2000[100]		195	<36m	Breastfed at age 6m Breastfed at age 12m Breastfed at age 18m Breastfed at age 24m	75.3 65.6 58.5 27.2		
KZN, rural Black Faber & Benadé, 1999[29]	1997	115	4–24m	Initially breastfed Currently breastfed, 4–12m Currently breastfed, 12–24m	99 80 56.9	Age: 3.6 ± 0.8m 95% introduced to solids before 4m Maize meal porridge, 85.1%	
KZN, rural Faber, 2005[97]	2002	475	6–12m	Currently breastfed	81		
KZN, rural Black Smuts *et al.*, 2008[121]	2003	698	<24m	Initially breastfed Currently breastfed, <6m Currently breastfed, 6-<12m Currently breastfed, 12-<18m Currently breastfed, 18-<24m	100 85 83 64 33		
KZN, rural Black Faber *et al.*, 2016[119]	2011	158 54 52 52	6–24m 6–11m 12–17m 18–24m	Initially breastfed Currently breastfed Currently breastfed Currently breastfed	79.1 46.3 46.2 11.5	Age: 3.5 ± 1.6m Maize meal porridge, 69.9% Infant cereals, 19.6% Jarred baby foods, 9.5%	**Infant cereal at least 1d/wk:** 6–11m: 31.5% 12–17m: 17.3% 18–24m: 1.9%

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Province Reference	Year	n	Age	Breastfeeding Description	%	Age when first food was introduced	Complementary foods
LP, rural Mamabolo *et al.*, 2004[123]	~1999	219	Cohort: 0–12 m	Exclusively breastfed up to 6m Breastfed at 6m Breastfed at 9m	4.1 91.8 84.8		**Primary complementary foods** **Age 6m (n=170)** Mabella, 71.7% Maize meal, 45.3% Infant cereals, 15.9% **Age 9m (n=132)** Mabella, 48.5% Maize meal, 59.1% Infant cereals, 21.9%
LP, rural Mushaphi *et al.*, 2008[42]	NS	185	<12m	Initially breastfed Currently breastfed	100 97	Average age for introducing soft porridge was 2 months	**At least 3d/wk:** Soft porridge, 71.9% Stiff porridge, 31.4% Baby food (Nestum, Purity), 20.5% Sorghum porridge, 12.4%
LP, rural Patil *et al.*, 2015[122]	NS	268	0–24m	Initially breastfed Exclusively breastfed at 1m	97.8 29.5		
MP, urban All PHC facilities are baby friendly Van der Merwe *et al.*, 2015[124]	2012	218	<6m	Initially breastfed Exclusively breastfed	89 60		
MP, urban No baby friendly PHC facilities Van der Merwe *et al.*, 2015[124]	2012	217	<6m	Initially breastfed Exclusively breastfed	64 48		
WC, urban Black & Coloured Goosen *et al.*, 2014[127]	2011	148	<6m	Initially breastfed[2] Exclusively breastfed Currently breastfed	77 6 69		
WC, urban Black Budree *et al.*, 2017[125]	2012–15	590	Cohort, 0–12m	Initially breastfed Exclusively breastfed up to 6m Breastfed at age 9m Breastfed at age 12m	77 15 51 48	Ate solids at age 6–10wk, 8% Ate solids at age 14wk, 20% Ate solids at age 6m, 64%	**Consumed daily:** **Age 6m (n=221)** Infant cereal, 92% Maize meal porridge, 20% **Age 9m (n=261)** Infant cereal, 81% Maize meal porridge, 44%
WC, urban Coloured Budree *et al.*, 2017[125]	2012–15	486	Cohort, 0–12m	Initially breastfed Exclusively breastfed up to 6m Breastfed at age 9m Breastfed at age 12m	96 12 66 65	Ate solids at age 6–10wk, 9% Ate solids at age 14wk, 19% Ate solids at age 6m, 82%	**Consumed daily:** **Age 6m** (n=290) Infant cereal, 82% Maize meal porridge, 9% **Age 9m (n=304)** Infant cereal, 56% Maize meal porridge, 24%
WC, urban Du Plessis *et al.*, 2016[126]	NS	117	<6m	Exclusively breastfed Exclusively bottle fed	38.5 19.7		

Table 4.22 Continued

EC, Eastern Cape; FS, Free State; NFCS, National Food Consumption Survey; NS, not specified; KZN, KwaZulu-Natal; LP, Limpopo Province; MP, Mpumalanga Province; NC, Northern Cape; PHC, primary health care; SADHS, South African Demographic and Health Survey; SANHANES, South African National Health and Nutrition Examination Survey; WC, Western Cape.
[1] Control group.
[2] 14% (n 9) mothers reported that they were HIV-positive; none of them initiated breastfeeding.

Table 4.23: Percentage of children under 2 years who consumed less-healthy foods

Province, area Ethnicity Year Reference	n	Age, months	Reference period	Salty snacks[1]	Chips, sweets	Sugary foods[2]	Cake, biscuits	Sweets	Sugary drinks	Cordial	Fizzy drinks	Fried foods	Processed meat
National 2016 SADHS[10]	1213	6–23	Previous day	43.9		35.2			17.9				
KZN, rural Black 2011 Faber *et al.*, 2016[119]	54 52 52	6–11 12–17 18–24	≥ 1d/wk ≥ 1d/wk ≥ 1d/wk	61.1 88.5 82.7			29.6 44.2 38.5	29.6 59.6 55.8		18.5 50.0 63.5	3.7 19.2 17.3		
KZN, urban Black 2011 Faber *et al.*, 2016[119]	54 52 52	6–11 12–17 18–24	≥ 1d/wk ≥ 1d/wk ≥ 1d/wk	42.9 76.9 78.8			20.4 51.9 50.0	20.4 51.9 50.0		16.7 51.9 51.9	3.7 21.2 23.1		
LP, rural Mushaphi *et al.*, 2008[42]	185	<12	≥ 3d/wk		5.9								
WC, urban Black Budree *et al.*, 2017[125]	204	12	Daily	30		44			54			35	59
WC, urban Coloured Budree *et al.*, 2017[125]	257	12	Daily	34		56			54			29	54

KZN, KwaZulu-Natal; LP, Limpopo Province; WC, Western Cape; wk, weeks.
[1] Salty snacks include NikNaks, Crisps, Flings, or Spookies.
[2] Sugary foods include chocolates, sweets, candies, pastries, cakes, or biscuits.

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Table 4.24: Percentage of children under 2 years who achieved minimum dietary diversity, minimum meal frequency and minimum acceptable diet

Province	Year	Age, months	n	DDS ≥4 (%)	Percentage of children consuming foods from each food group							Min meal frequency	Min acceptable diet	Reference
					Grains, roots, tubers	Legumes & nuts	Dairy	Flesh foods	Eggs	Vit A rich FAV	Other FAV			
National[1]	2016	6–8	146	23.5	-	-	-	-	-	-	-	57.3	16.8	SADHS 2016[10]
		9–11	143	47.9	-	-	-	-	-	-	-	48.3	16.7	
		12–17	311	49.9	-	-	-	-	-	-	-	49.3	21.7	
		18–23	267	63.7	-	-	-	-	-	-	-	53.9	31.1	
		6–23[2]	867	49.3	84[3]	14	51	47	43	52	43	51.9	22.9	
Eastern Cape		6-23	107	45.5	-	-	-	-	-	-	-	47.8	19.1	SADHS 2016[10]
Free State		6-23	36	61.2	-	-	-	-	-	-	-	62.3	42.3	
Gauteng		6-23	220	47.7	-	-	-	-	-	-	-	52.4	19.4	
KwaZulu-Natal		6-23	164	49.7	-	-	-	-	-	-	-	56.1	27.0	
Limpopo		6-23	96	29.7	-	-	-	-	-	-	-	47.3	6.7	
Mpumalanga		6-23	77	62.4	-	-	-	-	-	-	-	54.1	25.9	
Northern Cape		6-23	17	43.9	-	-	-	-	-	-	-	44.2	18.7	
North West		6-23	75	49.6	-	-	-	-	-	-	-	45.2	22.3	
Western Cape		6-23	74	65.9	-	-	-	-	-	-	-	54.5	40.2	
KZN, rural[1]	2011	6–11	54	5.6	88.9	20.4	11.1	11.1	5.6	14.8	7.4	-	-	Faber *et al.*, 2016[119]
Black		12–17	52	17.3	98.1	46.2	23.1	32.7	5.8	13.5	42.3	-	-	
		18–24	52	23.1	100	63.5	19.2	30.8	5.8	13.5	55.8	-	-	
KZN, urban[1]	2011	6–11	54	3.7	85.2	13.0	18.5	9.3	5.6	16.7	22.2	-	-	Faber *et al.*, 2016[119]
Black		12–17	52	21.2	100	46.2	30.8	40.4	5.8	11.5	36.5	-	-	
		18–24	52	21.2	100	34.6	28.8	51.9	5.8	11.5	44.2	-	-	
WC, urban[4]	2012–15													Budree *et al.*, 2017[125]
Black		6[5]	221	4	96	0.9	20	3	1	5	46	-	-	
Coloured		6[5]	290	6	91	2	48	4	4	17	18	-	-	
Black		9[5]	261	21	93	9	43	22	8	16	59	-	-	
Coloured		9[5]	304	26	81	15	74	19	12	29	38	-	-	
Black		12[5]	204	80	96	6	93	82	68	-	93	-	-	
Coloured		12[5]	257	71	96	2	92	74	56	-	92	-	-	
WC, urban[1]		6–23	205	44	-	-	-	-	-	-	-	70.7	44	Du Plessis *et al.*, 2016[126]

DDS, dietary diversity score; FAV, fruits and vegetables; FFQ, Food frequency questionnaire.
[1]Based on 24-hour recall;
[2]Breastfed and non-breastfed children combined;
[3]Includes fortified infant foods but excludes roots and tubers; roots and tubers were consumed by 43% children;
[4]Based on 7-day FFQ; DDS calculated based on food groups eaten daily;
[5]Cohort, birth to 12 months.

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Table 4.25: Mean dietary diversity score, percentage of children with low dietary diversity and food groups consumed

Province	Year	*n*	Age, years†	Indicator	Food group	%	Low DDS	DDS Mean	Reference
EC, rural		234	6–18	FVS*, median 22.9 (low FVS) FGDS[§], median 8.0 (high FGDS) FGDS, medium (4–5): 5.6%; high (6–9): 94.4%					Oldewage-Theron & Kruger, 2017[104]
GP, urban		220[1]	5–9	24-hour, 9 groups			DDS <4: 37.5%	4.2	Shiau *et al.*, 2017[63]
NC	2010/11	150	24–59m	24-hour, 9 groups			DDS <4: 55.7%	3.34 ± 1.06	Nel *et al.*, 2014[118]
National	1999	2200	1–8	24-hour, 9 groups	**Food group**	**%**		3.58 ± 1.37	Steyn *et al.*, 2006[129]
					Grains, roots & tubers	99.6			
					Legumes & nuts	19.7			
					Dairy products	55.8			
					Flesh foods	54.1			
					Eggs	13.3			
					Vit A-rich FAV	23.8			
					Other vegetables	30.8			
					Other fruit	22.0			
					Fats	38.9			
WC, rural	2009	998	Grade 4 9.9 ± 0.98	24-hour, 9 groups	**Food group**	**%**	**DDS ≤4:** 49%	4.56 ± 1.29 I 4.54 ± 1.22 C	Steyn *et al.*, 2015[130]
					Grains, roots & tubers	100			
					Legumes & nuts	54.4			
					Dairy products	73.7			
					Flesh foods	84.9			
					Eggs	13.2			
					Vit A-rich FAV	16.0			
					Other vegetables	22.7			
					Other fruit	21.7			
					Fats	68.9			
WC urban & rural	2008	717	Grade 4 10–11	24-hour, 9 groups			DDS ≤4: 47.1%		Abrahams *et al.*, 2011[51]

C, control group; DDS, dietary diversity score; EC, Eastern Cape; FAV, fruits and vegetables; FGDS, food group diversity score; FVS, food variety score; GP, Gauteng province; I, intervention group; NC, Northern Cape; WC, Western Cape.
† Age of children reported in years, unless indicated differently in months (m).
*FVS defined as the number of foods consumed over a 7-day period.
§ FGDS defined as the number of food groups (out of nine) consumed over a 7-day period
[1]HIV-uninfected group.

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Table 4.26: Top 15 foods consumed by children, 1 to 9 years old, on the day of recall, nationally and per province, as reported in the NFCS 1999

Province	National	Eastern Cape	Free State	Gauteng	KwaZulu-Natal
Reference	Labadarios *et al.*, 2000[109]	Labadarios *et al.*, 2000[109]	Labadarios *et al.*, 2000[109]	Labadarios *et al.*, 2000[109]	Labadarios *et al.*, 2000[109]
Location	Rural & Urban	Rural & Urban	Rural & Urban	Rural & Urban	Rural & Urban
Year	1999	1999	1999	1999	1999
Age, years	1–9	1–9	1–9	1–9	1–9
Sample size, *n*	2868	424	208	427	555
Assessment method	24-hour recall	24-hour recall	24-hour recall	24-hour recall	24-hour recall
Top foods	**Based on % consumers on day of recall:**	**Based on % consumers on day of recall:**	**Based on % consumers on day of recall:**	**Based on % consumers on day of recall:**	**Based on % consumers on day of recall:**
1	Maize meal, 77.6% *Ave portion*:* 221g *Amount/day:* 442g	Sugar (white), 80.2% *Ave portion:* 11g *Amount/day:* 13g	Maize meal, 95.2% *Ave portion:* 225g *Amount/day:* 541g	Sugar (white), 80.3% *Ave portion:* 12g *Amount/day:* 18g	Maize meal, 80.4% *Ave portion:* 210g *Amount/day:* 420g
2	Sugar (white), 76.2% *Ave portion:* 14g Amount/day: 21g	Maize meal, 79.0% *Ave portion:* 258g *Amount/day:* 439g	Whole milk, 65.9% *Ave portion:* 102mL *Amount/day:* 203mL	Maize meal, 80.3% *Ave portion:* 194g *Amount/day:* 369g	Sugar (white), 76.2% *Ave portion:* 15g *Amount/day:* 20g
3	Tea, 46.3% *Ave portion:* 196mL *Amount/day:* 235mL	Tea, 46.2% *Ave portion:* 213mL *Amount/day:* 277mL	Sugar (white), 58.2% *Ave portion:* 12g *Amount/day:* 16g	Whole milk, 54.6% *Ave portion:* 81mL *Amount/day:* 130mL	Tea, 56.6% *Ave portion:* 188mL *Amount/day:* 226mL
4	Whole milk, 41.8% *Ave portion:* 93mL *Amount/day:* 167mL	Rice (white), 37.3% *Ave portion:* 154g *Amount/day:* 185g	Tea, 45.7% *Ave portion:* 183mL *Amount/day:* 220mL	Tea, 47.1% *Ave portion:* 192mL *Amount/day:* 230mL	Rice (white), 37.5% *Ave portion:* 133g *Amount/day:* 173g
5	Bread (brown), 37.2% *Ave portion:* 78g *Amount/day:* 101g	Whole milk, 36.6% Ave portion: 106g *Amount/day:* 159g	Bread (brown), 34.1% Ave portion: 82g *Amount/day:* 98g	Bread (brown), 44.7% Ave portion: 66g *Amount/day:* 86g	Bread (brown), 37.5% Ave portion: 87g *Amount/day:* 104g
6	Rice (white), 26.9% *Ave portion:* 117g *Amount/day:* 140g	Bread (white), 36.1% *Ave portion:* 78g *Amount/day:* 102g	Cabbage group, 17.8% *Ave portion:* 60g *Amount/day:* 84g	Margarine (hard), 32.1% *Ave portion:* 9g *Amount/day:* 12g	Margarine (hard), 32.1% *Ave portion:* 9g *Amount/day:* 13g
7	Bread (white), 26.9% *Ave portion:* 69g *Amount/day:* 96g	Margarine (hard), 24.1% *Ave portion:* 10g *Amount/day:* 13g	Chicken, 16.3% *Ave portion:* 58g *Amount/day:* 81g	Chicken, 29.7% *Ave portion:* 58g *Amount/day:* 70g	Bread (white), 29.5% *Ave portion:* 83g *Amount/day:* 108g
8	Margarine (hard), 26.5% *Ave portion:* 9g *Amount/day:* 13g	Maas/Sour milk, 22.2% *Ave portion:* 284mL *Amount/day:* 369mL	Potatoes, 15.4% *Ave portion:* 80g *Amount/day:* 112g	Bread, white 26.5% *Ave portion:* 70g *Amount/day:* 91g	Sour milk/maas, 27.6% *Ave portion:* 278g *Amount/day:* 334g
9	Chicken, 25.3% *Ave portion:* 67g *Amount/day:* 80g	Potatoes, 22.2% *Ave portion:* 108g *Amount/day:* 129g	Green leaves, 12.5% *Ave portion:* 95g *Amount/day:* 124g	Beef, 25.1% *Ave portion:* 73g *Amount/day:* 88g	Whole milk, 26.3% *Ave portion:* 87mL *Amount/day:* 122mL
10	Potatoes, 22.6% *Ave portion:* 90g *Amount/day:* 117g	Samp-and-beans, 21.5% *Ave portion:* 269g *Amount/day:* 350g	Margarine (hard), 11.1% *Ave portion:* 13g *Amount/day:* 14g	Fruit, other[1], 19.4% *Ave portion:* 106g *Amount/day:* 149g	Potatoes, 26.1% *Ave portion:* 106g *Amount/day:* 149g

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Table 4.26 Continued					
Province	**National**	**Eastern Cape**	**Free State**	**Gauteng**	**KwaZulu-Natal**
Reference	Labadarios *et al.*, 2000[109]	Labadarios *et al.*, 2000[109]	Labadarios *et al.*, 2000[109]	Labadarios *et al.*, 2000[109]	Labadarios *et al.*, 2000[109]
Location	Rural & Urban	Rural & Urban	Rural & Urban	Rural & Urban	Rural & Urban
Year	1999	1999	1999	1999	1999
Age, years	1–9	1–9	1–9	1–9	1–9
Sample size, *n*	2868	424	208	427	555
Assessment method	24-hour recall	24-hour recall	24-hour recall	24-hour recall	24-hour recall
Top foods	**Based on % consumers on day of recall:**	**Based on % consumers on day of recall:**	**Based on % consumers on day of recall:**	**Based on % consumers on day of recall:**	**Based on % consumers on day of recall:**
11	Beef, 17.2% *Ave portion:* 90g *Amount/day:* 108g	Bread (brown), 20.0% *Ave portion:* 82g *Amount/day:* 90g	Beef, 10.1% *Ave portion:* 66g *Amount/day:* 86g	Rice (white), 17.8% *Ave portion:* 106g *Amount/day:* 117g	Chicken, 25.2% *Ave portion:* 87g *Amount/day:* 104g
12	Fruit (other)1, 15.3% *Ave portion:* 114g *Amount/day:* 159g	Cabbage group, 15.3% *Ave portion:* 73g *Amount/day:* 87g	Fruit, other1, 9.1% *Ave portion:* 125g *Amount/day:* 162g	Potatoes, 17.3% *Ave portion:* 78g *Amount/day:* 94g	Legumes, 24.1% *Ave portion:* 166g *Amount/day:* 199g
13	Cabbage group, 14.5% *Ave portion:* 71g *Amount/day:* 82g	Cordial with water, 12.5% *Ave portion:* 279mL *Amount/day:* 335mL	Fruit, vit A-rich, 9.1% *Ave portion:* 163g *Amount/day:* 195g	Vegetable, other[2], 17.1% *Ave portion:* 70g *Amount/day:* 84g	Non-dairy milk, 20.7% *Ave portion:* 6g *Amount/day:* 7g
14	Cordial with water, 13.7% *Ave portion:* 211mL *Amount/day:* 295mL	Chicken, 12.3% *Ave portion:* 62g *Amount/day:* 68g	Rice (white), 8.7% *Ave portion:* 73g *Amount/day:* 102g	Rooibos tea, 16.9% *Ave portion:* 188mL *Amount/day:* 245mL	Beef, 18.6% *Ave portion:* 119g *Amount/day:* 143g
15	Eggs, 13.0% *Ave portion:* 67g *Amount/day:* 74g	Soup, 12.0% *Ave portion:* 151g *Amount/day:* 181g	Eggs, 8.2% *Ave portion:* 91g *Amount/day:* 100g	Eggs, 16.9% *Ave portion:* 72g *Amount/day:* 79g	Vegetable, other[2], 13.9% *Ave portion:* 55g *Amount/day:* 71g

*Average portion and Amount per day are reported for those who consumed the food item on the day of recall.
[1] Fruit other than those rich in vitamin A and C.
[2] Vegetables other than green leafy, cabbage group or pumpkin group.

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Table 4.26 (continued). Top 15 foods consumed by children, 1 to 9 years old, on the day of recall, nationally and per province, as reported in the NFCS 1999

Province	**Limpopo**	**Mpumalanga**	**Northern Cape**	**North West**	**Western Cape**
Reference	Labadarios *et al*., 2000[109]	Labadarios *et al*., 2000[109]	Labadarios *et al*., 2000[109]	Labadarios *et al*., 2000[109]	Labadarios *et al*., 2000[109]
Location	Urban and Rural	Urban and Rural	Urban and Rural	Urban and Rural	Urban and Rural
Year	1999	1999	1999	1999	1999
Age, years	1–9	1–9	1–9	1–9	1–9
Sample size, *n*	352	162	153	230	357
Assessment method	24-hour recall	24-hour recall	24-hour recall	24-hour recall	24-hour recall
Top foods	**Based on % consumers on day of recall:**	**Based on % consumers on day of recall:**	**Based on % consumers on day of recall:**	**Based on % consumers on day of recall:**	**Based on % consumers on day of recall:**
1	Maize meal, 94.9% *Ave portion**: 238g *Amount/day:* 534g	Maize meal, 80.9% *Ave portion:* 244g *Amount/day:* 463g	Sugar (white), 79.7% *Ave portion:* 14g *Amount/day:* 24g	Maize meal, 90.9% *Ave portion:* 220g *Amount/day:* 483g	Sugar (white), 85.7% *Ave portion:* 14g *Amount/day:* 23g
2	Sugar (white), 59.1% *Ave portion:* 13g *Amount/day:* 16g	Sugar (white), 79.6% *Ave portion:* 13g *Amount/day:* 17g	Maize meal, 77.8% *Ave portion:* 222g *Amount/day:* 400g	Sugar (white), 84.8% *Ave portion:* 12g *Amount/day:* 22g	Whole milk, 63.9% *Ave portion:* 118mL *Amount/day:* 247mL
3	Bread (brown), 58.2% *Ave portion:* 98g *Amount/day:* 117g	Bread (brown), 60.5% *Ave portion:* 97g *Amount/day:* 116g	Bread (white), 45.8% *Ave portion:* 50g *Amount/day:* 75g	Whole milk, 63.9% *Ave portion:* 71mL *Amount/day:* 141mL	Rice (white), 57.4% *Ave portion:* 68g *Amount/day:* 82g
4	Green leaves, 46.3% *Ave portion:* 91g *Amount/day:* 155g	Tea, 50.6% *Ave portion:* 206mL *Amount/day:* 227mL	Tea, 43.1% *Ave portion:* 165mL *Amount/day:* 215mL	Tea, 60.0% *Ave portion:* 188mL *Amount/day:* 225mL	Margarine (hard), 56.9% *Ave portion:* 10g *Amount/day:* 17g
5	Tea, 42.0% *Ave portion:* 206mL *Amount/day:* 227mL	Chicken, 36.4% *Ave portion:* 60g *Amount/day:* 76g	Whole milk, 41.2% *Ave portion:* 83mL *Amount/day:* 125mL	Bread (brown), 34.3% *Ave portion:* 82g *Amount/day:* 107g	Bread (white), 56.9% *Ave portion:* 56g *Amount/day:* 89g
6	Chicken, 28.7% *Ave portion:* 51g *Amount/day:* 71g	Whole milk, 27.2% *Ave portion:* 116mL *Amount/day:* 186mL	Rice (white), 22.2% *Ave portion:* 84g *Amount/day:*109g	Cabbage group, 27.0% *Ave portion:* 68g *Amount/day:* 75g	Potatoes, 48.2% *Ave portion:* 83g *Amount/day:* 99g
7	Non-dairy milk, 17.3% *Ave portion:* 6g *Amount/day:* 7g	Non-dairy milk, 5.9% *Ave portion:* 6g *Amount/day:* 6g	Mutton, 20.3% *Ave portion:* 105g *Amount/day:* 136g	Chicken, 24.8% *Ave portion:* 60g *Amount/day:* 66g	Cordial with water, 42.9% *Ave portion:* 192mL *Amount/day:* 307mL
8	Rooibos tea, 15.6% *Ave portion:* 198mL *Amount/day:* 218mL	Beef, 21.6% *Ave portion:* 74g *Amount/day:* 81g	Bread (brown), 19.0% *Ave portion:* 63g *Amount/day:* 95g	Mabella, 23.5% *Ave portion:* 264g *Amount/day:* 343g	Fruit (other)[1], 40.9% *Ave portion:* 121g *Amount/day:* 169g
9	Whole milk, 13.4% *Ave portion:* 96mL *Amount/day:* 144mL	Potatoes, 21.0% *Ave portion:* 75g *Amount/day:* 98g	Potatoes, 18.3% *Ave portion:* 75g *Amount/day:* 98g	Potatoes, 20.0% *Ave portion:* 102g *Amount/day:* 122g	Chicken, 36.4% *Ave portion:* 71g *Amount/day:* 85g
10	Beef, 13.1% *Ave portion:* 94g *Amount/day:*131g	Rooibos tea, 19.8% *Ave portion:* 202mL *Amount/day:*222mL	Coffee, 17.0% *Ave portion:* 176mL *Amount/day:* 299mL	Beef, 15.2% *Ave portion:* 81g *Amount/day:* 97g	Maize meal, 31.1% *Ave portion:* 232g *Amount/day:* 278g

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Table 4.26 Continued

Province	Limpopo	Mpumalanga	Northern Cape	North West	Western Cape
Reference	Labadarios *et al.*, 2000[109]	Labadarios *et al.*, 2000[109]	Labadarios *et al.*, 2000[109]	Labadarios *et al.*, 2000[109]	Labadarios *et al.*, 2000[109]
Location	Urban and Rural	Urban and Rural	Urban and Rural	Urban and Rural	Urban and Rural
Year	1999	1999	1999	1999	1999
Age, years	1–9	1–9	1–9	1–9	1–9
Sample size, *n*	352	162	153	230	357
Assessment method	24-hour recall	24-hour recall	24-hour recall	24-hour recall	24-hour recall
Top foods	**Based on % consumers on day of recall:**	**Based on % consumers on day of recall:**	**Based on % consumers on day of recall:**	**Based on % consumers on day of recall:**	**Based on % consumers on day of recall:**
11	Fruit, other[1], 11.9% *Ave portion:* 126g *Amount/day:* 151g	Cabbage group, 19.8% *Ave portion:* 66g *Amount/day:* 86g	Chicken, 17.0% *Ave portion:* 62g *Amount/day:* 80g	Rooibos tea, 14.3% Ave portion: 183mL *Amount/day:* 256mL	Breakfast cereal, 31.1% *Ave portion:* 38g *Amount/day:* 38g
12	Margarine (hard), 11.4% *Ave portion:* 8g *Amount/day:* 10g	Margarine (hard), 18.5% *Ave portion:* 8g *Amount/day:* 10g	Margarine (hard), 14.4% *Ave portion:* 8g *Amount/day:* 10g	Vegetable, other[2], 13.0% *Ave portion:* 56g *Amount/day:* 62g	Beef, 29.4% *Ave portion:* 90g *Amount/day:* 108g
13	Peanut butter, 9.4% *Ave portion:* 13g *Amount/day:* 15g	Eggs, 17.9% *Ave portion:* 72g Amount/day: 79g	Sweet spreads, 13.7% *Ave portion:* 18g *Amount/day:* 23g	Rice (white), 12.6% *Ave portion:* 138g *Amount/day:* 152g	Bread (brown), 28.3% *Ave portion:* 60g *Amount/day:* 90g
14	Eggs, 9.4% *Ave portion:* 70g *Amount/day:* 77g	Fruit, other1, 14.8% *Ave portion:* 118g *Amount/day:* 165g	Beef, 13.7% *Ave portion:* 79g *Amount/day:* 87g	Bread (white), 11.7% *Ave portion:* 90g *Amount/day:* 99g	Salty snacks, 26.6% *Ave portion:* 27g *Amount/day:* 32g
15	Vegetable, other[2], 8.8% *Ave portion:* 75g *Amount/day:* 105g	Rice (white), 14.2% *Ave portion:* 123g *Amount/day:* 172g	Eggs, 13.1% *Ave portion:* 65g *Amount/day:* 71g	Margarine (hard), 11.3% *Ave portion:* 7.5g *Amount/day:* 9g	Sweets, 24.4% *Ave portion:* 23g *Amount/day:* 28g

*Average portion and Amount per day are reported for those who consumed the food item on the day of recall.
[1] Fruit other than those rich in vitamin A and C
[2] Vegetables other than green leafy, cabbage group or pumpkin group

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Table 4.27: Top foods consumed by children under 5 years old

Province	KwaZulu-Natal	KwaZulu-Natal	KwaZulu-Natal	KwaZulu-Natal[4]
Reference	Faber, 2005[97]	Faber & Benadé, 2001[45]	Faber *et al.*, 2001[46]	Faber *et al.*, 2013[131]
Location	Rural, Black	Rural, Black	Rural, Black	Urban, Black
Year	2002	2000	1999	2007
Age, years †	6–12m	4–24m	2–5	2–5
Sample size, *n*	75	50	154	73
Assessment method	24-hour recall	24-hour recall	24-hour recall	2x 24-hour recall
Top foods	**Based on % consumers on day of recall:[1] Average portion Average amount per day[2]**	**Based on % consumers on day of recall: Average portion**	**Based on % consumers on day of recall:[3] Average portion**	**Based on number of times reported over 2-day recall period; re-ordered according to % consumers: Average portion Average amount per day[2]**
1	Maize meal porridge (soft), 82% *Ave portion:* 115g *Amount/day:* 188g	Oil, 80% *Ave portion:* 3mL	Maize meal porridge (stiff), 77% *Ave portion:* 250g	Sugar, 96% *Ave portion:* 10g *Amount/day:* 24g
2	Breast milk, 78%	Maize meal porridge (soft), 68% *Ave portion:* 130g	Tea, 71% *Ave portion:* 170mL	Maize meal porridge (soft, stiff), 89% *Ave portion:* 175g *Amount/day:* 444g
3	Rice, 38% *Ave portion:* 45g *Amount/day: 53g*	Sugar, 68% *Ave portion:* 5g	Bread (brown, white, homemade), 70% *Ave portion:* 60g	Bread (brown or white), 94% *Ave portion:* 65g *Amount/day: 138g*
4	Formula milk, 33% *Ave portion:* 20g (dry product) *Amount/day:* 70g (dry product)	Beans (legumes), 62% *Ave portion:* 65g	Beans (legumes), 56% *Ave portion:* 115g	Rice, 93% *Ave portion:* 85g *Amount/day:* 153g
5	Infant cereals, 31% *Ave portion:* 20g (dry product) *Amount/day:* 31g (dry product)	Rice, 60% *Ave portion:* 53g	Rice, 53% *Ave portion:* 130g	Cordial with water, 71% *Ave portion:* 190mL *Amount/day:* 420mL
6	Legumes, 24% *Ave portion:* 50g *Amount/day: 57g*	Maize meal porridge (stiff), 58% *Ave portion:* 115g	Cabbage, 37% *Ave portion:* 95g	Margarine (hard), 62% *Ave portion:* 10g *Amount/day:* 18g
7	Peanut butter, 22% *Ave portion:* 5g *Amount/day:* 6g	Margarine (hard), 56% *Ave portion:* 5g	Maize meal porridge (soft), 32% *Ave portion:* 225g	Tea, 59% *Ave portion:* 175mL *Amount/day:* 281mL
8	Potato, 21% *Ave portion:* 80g *Amount/day:* 91g	Breast milk, 54%	Potato, 29% *Ave portion:* 130g	Milk, 52% *Ave portion:* 105mL *Amount/day:* 185mL
9	Maize meal porridge (stiff), 17% *Ave portion:* 90g *Amount/day:* 93g	Pumpkin/butternut, 46% *Ave portion:* 70g	Non-dairy creamer, 28% *Ave portion:* 5g	Legumes, 66% *Ave portion:* 90g *Amount/day:* 126g

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Table 4.27 Continued

Province	**KwaZulu-Natal**	**KwaZulu-Natal**	**KwaZulu-Natal**	**KwaZulu-Natal**[4]
Reference	Faber, 2005[97]	Faber & Benadé, 2001[45]	Faber *et al.*, 2001[46]	Faber *et al.*, 2013[131]
Location	Rural, Black	Rural, Black	Rural, Black	Urban, Black
Year	2002	2000	1999	2007
Age, years †	6–12m	4–24m	2–5	2–5
Sample size, *n*	75	50	154	73
Assessment method	24-hour recall	24-hour recall	24-hour recall	2x 24-hour recall
Top foods	**Based on % consumers on day of recall:**[1] **Average portion** **Average amount per day**[2]	**Based on % consumers on day of recall:** **Average portion**	**Based on % consumers on day of recall:**[3] **Average portion**	**Based on number of times reported over 2-day recall period; re-ordered according to % consumers:** **Average portion** **Average amount per day**[2]
10	Jarred baby foods, 17% *Ave portion:* 135g *Amount/day:* 165g	Tea, 36% *Ave portion:* 185mL	Banana, 26% *Ave portion:* 75g	Potato, 42% *Ave portion:* 70g *Amount/day:* 99g
11	Pumpkin / butternut, 14% *Ave portion:* 80g *Amount/day:* 82g	Imifino, 26% *Ave portion:* 45g	Orange, 26% *Ave portion:* 120g	Breakfast cereal, 31.1% *Ave portion:* 38g *Amount/day:* 38g
12	Orange, 12% *Ave portion:* 115g *Amount/day:* 115g	Potato, 26% *Ave portion:* 105g	Eggs, 25% *Ave portion:* 65g	
13	Banana, 9% *Ave portion:* 60g *Amount/day:* 60g	Bread (brown), 24% *Ave portion:* 60g	Imifino, 18% *Ave portion:* 100g	
14	Yoghurt, 9% *Ave portion:* 130g *Amount/day:* 139g	Formula milk, 18% *Ave portion:* 145mL	Pumpkin, 12% *Ave portion:* 90g	
15	Milk powder, 9% *Ave portion:* 20g *Amount/day:* 59g	Bread (white or homemade), 16% *Ave portion:* 45g	Tomato-and-onion, 12% *Ave portion:* 150g	

† Age of children reported in years, unless indicated differently in months (m).
[1] Sugar and fats are not listed, as these were often added to foods but were not coded separately.
[2] Calculated as: (number of times reported x average portion)/number of consumers.
[3] Sugar, oil, margarine and hydrogenated plant fat were not listed as these food items often are included in dishes and used during food preparation and were not coded separately.
[4] Average per capita intake of vegetables and/or fruit: 99g. Contribution of vegetables and/or fruit towards total intake, for children who consumed vegetables and/or fruit during the recall period: fibre, 16%; calcium, 13%; vitamin A, 28% and vitamin C, 47%.

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Table 4.28: Top foods consumed by children under 5 years old

Province	KwaZulu-Natal	Limpopo	Northern Cape	Western Cape
Reference	Faber *et al.*, 2015[78]	Faber *et al.*, 2015[78]	Faber *et al.*, 2015[78]	Faber *et al.*, 2015[78]
Location	Rural, Black	Rural, Black	Urban, Coloured	Urban, Coloured
Year	2011	2011	2011	2011
Age, years	1.5–6	1.5–6	1.5–6	1.5–6
Sample size, *n*	105	166	159	182
Assessment method	24-hour recall	24-hour recall	24-hour recall	24-hour recall
Top foods	**Based on % consumers on day of recall**	**Based on % consumers on day of recall**	**Based on % consumers on day of recall**	**Based on % consumers on day of recall**
1	Sugar, 88.6%	Maize meal, 97.6%	Sugar, 81.1%	Sugar, 85.7%
2	Maize meal, 81.0%	Sugar, 70.5%	Bread (brown or white), 62.3%	Bread (brown or white), 71.4%
3	Oil, 73.3%	Tea (including rooibos), 62.0%	Maize meal, 59.7%	Rice, 59.9%
4	Rice, 68.6%	Vegetables, excl vit A-rich, 50.6%	Tea (including rooibos), 50.9%	Fresh milk (mostly full cream), 59.3%
5	Bread (brown or white), 63.8%	Bread (brown or white), 48.8%	Rice, 50.3%	Salty snacks (chips/NikNaks), 56.6%
6	Tea (including rooibos), 59.0%	Chicken, 43.4%	Salty snacks (chips/NikNaks), 50.3%	Margarine, 53.8%
7	Margarine, 48.6%	Fruit, other than vit A-rich, 31.9%	Margarine, 44.0%	Tea (including rooibos), 46.7%
8	Legumes, 41.9%	Other cooked porridges, 31.3%	Chicken, 42.8%	Roots & tubers (mostly potato), 42.3%
9	Cold drinks, 35.2%	Milk powder (mostly full cream), 24.7%	Meat (beef, mutton, pork), 41.5%	Vegetables, excl vit A-rich, 41.2%
10	Fruit, other than vit A-rich, 31.4%	Fish, 19.3%	Fresh milk (mostly full cream), 41.5%	Meat (beef, mutton, pork), 38.5%
11	Chicken, 30.5%	Margarine, 18.1%	Cold drinks, 35.2%	Sweets, chocolate, cakes, 37.9%
12	Vegetables, excl vit A-rich, 29.5%	Cold drinks, 17.5%	Roots & tubers (mostly potato), 34.0%	Oil, 37.4%
13	Roots & tubers (mostly potato), 28.6%	Fresh milk (mostly full cream), 15.7%	Sweets, chocolate, cakes, 33.3%	Cold drinks, 36.8%
14	Salty snacks (NikNaks/crisps), 26.7%	Sour milk (maas), 15.1%	Oil, 32.1%	Chicken, 36.3%
15	Non-dairy creamer, 23.8%	Legumes, 15.1%	Vegetables, excl vit A-rich, 30.2%	Breakfast cereals, 32.4%
	Vegetables and fruit, 61.9%	**Vegetables and fruit, 70.5%**	**Vegetables and fruit, 48.4%**	**Vegetables and fruit, 61.5%**

[1] Sugar, oil, margarine and hydrogenated plant fat are not listed as these food items are often included in dishes and used during food preparation and were not coded separately.

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Table 4.29: Top foods consumed by primary school-age children

Province	Gauteng	Gauteng	Gauteng	Free State
Reference	Shiau *et al.*, 2017[63]	Samuel *et al.*, 2010[102]	Oldewage-Theron *et al.*, 2006[50]	Oldewage-Theron & Egal, 2010[105]
Location	Urban	Urban	Urban	Rural
Age, years	5–9	7–11	9–13	9–13
Sample size, *n*	220[1]	149	149	142
Assessment method	QFFQ, 6-month reference period	QFFQ (previous month)	QFFQ	3x 24-hour recall
Top foods	**Based on % energy contribution (%TE):**	**Based on mean quantity consumed; re-ordered based on % consumers Average amount per day (over a month period)**	**Based on mean quantity consumed (number of consumers not known) Average amount per day (over a month period)**	**Based on total daily mean amount consumed for the group:** re-ordered based on % consumers **Average amount per day (over a 3-day period) for consumers[2]**
1	Sunflower oil, 7.4%TE	Rice, 67% *Ave amount/day:* 39g	Maize meal (stiff) *Ave amount/day:* 404g	Maize meal (stiff), 99.3% *Ave amount/day:* 249g
2	Savoury snacks, 6.0%TE	Maize meal porridge (stiff), 66% *Ave amount/day:* 404g	Rooibos tea *Ave amount/day:* 221mL	Soup (meat and vegetable), 81.0% *Ave amount/day:* 70g
3	Bread (brown), 4.7%TE	Sugar (white), 66% *Ave amount/day:* 9g	Tea *Ave amount/day:* 203mL	Sugar, 62.0% *Ave amount/day:* 10g
4	Potato chips (fries), 4.0%	Apple, 66% *Ave amount/day:* 28g	Maize meal (soft) *Ave amount/day:* 137g	Tea, 56.3% *Ave amount/day:* 232mL
5	Maize porridge (stiff), 3.4%TE	Tomato-and-onion sauce, 65% *Ave amount/day:* 18g	Maize meal (crumbly) *Ave amount/day:* 87g	Bread (brown or white), 45.1% *Ave amount/day:* 113g
6	Bread (white), 3.1%TE	Tea, 62% *Ave amount/day:* 203mL	Coffee *Ave amount/day:* 81g	Chicken, 25.4% *Ave amount/day:* 79g
7	Bologna, beef/pork, 3.0%TE	Bread (brown), 59% *Ave amount/day:* 56g	Sorghum porridge *Ave amount/day:* 79g	Milk (full cream), 24.6% *Ave amount/day:* 203mL
8	Noodles, 2.4%TE	Banana, 51% *Ave amount/day:* 32g	Cold drink (carbonated) *Ave amount/day:* 66mL	Gravy, 19.0% *Ave amount/day:* 29g
9	Sausage, beef/pork, 2.0%TE	Milk (full cream), 47% *Ave amount/day:* 47mL	Bread (brown) *Ave amount/day:* 56g	Potato crisps, 18.3% *Ave amount/day:* 47g
10	Mayonnaise, 1.9%TE	Cordial with water, 45% *Ave amount/day:* 53mL	Cordial with water *Ave amount/day:* 53mL	Spinach, 16.9% *Ave amount/day:* 56g
11		Sorghum porridge, 40% *Ave amount/day:* 79g	Milk (full cream) *Ave amount/day:* 47mL	Potato, 16.2% *Ave amount/day:* 56g
12		Pear, 38% *Ave amount/day:* 47g	Samp-and-beans *Ave amount/day:* 42mg	Sausage pork, 13.4% *Ave amount/day:* 74g
13		Maize meal porridge (soft), 36% *Ave amount/day:* 137g	Pasta *Ave amount/day:* 40g	Boerewors, 12.0% *Ave amount/day:* 65g

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Table 4.29 Continued				
Province	**Gauteng**	**Gauteng**	**Gauteng**	**Free State**
Reference	Shiau *et al.*, 2017[63]	Samuel *et al.*, 2010[102]	Oldewage-Theron *et al.*, 2006[50]	Oldewage-Theron & Egal, 2010[105]
Location	Urban	Urban	Urban	Rural
Age, years †	5–9	7–11	9–13	9–13
Sample size, *n*	220[1]	149	149	142
Assessment method	QFFQ, 6-month reference period	QFFQ (previous month)	QFFQ	3x 24-hour recall
Top foods	**Based on % energy contribution (%TE):**	**Based on mean quantity consumed; re-ordered based on % consumers Average amount per day (over a month period)**	**Based on mean quantity consumed (number of consumers not known) Average amount per day (over a month period)**	**Based on total daily mean amount consumed for the group:** re-ordered based on % consumers **Average amount per day (over a 3-day period) for consumers[2]**
14		Cold drink (carbonated), 34% *Ave amount/day:* 66mL	Rice *Ave amount/day:* 39g	Cabbage, 10.6% *Ave amount/day:* 54g
15		Orange, 29% *Ave amount/day:* 31g	Orange *Ave amount/day:* 31g	Scone, 9.9% *Ave amount/day:* 119g

QFFQ, Quantified food frequency questionnaires; TE, total energy.
[1] HIV-uninfected group.
[2] Calculated as: (Average amount per day x number of consumers)/total sample

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Table 4.30: Top foods consumed by primary school-age children and adolescents

Province	KwaZulu-Natal[1]	KwaZulu-Natal
Reference	Faber *et al.*, 2013[131]	Napier & Hlambelo, 2014[103]
Location	Urban, Black	Urban
Year	2007	
Age, years	Grade 6,7 (12.7±1.2)	14–18
Sample size, *n*	399	61F
Assessment method	2x 24-hour recall	2x 24-hour recall
Top foods	**Based on % consumers on days of recall:** **Average portion**	**Top 20 foods were identified based on total amount consumed for the group** (re-ordered based on number of times reported for total group) **Average portion**
1	Bread (white or brown), 93% *Ave portion:* 110g	Bread (white or brown) (150x) *Ave portion:* 115g
2	Sugar, 90% *Ave portion:* 15g	Rice (93x) *Ave portion:* 306g
3	Rice, 90% *Ave portion:* 150g	Cordial diluted with water (72x) *Ave portion:* 276mL
4	Cordial with water, 66% *Ave portion:* 255mL	Polony (65x) *Ave portion:* 49g
5	Maize meal porridge (soft or stiff), 81% *Ave portion:* 300g	Maize-meal porridge (63x) *Ave portion:* 284g
6	Tea, 75% *Ave portion:* 310mL	Tea (40x) *Ave portion:* 251mL
7	Margarine (hard), 72% *Ave portion:* 20g	Milk, full cream (39x) *Ave portion:* 73mL
8	Legumes, 66% *Ave portion:* 177g	Chicken curry (23x) *Ave portion:* 139g
9	Potato, 42% *Ave portion:* 100g	Mixed vegetables (22x) *Ave portion:* 86g
10	Chicken, 48% *Ave portion:* 60g	Beans (legumes), cooked (20x) *Ave portion:* 120g
11		Egg, fried (19x) *Ave portion:* 93g
12		Chicken, fried (18x) *Ave portion:* 121g
13		Chicken stew, (17x) *Ave portion:* 177g
14		Ice block (frozen, flavoured water) (16x) *Ave portion:* 108g
15		Samp-and-beans (12x) *Ave portion:* 242g

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F, female.
[1] Average daily per capita intake of vegetables and/ fruit: 109g.
Contribution of vegetables and/or fruit towards total intake, for children who consumed vegetables and/or fruit during the recall period: fibre, 21%; calcium, 18%; vitamin A, 27% and vitamin C, 49%. Cost was the major constraint to not eating vegetables and/or fruit daily.

Table 4.31: Top 10 foods consumed by children

Province	**Limpopo**	**Limpopo**	**Limpopo**	**Limpopo**	**Limpopo**	**Limpopo**
Reference	Mamabolo *et al.*, 2006[34]	Mamabolo *et al.*, 2006[34]	MacIntyre & Du Plessis 2006[65]	MacIntyre & Du Plessis 2006[65]	MacIntyre & Du Plessis 2006[65]	MacIntyre & Du Plessis 2006[65]
Location	Rural (cohort)	Rural (cohort)	Urban	Rural	Urban	Rural
Year	2000/01	2002/03				
Age, years	1	3	10	10	15	15
Sample size, *n*	156	162	25	25	25	25
Assessment method	QFFQ	QFFQ	4x 24-hour recall	4x 24-hour recall	4x 24-hour recall	4x 24-hour recall
Top foods	**Most frequently consumed foods**	**Most frequently consumed foods**	**Based on % consumers:**	**Based on % consumers:**	**Based on % consumers:**	**Based on % consumers:**
1	Potato	Sugar	Bread (brown)	Maize meal porridge (fermented)	Bread (brown)	Maize meal porridge (fermented)
2	Bread (brown or white)	Maize meal	Maize meal porridge	Bread (brown)	Tea	Bread (brown)
3	Maize meal	Sweets	Margarine (hard)	Tea	Maize meal porridge (unfermented)	Tea
4	Milk	Salty snacks	Cordial with water	Sugar (brown)	Maize meal porridge (fermented)	Atchar
5	Banana	Potato	Tea	Spinach	Margarine (hard)	Maize meal porridge (unfermented)
6	Sugar	Bread (brown or white)	Sugar (white)	Orange	Sugar (white)	Orange
7	Eggs	Cabbage	Maize meal porridge (fermented)	Atchar	Orange	Sugar (brown)
8	Tea	Fish	Orange	Savoury snacks	Cordial with water	Avocado
9	Chicken	Tea	Bread (white)	Chicken (boiled)	Sugar (brown)	Sugar (white)
10	Orange	Banana	Savoury snacks	Maize meal porridge (unfermented)	Bread white	Fatcakes

QFFQ, Quantified food frequency questionnaire.

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Table 4.32: Frequency of certain foods consumed, expressed as a percentage (%) of children who consumed the food during the reference period

Province	KwaZulu-Natal			Eastern Cape			Limpopo		
Reference	Smuts *et al.*, 2008[121]			Smuts *et al.*, 2008[121]			Malongane & Mbhenyane, 2017[132]		
Location	Rural			Rural					
Year	2003			2003			2007–08		
Age, years	2–5			2–5			10–12		
Sample size, *n*	1222			864			602		
Days per week	**Days per week**	**1–3 d**	**≥4 d**	**Days per week**	**1–3 d**	**≥4 d**	**Days per week**	**1–3 d**	**≥4 d**
Flesh foods	Meat	22	26	Meat	20	8	Chicken neck, feet, liver	70.1	
	Chicken	25	27	Chicken	22	10	Chicken	63.5	
	Fish	17	21	Fish	10	5	Fish	76.2	
Eggs and dairy products	Eggs	13	28	Eggs	20	27	Eggs	72.6	
	Milk	12	37	Milk	13	23	Milk	58.6	
							Yoghurt	59.0	
Legumes and nuts							Peanuts	75.4	
							Beans	69.4	
							Peas	39.9	
Vegetables	Carrots	7	9	Carrots	8	6	Spinach	51.8	
	Pumpkin/butternut	17	26	Pumpkin/butternut	20	20	Traditional vegetables	53.2	
	Spinach	18	34	Spinach	19	19	Beetroot	59.3	
	Imifino*	15	37	Imifino	19	3	Cabbage	59.6	
Fruit	Mango	8	13	Mango	1	1	Apple	-	26.7
	Paw-Paw	8	12	Paw-Paw	2	1	Banana		18.9
Starchy foods							Porridge	-	93.5
							Bread	-	74.8
Unhealthy foods							Maize chips	60.6	-
							Sweets	56.6	-
							Potato chips	54.3	-
							Ice cream	51.5	-
							Artificial juice	41.3	-
							Carbonated drinks	11.0	-

*Imifino is a leafy, green vegetable that traditionally grows wild. It can be cooked and eaten in much the same way as spinach.

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Table 4.33: Dietary practices as reported in the National Youth Risk and Behaviour Study 2008[8]; nationally, per ethnicity and per province. Information is presented as a percentage of school children who frequently consumed (>4 days during the previous week) certain foods and the serving sizes for each food type

		Ethnicity					Province								
	Year	**SA**	**B**	**C**	**W**	**I**	**EC**	**FS**	**GP**	**KZN**	**LP**	**MP**	**NC**	**NW**	**WC**
Fresh fruit															
Eaten often (>4 days/week)	2008	58.4	59.4	52.3	52.1	50.3	50.5	62.8	58.6	62.6	57.4	61.6	58.4	58.1	55.9
	2011	**49.2**	**49.3**	**45.4**	**52.9**	**37.7**	**42.4**	**54.7**	**53.6**	**48.8**	**47.9**	**47.0**	**49.5**	**53.4**	**50.6**
Serving size (≥1 fruit)	2008	79.8	79.3	80.8	85.8	86.4	72.2	85.5	87.1	80.2	76.3	77.6	75.5	84.1	82.4
	2011	**74.9**	**74.2**	**79.5**	**84.3**	**84.5**	**71.0**	**77.0**	**82.3**	**70.7**	**70.2**	**76.7**	**80.1**	**78.7**	**80.6**
Uncooked vegetables															
Eaten often (>4 days/week)	2008	38.8	39.2	38.9	34.3	25.9	37.0	33.4	38.7	44.0	33.4	44.8	44.7	34.0	38.5
	2011	**33.9**	**34.0**	**35.7**	**33.3**	**23.0**	**31.2**	**31.1**	**34.2**	**37.8**	**32.3**	**30.6**	**35.0**	**33.4**	**36.3**
Serving size (≥1 cup)	2008	48.1	48.8	43.2	48.8	30.1	42.3	53.1	52.7	50.1	43.9	50.4	42.2	53.9	44.6
	2011	**40.4**	**40.2**	**40.8**	**48.3**	**23.1**	**34.4**	**42.1**	**43.3**	**34.5**	**41.7**	**46.9**	**42.7**	**46.9**	**44.6**
Cooked vegetables															
Eaten often (>4 days/week)	2008	50.3	49.8	52.7	52.1	40.8	49.8	51.3	50.1	53.9	45.5	51.4	55.7	51.6	46.4
	2011	**43.8**	**43.6**	**44.2**	**51.8**	**61.0**	**44.3**	**43.6**	**47.2**	**43.8**	**40.9**	**38.6**	**46.7**	**46.8**	**44.0**
Serving size (≥1 cup)	2008	60.9	61.5	56.5	62.0	51.7	56.1	69.1	65.7	62.1	57.8	59.2	50.5	66.7	57.4
	2011	**52.9**	**52.4**	**55.4**	**30.3**	**49.2**	**50.8**	**58.6**	**62.1**	**39.7**	**52.5**	**61.0**	**55.8**	**60.8**	**55.4**
Milk															
Eaten often (> 4days/week)	2008	44.0	41.8	49.9	61.7	50.9	39.6	42.9	46.1	46.4	39.9	43.0	47.8	43.6	51.0
	2011	**42.9**	**41.0**	**50.2**	**64.4**	**51.1**	**39.8**	**47.0**	**46.0**	**45.2**	**37.4**	**39.4**	**45.4**	**42.1**	**47.5**
Serving size (≥1 cup)	2008	67.8	67.7	65.2	69.6	66.1	65.2	70.9	75.7	66.0	65.2	65.6	62.5	73.9	62.8
	2011	**62.8**	**62.8**	**62.7**	**66.9**	**62.9**	**62.3**	**64.1**	**67.4**	**58.3**	**57.5**	**68.2**	**66.4**	**67.7**	**66.1**
Maize															
Eaten often (>4 days/week)	2008	63.0	65.1	54.9	50.7	32.3	56.7	73.4	64.9	60.9	67.4	66.4	58.3	67.7	52.7
	2011	**57.2**	**59.4**	**48.5**	**34.9**	**30.1**	**49.7**	**67.4**	**60.6**	**51.9**	**59.9**	**68.6**	**55.3**	**63.8**	**47.5**
Serving size (≥1 cup)	2008	69.7	71.7	62.6	58.4	41.8	65.9	79.0	70.0	72.1	70.3	67.5	62.3	75.7	60.1
	2011	**63.9**	**65.5**	**55.2**	**55.1**	**37.9**	**62.1**	**70.2**	**65.4**	**59.3**	**64.5**	**70.6**	**66.1**	**71.3**	**56.3**
Meat															
Eaten often (>4 days/week)	2008	52.2	49.6	65.4	67.0	45.0	42.2	49.7	58.9	56.1	44.4	53.0	61.2	52.3	63.0
	2011	**52.6**	**51.4**	**57.4**	**67.5**	**52.0**	**44.2**	**51.8**	**62.1**	**59.0**	**44.4**	**48.3**	**59.3**	**48.6**	**53.7**

Table 4.33 Continued

		Ethnicity					Province								
		SA	**B**	**C**	**W**	**I**	**EC**	**FS**	**GP**	**KZN**	**LP**	**MP**	**NC**	**NW**	**WC**
Meat															
Serving size (≥1 cup)	2008	65.4	64.5	68.2	73.6	60.1	58.0	72.3	70.9	64.5	64.6	62.9	62.1	70.2	67.4
	2011	**59.7**	**58.6**	**64.6**	**76.4**	**62.9**	**55.6**	**64.3**	**67.8**	**54.1**	**53.9**	**63.5**	**67.8**	**65.8**	**64.4**
Fast food															
Eaten often (>4 days/week)	2008	39.2	40.1	42.6	24.0	34.8	35.6	35.7	40.3	43.3	36.7	41.2	44.6	35.5	40.2
	2011	**37.7**	**38.8**	**36.3**	**19.9**	**33.4**	**34.2**	**37.4**	**35.6**	**44.7**	**36.5**	**36.4**	**36.7**	**34.7**	**35.0**
Serving size (Supersize)	2008	26.5	26.6	26.8	25.8	22.8	31.7	24.9	26.1	23.8	27.1	23.9	26.5	25.1	29.3
	2011	**21.8**	**21.9**	**23.0**	**18.1**	**19.6**	**22.0**	**25.9**	**23.5**	**20.5**	**20.1**	**22.2**	**22.6**	**21.2**	**21.6**
Cakes and biscuits															
Eaten often (>4 days/week)	2008	42.6	43.6	44.1	27.2	33.9	45.6	38.7	34.6	46.0	43.7	41.0	53.5	40.8	43.9
	2011	**38.9**	**40.0**	**38.6**	**17.0**	**37.1**	**35.2**	**39.7**	**35.5**	**46.4**	**39.5**	**31.9**	**42.5**	**37.5**	**37.3**
Serving size (See footnote)	2008	44.2	45.3	45.9	31.3	30.4	45.9	49.0	43.4	44.0	40.5	41.2	45.4	47.9	47.1
	2011	**40.4**	**40.8**	**47.0**	**23.3**	**33.2**	**37.0**	**41.6**	**40.7**	**43.4**	**33.8**	**45.4**	**42.1**	**40.2**	**44.6**
Cool drinks															
Eaten often (>4 days/week)	2008	50.3	49.2	57.4	48.7	59.3	45.3	48.3	58.0	51.0	41.5	50.6	60.3	55.7	56.2
	2011	**48.9**	**48.5**	**53.4**	**45.9**	**59.6**	**38.1**	**51.2**	**57.4**	**51.6**	**47.0**	**44.3**	**54.8**	**51.2**	**47.8**
Serving size (≥1 cup)	2008	53.5	52.2	64.6	55.7	56.4	45.2	61.5	61.7	51.7	48.6	49.7	58.2	59.6	60.9
	2011	**48.3**	**46.8**	**60.4**	**54.6**	**54.9**	**36.1**	**56.3**	**56.9**	**44.4**	**44.1**	**49.9**	**59.5**	**55.1**	**57.0**
Did not eat breakfast															
	2011	**17.7**	**18.1**	**14.9**	**13.9**	**16.2**	**19.0**	**12.9**	**17.3**	**19.3**	**19.1**	**15.8**	**12.1**	**14.7**	**18.3**

B, Black; C, Coloured; EC, Eastern Cape; F, Free State; GP, Gauteng Province; I, Indian; LP, Limpopo province; MP, Mpumalanga; NC, Northern Cape; NW, North West; SA, South Africa; W, White; WC, Western Cape; wk, week.

Fast foods include foods like hamburgers, fried chicken, boerewors roll, hot dog, hot chips, Gatsby (a baguette filled with hot chips, sauce, and other ingredients), pies, vetkoek (a small, unsweetened deep-fried dough) or polony.

Serving size for cake and biscuits: at least 2 slices of cake, 2 biscuits, doughnuts or koeksisters (a plaited doughnut dipped in sugar syrup).

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Table 4.34A: Fast foods, sugar-sweetened beverages, confectionery and salty snacks, meals and snacking of school-age children

Province	**Gauteng[1,2]**					**Gauteng[2]**			**Western Cape**	
Reference	Feeley & Norris, 2014[149]					Feeley *et al.*, 2013[133]			Steyn *et al.*, 2015[130]	
Location	Urban, Black (Cohort)					Urban, Black (Cohort)			Rural	
Year	2007					2003, 2005, 2007			2009	
Age, years	17– 18					13, 15, and 17			9.9 (0.98), Grade 4	
Sample size, *n*	720M; 731F					645M; 653F			998	
Assessment method	QFFQ, 7 days (median (IQR) number of times eaten during the last 7 days also reported)					QFFQ, 7 days			24-hour recall	
		Males		**Females**			**Males**	**Females**	**% children who ate the food the previous day**	
		%	**Median**	**%**	**Median**		**%**	**%**		
Fast food										
	Fast food (any)	100	11 (7, 16)	100	11 (7, 15)	**>3 times/week**			Processed meat	34
	Fried chips	37.1	5 (3, 7)	35.6	5 (3, 7)	13y	67.9	69.5	Fried food	22.0
	Vetkoek	18.6	4 (2, 6)	17.0	4 (2, 6)	15y	68.2	64.6	Fried potato chips	7.1
	Pie	12.4	4 (2, 6)	16.4	4 (2, 5)	17y	64.3	60.5	Pies	3
	Boerewors	8.1	2 (1, 3)	6.6	2 (2, 3)				Take away foods	0.6
	Fried fish	5.8	2 (1, 2)	5.5	2 (1, 2)					
Sugar sweetened beverages (SSB)										
	SSB (any)	100	8 (5, 11)	100	10 (6, 11)	**>2 times/week**			Cordials	44.1
	Soft drinks	79.9	7 (5, 10)	75.0	7 (5, 10)	13y	66.8	69.1	Carbonated drinks	13.1
	Squash	10.9	4 (2, 5)	12.8	3 (2, 5)	15y	70.1	71.4		
	Fruit juice	9.3	3 (2, 5)	12.2	4 (2, 5)	17y	66.8	68.9		
Confectionery										
	Confectionery (any)	100	11 (8, 15)	100	13 (9, 17)	**>7 times/week**			Sweets	28.3
	Sweets	60.5	8 (5, 10)	58.0	8 (5, 10)	13y	59.8	64.6	Cake/biscuits	6.2
	Cake	15.2	4 (2, 5)	16.5	3 (2, 5)	15y	64.3	75.8	Chocolate	4.1
	Doughnuts	2.1	2 (1, 3)	13.5	4 (2, 5)	17y	58.9	66.6		
	Chocolate	13.1	2 (2, 4)	9.7	3 (2, 5)					
	Ice cream	9.2	2 (2, 4)	2.3	2 (2, 3)					

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Table 4.34A Continued

		Males		Females			Males	Females	% children who ate the food the previous day	
		%	Median	%	Median		%	%		
Salty snacks										
	Salty snacks (any)	100	7 (5, 10)	100	7 (5, 10)				Potato crisps	55
	Crisps (potato, maize)	84.3	6 (5, 9)	89.0	6 (5, 9)					
	Peanuts	9.2	3 (2, 5)	8.2	3 (2, 4)					
	Popcorn	6.4	3 (2, 4)	2.8	2 (2, 5)					

Province	**Gauteng**[1,2]					**Gauteng**[2]			**Western Cape**	
Reference	Feeley & Norris, 2014[149]					Feeley *et al.*, 2013[133]			Steyn *et al.*, 2015[130]	
Location	Urban, Black (Cohort)					Urban, Black (Cohort)			Rural	
Year	2007					2003, 2005, 2007			2009	
Age, years	17– 18					13, 15, and 17			9.9 (0.98), Grade 4	
Sample size, *n*	720M; 731F					645M; 653F			998	
Assessment method	QFFQ, 7 days (median (IQR) number of times eaten during the last 7 days also reported)					QFFQ, 7 days			24-hour recall	
		Males		**Females**			**Males**	**Females**	**% children who ate the food the previous day**	
		%	**Median**	**%**	**Median**		**%**	**%**		
Snacking										
						TV snacks >3 times/week				
						13y	54.7	61.2		
						15y	51.0	60.5		
						17y	58.9	68.9		

IQR, inter quartile range; QFFQ, Quantified Food Frequency Questionnaire; SSB, sugar-sweetened beverages.

[1] Overall, mean added sugar intake from these purchased food items was estimated at 561.6 g/week for males and 485.3 g/week for females, respectively, and dietary salt at 4803 mg/week for males and 4 761 mg/week for females, respectively. Males and females consumed on average three times the recommended daily intake of added sugar, and more than half of the recommended daily salt intake from these purchased foods alone. Beverages (55.7%) and confectionery (44.2%) contributed the greatest amount to added sugar. Fast foods contributed the greatest amount to sodium (52.5%), followed by salty snacks (31.2%), confectionery (12.7%) and sweetened beverages (3.6%).

[2] Birth to twenty cohort.

[3] Sweetened beverage consumption was positively associated with BMI Z-score and fat mass in males, but not females.

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Table 4.34B: Fast foods, sugar-sweetened beverages, confectionery and salty snacks, meals and snacking of school-age children

Province	Gauteng		Gauteng		Mpumalanga		Mpumalanga	
Reference	Sedibe *et al.*, 2018[134]		Sedibe *et al.*, 2018[134]		Sedibe *et al.*, 2018[134]		Sedibe *et al.*, 2018[134]	
Location	Urban, Bt20		Urban, Bt20		Rural, AHDSS		Rural, AHDSS	
Year	2008-09		2008-09		2008-09		2008-09	
Age, years	13		15		11–12		14–15	
Sample size, *n*	760M 805F		747M 786F		105M 98F		89M 100F	
	Males %	**Females %**	**Males %**	**Females %**	**Males %**	**Females %**	**Males %**	**Females %**
Fast foods								
≤3 times/week	1.97	1.47	3.21	2.35	5.71	20.2	9.89	9.71
>3 times/week	98.03	98.26	96.79	97.65	94.26	89.8	90.1	90.29
Breakfast								
≤3 times/week	21.19	29.25	27.47	44.89	11.43	6.12	10	13.59
>3 times/week	78.81	70.75	72.53	55.1	88.57	93.88	90	86.41
Snacking								
≤3 times/week	51.71	48.29	1.03	2.11	84.76	77.55	1.1	0.97
>3 times/week	49.44	50.56	98.97	97.89	15.24	22.45	98.9	99.03

AHDSS, Agincourt Health and Socio-Demographic Surveillance System; Bt20, birth-to-twenty cohort; F, females; M, males.

Table 4.34C: Fast foods, sugar-sweetened beverages, confectionery and salty snacks, meals, and snacking

Province	KwaZulu-Natal				Limpopo	
Reference	Morar *et al.*, 2014[135]				Malongane *et al.*, 2017[132]	
Location	Urban					
Year					2007–2008	
Age, years	10–13				10–12	
Sample size, n & Socio-economic status (SES)	320 Low SES 320 Middle SES 320 High SES				602	
Assessment method	**Frequency of eating meals and snacks**	**Socio-economic status**			**Food Frequency Questionnaire**	
		Low %	**Middle %**	**High %**		
Breakfast	Eats breakfast daily	55.8	86.1	88	Breakfast >5 days/week	77.2
					None /occasionally	22.5
Meals	Three meals per day	59.6	84.1	90.1	3 or 4 meals / day	95
	Frequency of snacking					
	Continuously	6.7	18.9	30.3		
	Often daily	8.8	42.4	37.9		
	Seldomly	51.9	24.8	24.9		
	Never	32.5	13.9	6.9		
Foods	Eats vegetables daily	95.2	73.3	65		
	Prefer eating red meat	92.8	48.2	35.7		
	Ate junk food					
	Every day	35	13.1	5.7		
	Three times a week	38.9	29.2	24.8		
	Once a week	18.7	54	61.1		

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CHAPTER 5

THE NUTRITIONAL STATUS OF SOUTH AFRICAN ADULTS: A REVIEW OF THE LITERATURE PUBLISHED FROM 1997–2019 (NARRATIVE REVIEW BASED ON REFERENCE TABLES)

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5.1 INTRODUCTION

5.1.1 Background

In 1997, Vorster *et al.* published a review of the literature from 1975 to 1996 related to the nutritional status of South Africans. They described the problem of inadequate diet and malnutrition and highlighted the interrelated determinants of nutritional status that should be taken into account during the development of relevant policies and interventions.[1] Since that time, a number of national and local surveys have been completed. These include the National Food Consumption Survey (NFCS) in children aged 1–9 years in 1999,[2] which was followed in 2005 by the National Food Consumption Survey-Fortification Baseline (NFCS-FB);[3] three South African Demographic and Health Surveys (SADHS) in 1998,[4] 2003[5] and 2016;[6] and the South African National Health and Nutrition Examination Survey (SANHANES-1) in 2012.[7] Although these and other national surveys have provided much-needed information on the health and nutritional status of South Africans, they have not included a comprehensive assessment of the dietary intake of South African adults. Consequently, the need for a National Food Consumption Survey, which includes both children and adults, was identified.

In the absence of national data on the dietary intake of adults in South Africa, the nutrition fraternity have depended on local studies to provide information about the dietary intake and food consumption patterns of adults in the country. A 2011 review by Van Heerden and Schönfeldt reported a decline in the number of studies on food intake in South Africa from 1979–2010.[8] The authors emphasised the importance of focusing on food intake in addition to nutrient intake for the successful planning and implementation of food and nutrition policies, such as those related to fortification and food aid, as well as for the development and updating of food-based dietary guidelines and nutrient profiling. They reported that dietary intake studies in South Africa are complicated by 'the complex demographics of the population in relation to different ethnic and age groups, highly divergent economic circumstances and different cultural traditions affecting food intake'. This highlights the reality that although local studies have made an important contribution to the understanding of regional contexts, they are not representative of the situation in the country as a whole and often provide a fragmented picture of current circumstances.

It is, however, possible to integrate the findings from local studies to provide a more holistic picture of the nutrition situation in a country. To this end, a number of reviews of existing surveys, some of which include secondary data analyses and meta-analyses, have made an important contribution by providing a more comprehensive overview of the nutritional status of adult South Africans since 1997. They include:

- A review by Bourne *et al.* (2002) of the nutrition transition in the Black population of South Africa;[9]
- A secondary data analysis of local dietary surveys published between 1983 and 2000 by Steyn *et al.* (2003);[10]
- A secondary data analysis to determine the micronutrient intake of South African adults in 2007 after the introduction of the mandatory fortification of certain foods in 2003;[11]
- Reviews focusing on the prevalence and consequences of obesity in South Africa by Kruger *et al.* (2005)[12] and Van Der Merwe and Pepper (2006);[13]
- Links between nutritional status, agriculture and water by Wenhold and Faber (2008);[14]
- A comparative analysis to determine changes in food consumption in South Africa since 1994 by Ronquest-Ross *et al.* (2014);[15]
- A review of dietary surveys in the adult South African population from 2000–2015 by Mchiza *et al.* (2015);[16]
- Three reviews on food security in South Africa by Rose and Charlton (2002),[17] Klerk *et al.* (2004),[18] and Labadarios *et al.* (2011);[19]
- Three reviews on the nutritional status of older adults in South Africa by Charlton and Rose (2001),[20] Kimokoti and Hamer (2008),[21] and Trevisan *et al.* (2019);[22] and
- A systematic review on salt intakes in Sub-Saharan Africa.[23]

5.1.2 Aims of the review

The aims of this review were to:

- undertake electronic searches to identify the studies and reports on the nutritional status (dietary intake, biochemical indicators and anthropometry) of adults which were published between 1997 and 2019;
- categorise the studies according to each overarching study with publications emanating from each; year of data collection; site (province and specific location); geographical area (rural or urban); study design, population and sampling (including age, gender and ethnicity of participants, and sample size); and variables measured and methodology employed;
- summarise the anthropometric, biochemical and dietary data from these studies in table form (separately for males and females, and in chronological order according to age, ethnicity, province and geographical area for easy comparison); and
- identify trends and changes over time to describe the current situation in South Africa.

5.2 METHODOLOGY

5.2.1 Introduction

Only data from studies published between 1997 and 2019 and reports of national surveys are included in this review.

5.2.2 Inclusion and exclusion criteria

The following inclusion and exclusion criteria were followed:

Inclusion criteria

- Studies including anthropometric indicators (body mass index, waist circumference, hip circumference, body composition);
- Studies including biochemical indicators of nutritional status (vitamin A (serum retinol), haemoglobin (Hb), serum ferritin, transferrin receptor (TfR), markers of inflammation (ferritin and CRP), serum and red blood cell folate and serum vitamin B12, serum vitamin D, serum zinc and urinary iodine).
- Studies including an assessment of dietary intake (food intake, nutrient intake, food security, dietary diversity, dietary quality, dietary patterns);
- Studies including participants who were 15 years and older for assessment of dietary intake and older than 18 years for anthropometric and/or biochemical assessment.

Exclusion criteria

- Studies including participants who were pregnant or lactating;
- Studies including participants who were eligible to be included in the study because of their being diagnosed as having HIV, TB or a chronic condition (e.g. CHD, diabetes, cancer or disabled);
- Studies that were hospital-based.

5.2.3 Electronic search

An electronic search of peer-reviewed literature published between 1997 and 2019 was undertaken. Databases included:

- EBSCOHost (Academic Search Ultimate, Africa-Wide Information, CAB Abstracts, CINAHL with Full Text, GreenFILE, Health Source—Consumer Edition, Health Source: Nursing/Academic Edition, APA PsycArticles, APA PsycInfo, Sociology Source Ultimate, MEDLINE, MasterFILE Premier);
- Scopus; and
- Web of Science.

In addition to these, the reports of national surveys that had been undertaken since 1997 were downloaded.

For **dietary intake**, the following keywords were used:
"South Africa*"
(adult* or student* or elderly)

("diet* intake" or "energy intake" or "food intake" or "food habit*" or "diet* habit*" or "diet* survey*" or "diet* diversity" or "diet* quality" or "nutrition* status*" or "food secur*" or "nutrient intake" or "nutrition* intake*" or "nutrition* habit*" or "nutrition* survey*" or "nutrition* diversity*" or "nutrition* quality*" or "nutrition* secur*")

For **anthropometry**, the following keywords were used:
"South Africa*"
(adult* or student* or elderly)
("body mass index" or weight or height or "mid upper arm circumferenc*" or "waist circumferenc*" or "hip circumferenc*" or "body composition" or skinfold* or "fat percentage*" or anthropometr*)

For **biochemical indicators**, the following keywords were used:
"South Africa*"
(adult* or student* or elderly)
(biochem* or haemoglobin or hemoglobin or ferritin or transferrin or anaemi* or anemi* or iron or retinol or "vitamin A" or zinc or magnesium or "vitamin D" or folate or iodine or CRP or "fatty acid*")

It is possible that, despite all these efforts, there may be publications and reports with valuable information on nutritional status of South Africans that were missed. After screening and selecting all available titles, some documents could not be traced and are thus not included in the review.

5.2.4 Evidence and procedures

The Ebscohost search yielded 2024 studies (247 for dietary intake, 1221 for anthropometric indicators and 556 for biochemical indicators); Web of Science yielded 1535 studies (238 for dietary intake, 921 for anthropometric indicators and 376 for biochemical indicators); and Scopus yielded 3269 studies (633 for dietary intake, 1965 for anthropometric indicators and 671 for biochemical indicators).

All the study titles and relevant abstracts were read by the two authors who agreed on the eligibility of studies for inclusion in the review. Because three searches were performed, the number of duplicates was very high. After removing these duplicates and the studies that did not meet the inclusion criteria, a total of 195 studies remained. Studies were categorised (depicted in Table 5.1) according to the overarching study with publications emanating from each; year of data collection; site (province and specific location); geographical area (rural or urban); study design, population and sampling (including age, gender and ethnicity of participants, and sample size); and variables measured and methodology employed.

The descriptive data per variable of interest were extracted from the publications for presentation in the subsequent tables, as means and standard deviations or 95% confidence intervals, or medians and standard error, for continuous variables, while categorical variables were described by the percentage of participants with values in the different categories.

As far as biochemical indicators are concerned, publications that report on these variables often used different units. In these cases, the values were converted to the SI unit (preferably) or the most commonly used unit, using conversion software, in order to make comparisons possible.

5.3 RESULTS

The purpose of this section is to give an overview of the nutritional status of South Africans, focusing on the major nutritional problems and the most vulnerable groups. The results are depicted in tables, divided into three sections, namely anthropometric indicators, biochemical indicators and dietary intake.

5.3.1 Description of studies, study participants and methods used to assess nutritional status

As summarised in Table 5.1, the review includes the results of 97 overarching studies, with results of these studies published in 195 publications. The overarching studies include 11 national representative surveys, 10 of which are cross-sectional surveys and one a longitudinal study, with the number of participants ranging from 554 to 25,532 per survey. Additionally, seven international surveys with a South African component, of which five are cross-sectional surveys and two are longitudinal cohort studies, including 500 to 4223 participants per study, have been published. Among university/college students (constituting young adults), 16 cross-sectional studies, one a randomised controlled trial and one a prospective study (100 to 941 participants), were conducted during the reference period. The remaining 62 studies were regional (cite-specific) cross-sectional studies, with 13 to 7711 participants per study.

All studies (97) included female participants, while 78 also included male participants. In terms of ethnicity, 72 studies included Black Africans, 27 included Coloured participants (of mixed ancestry), 22 included Whites and 22 included Asian Indians (Indians). Participants of 15 years and older were included. Five of the national surveys, one international survey with a South African component and 12 regional studies reported data for ≥ 55 year-olds. While all but one of the national surveys reported data specifically for the age groups 55–64 years and ≥ 65 years, six other studies focused specifically on elderly ≥ 60 year-olds, and two on elderly ≥ 65 year olds.

The urban areas that were represented in these studies include urban, peri-urban and informal settlements. Of the 98 studies, 71 included an urban component, described as "urban" (three studies); "formal urban" (four studies); "informal urban" (four studies); "peri-urban" (18 studies); and "informal settlement" (eight studies). One study on laboratory values (EARISA study) did not define geographical area, but it was almost certainly urban, considering the population of the study. Of the total studies, 44 included a rural component, of which three were described as "non-urban", three as "rural formal" and five as "tribal".

In terms of the provinces that were included, all nine provinces were represented in 13 studies, whereas for the remaining studies, participants were included from the Western Cape in 26 studies; from the Eastern Cape in nine; from the Free State in 10; from the Northern Cape in one; from North West province in two; from Kwazulu-Natal in 18; from Gauteng in 13; from Mpumalanga in five; and from Limpopo province in 10 studies.

Of the 18 studies conducted on students, one did not define the province; four were conducted at the University of the North/ Limpopo and one at the University of Venda (thus five in Limpopo); one at the University of the Western Cape (UWC); and three at the University of Stellenbosch (US) (thus four in the Western Cape); one at the University of Fort Hare and one at Walter Sisulu University (thus two in the Eastern Cape); two at the University of the Free State (UFS); two at the University of Pretoria (UP) and one at the University of the Witwatersrand (WITS) (thus three in Gauteng province); and two at the University of KwaZulu-Natal (UKZN). Of the total of 98 studies, 79 included information on anthropometry, 34 on biochemistry and 52 on dietary intake.

The studies on dietary intake made use of quantified food frequency questionnaires (QFFQs) (nine studies) and 24-hour recall (26 studies), of which 12 used one 24-hour recall, two used two 24-hour recalls and three used three 24-hour recalls. In 10 studies, South

African Foodfinder Dietary Software was used to determine nutrient intake; in nine studies, the MRC Food Composition database was used; while one study made use of the USDA Food Composition database. Twelve (12) studies reported on dietary diversity and 19 on food security.

5.3.2 Anthropometric indicators

Data on anthropometric status are summarised in Tables 5.2.1 to 5.2.3. Anthropometric data were collected as part of 79 of the included studies. All of these included body mass index (BMI), mostly classifying results according to the World Health Organization's general cut-offs, as indicated in Tables 5.2.1 and 5.2.2 (except in two studies that classified underweight as < 20.0 kg/m^2). Waist circumference (WC) and waist-hip ratio (WHR) were reported in 36 and 17 studies, respectively. The newer waist-to-height ratio (WtHR) was only measured in two studies. Only nine studies reported mid-upper-arm circumference (MUAC).

In terms of anthropometry, a larger proportion of studies were from urban than from rural areas. Race and ethnicity of the study participants were not always reported, but no studies on exclusively White adults were reported, while few regional studies on Indian[24–27] and Coloured[26,28–31] participants were published over the reference period. National studies and studies with a large sample size generally included adults from all race groups.

Body mass index

Overweight (BMI > 25 to < 30 kg/m^2) and obesity (BMI > 30 kg/m^2) are common among South Africans, especially women.

According to the SANHANES conducted in 2012, the highest prevalence of overweight and obesity was in Black African women (64.8%),[7] while the 2016 SADHS showed that the majority of women in all ethnic groups were overweight and obese (67.4% Black African, 67.8% Coloured, 69.4% White and 70% Indian).[6] Some international surveys with a South African component reported an even higher prevalence of overweight and obesity among women than the national surveys.[32–36] The high prevalence of overweight and obesity in South African women has also been shown in the National Income Dynamics Study (NIDS) in sample sizes of almost 8000 men and more than 10,000 women[37,38] as well as in regional studies in both rural and urban areas in the Western Cape,[29,39–44] KwaZulu-Natal,[24,25,45–49] Limpopo,[50–54] North West,[55,56] Eastern Cape,[57] Free State,[58–61] Gauteng[27,62,63] and Mpumalanga.[64,65]

As women age, the prevalence of overweight and obesity seems to increase, with the highest prevalence observed among women aged 45–54 years (81.9%) in the 2016 SADHS[6] and in women aged 55–64 years (79.8%) in SANHANES.[7] Although the national surveys indicate that a decrease in BMI is seen in women after the age of 65 years, a number of regional studies have reported higher BMI in older participants.[32,62]

In most age and ethnic groups (with the exception of White men and women[6,66]), the prevalence of obesity in men is much lower than in women. In men, BMI also increases with age,[6,51] but the increase is not as pronounced over time as in women.

In the SANHANES study, the influence of urbanisation on obesity prevalence was evident, with more African Black women residing in urban formal areas being overweight and obese than those from rural formal areas (66.4% vs. 57.5%).[7] The same was true for men from urban formal and rural formal areas (36.0% vs. 23.5%). In contrast to women, fewer men from urban informal areas had a BMI > 25 kg/m^2 (22.4%).[7] Although the median BMI of men from urban and rural areas in the PURE-NWP survey was very similar (20.0 kg/m^2 vs. 19.7 kg/m^2), the median BMI of urban women was higher than that of rural women (27.2 kg/m^2 vs. 24.9 kg/m^2).[33] In contrast to the mentioned urban rural differences, some regional studies reported a similar prevalence of overweight and obesity in urban and rural women.[59]

The prevalence of overweight and obesity has steadily increased over the review period. Results of the SADHS show that obesity and overweight (BMI > 25 kg/m^2) in women aged 15–24 years increased from 29.6% in 1998[4] to 39.8% in 2016,[6] while in women aged 45–54 years it increased from 72% in 1998[4] to 81.9% in 2016.[6] Between 1998 and 2016, increases in BMI of men and women occurred in all provinces. In 2016, the prevalence of overweight and obesity was highest in the Western Cape (73.3% in women and 43.7% in men).[6]

Despite the fact that the prevalence of underweight in adults has decreased in most groups over the review period,[4,6] a number of surveys indicate that underweight persists in some groups, especially men. SANHANES showed that 17.9% of men from 18–24 years, 32.6% of Indian men and 16.4% of Indian women, 23.6% of men from North West province and 20.7% from Limpopo had a BMI <18.5 kg/m^2. The most recent SADHS showed that 15.8% of men from 15–24 years and 19.2% of men from the Northern Cape were underweight. In the SA National Database Survey, 19.4% of Indian men and 18.5% of Indian women were underweight.[66] In addition to national studies, a number of regional studies have also reported a high prevalence of underweight in men (e.g., 25% in men > 60 years in The HelpAge study;[32] 19.2% in men > 60 in the Cape Town peri-urban study;[41] 33.1% in the rural AHA-FS study;[59] 23% in the urban AHA-FS study;[59] 30% in the rural QwaQwa study;[61] 20% in the rural AWI-GEN Dikgale study;[54] and 20.5% in the rural Ellisras Longitudinal Study[67]).

Waist circumference

National surveys show that in women, a high-risk WC was present at an earlier age than in men[4,6,7] and far more women than men had a high-risk WC.[4,6,7] WC increased with age in both men and women.[4,6,7] These findings were confirmed in regional studies conducted in the Western Cape,[31,43] KwaZulu-Natal[68] and the Free State.[59]

The percentage of women and men with a WC in the high-risk category increased over the review period.[4,6] Waist circumference of Black African men was much lower than that of Black African women,[4,6,7,59] while WC of White men was higher than that of men in all other groups.[46] As seen with BMI, the highest percentage of male and female participants from the Western Cape had a waist circumference in the high-risk category in the SADHS 2016 (17.4% and 59.0%, respectively).[6] In 2012, the SANHANES found the highest WC in men from the Western Cape (12.8%) and Gauteng (13.4%), and in women from KwaZulu-Natal (53.6%).[7]

In 1998, a smaller percentage of rural compared to urban women had a WC in the high risk category,[4] but by 2016 there was no difference in waist circumference of women from urban and rural areas (45.3% and 45.4%, respectively).[6] This is in contrast to men, in whom double the percentage of urban (11.7%) compared to rural (6.4%) men had a WC in the high-risk category in 2016.[6] Similarly, results from SANHANES-1 showed that 13.8% of urban formal men had a WC in the high-risk category compared to only 3.2% of men from urban informal, 4.9% from rural formal and 5.8% from rural informal areas.[7]

Waist-hip ratio

The waist-hip ratio was determined commonly in earlier surveys, but not as often in later surveys. In all studies, a much larger percentage of women than men had a WHR in the at-risk category. According to the SADHS (1998),[4] the percentage of men and women with a WHR in the at-risk category increased with age (men: 2.9% in 15–24 years and 16.8% in > 65 years; women: 13.1% in 15–24 years and 58.1% in > 65 years). More White men (14.7%) and Black African and Coloured women (33.3% and 36.2%, respectively) had an at-risk WHR than the other groups, as did men from urban areas (8.1%).[4] In the following SADHS (2003),[5] these figures stayed more or less the same, except for the increase in the percentage of White men (22.1%) and young girls 15–24 years (17.9%) with an at-risk WHR.[5]

By 2012, SANHANES-1[7] showed similar results for men (at-risk WHR in 15.6% of men 65 years and older; in 24.9% of White men; and in 8.4% of urban dwellers), but the percentage of women in the at-risk category increased significantly in all groups (67.8% in women > 65 years; 45.7% in Black African, 52.9% in Coloured and 64.8% in Indian women; 47.2% in urban and 53.9% in rural areas).[7]

Waist-to-height ratio

The waist-to-height ratio was only determined in one national survey (SADHS 2016)[6] and one regional study on elderly African Black participants in Umlazi (2009–2010).[49] Similar to the other anthropometric measurements, the percentage of women with a WtHR was much higher in women than in men in the 2016 SADHS.[6] WtHR in the at-risk category increased with age in men (7.9% in 15–24 yrs and 69.9% in > 65 years), and women (33.4% in 15–24 years and 87.9% in > 65 years). The highest at-risk WtHR was in White men (73.6%) and Coloured women (75.5%).[6] As seen with BMI and WC, the highest percentage of male and female participants from the Western Cape had a waist circumference in the high-risk category (48.5% and 77.1%, respectively).[6] The percentage of men and women in the at-risk category was higher in urban than in rural men (36.9% vs. 31.6%), but quite similar in urban and rural women (66.7% vs. 67.4%).[6] In the Umlazi study, 47.9% of elderly men and 87.4% of elderly women had an at-risk WtHR.[49]

Mid-upper-arm circumference

Measures of MUAC were conducted as part of the 1998 SADHS and in studies that included mostly elderly participants. The MUAC of women was higher than that of men and slightly higher among urban than rural participants.[4] Studies in elderly participants included the HelpAge elderly,[32] Cape Town Black elderly study,[30] Cape Flats study[30] and Cape Town peri-urban study.[41] A MUAC < 24 cm indicates risk in older Africans.[21] Older South Africans in the HelpAge study had a mean MUAC of 27.5 cm (21.2% at risk) for men, and 33.9 cm (4.8% at risk) for women.[21] Similar values were reported in elderly Black African participants in Cape Town (mean MUAC of 29.9 cm for men and 31.3 cm for women in the Cape Town Black elderly study[21] and 27.5 cm for men and 33.9 cm for women in the Cape Town peri-urban study,[41] as well as elderly Coloured women in the Cape Flats study (29.0 cm).[30]

5.3.3 Biochemical indicators

As biochemical measurements generally correlate poorly with other parameters of nutritional status, these measurements are best used to assess specific nutrient deficiencies.[1] Only a limited number of studies reported on the biochemical variables of nutritional status and focused mainly on vitamin A and iron status. A few studies gave information on other vitamins and some minerals.

Vitamin A status

Studies published during the reference period reported vitamin A status as serum retinol levels, expressed as either µmol/L or µg/dL, making comparison difficult; therefore, all values were converted to µmol/L and summarised in Tables 5.3.1 to 5.3.3. Vitamin A deficiency was defined as < 20 µg/dL (< 0.7 µmol/L) in all of the studies included in this review.

The vitamin A status of women of reproductive age (16–35 years) was assessed in the NFCS-FB[3] in 2005, as well as in SANHANES[17,69] in 2012. The NFCS-FB report[3] concluded that the vitamin A findings interpreted together with poor iron status also found in the survey (see next section) indicated that the fortification of maize, wheat flour and bread, which became mandatory in South Africa on 7 October 2003[70] (and were thus running for under two years at the time of data collection for the NFCS-FB), apparently did not 'influence the status of these specific micronutrients'.

When comparing the data of the fortification baseline with that of SANHANES-1, collected eight years later in 2012, however, the serum retinol levels of women of reproductive age (16–35 years) did show improvement from the NFCS-FB levels. A decrease in the prevalence of vitamin A deficiency (from 20% to 13.3% at the national level) was evident across six provinces, being most pronounced in KwaZulu-Natal (from 41.8% to 16.4%) and the Eastern Cape (from 22% to 9%), while not changing in Gauteng (remaining at 17.8%). No data were available for the Northern Cape, which had a 0% deficiency rate in 2005, or for Mpumalanga and Limpopo province which had deficiency rates of 9.6% and 22.4%, respectively, in 2005. This improvement could be due to the mandatory fortification of staples with vitamin A, among other nutrients. Follow-up data are, however, necessary for Limpopo, Mpumalanga and Northern Cape for which only fortification baseline data are available.

Data on vitamin A status of other adult groups are minimal for the reference period. Over these two decades, only two studies published regional data for vitamin A status in adult men per se; the THUSA study in North West province collected data in 1996 and 1998 on 447 urban and 314 rural men (18–80 years),[71] while another study in Sharpeville, Gauteng collected data in 2004 on 67 elderly men (≥ 60 years).[72] In these studies, vitamin A deficiency was higher (7%) among urban than among rural men (3%),[71] and as high as 26.5% in elderly men.[72] Another study, published in 1999 (date of data collection not disclosed in the publication), reported retinol levels for 82 adults (men and women combined) and found higher levels among Whites than among Black Africans.[73] Only the two regional studies[71,72] mentioned for men further reported on vitamin A status in women, finding similar levels of vitamin A deficiency (26.5%) among elderly women (n=196). Additionally, an early study with data collected in 1998 reported 8% vitamin A deficiency among women aged 25–55 years (n=126) in tribal KwaZulu-Natal. The THUSA study,[71] however, found a less pronounced difference between vitamin A status of urban and rural women, and this was also confirmed by SANHANES.[7,69]

As far as ethnic differences are concerned, data across the reference period are too limited for any comparisons; notably, no data are available in the reference period for Whites, while for Asian Indians, data are only available for 36 women in SANHANES-1.[7,69] Furthermore, there is a lack of data to draw conclusions on vitamin A levels among men and older women. Data are also needed for the middle-aged and elderly, and to confirm and explore the urban-rural gap suggested by the THUSA study.

Anaemia and iron status

Data on anaemia, iron status and inflammatory markers are summarised in Tables 5.3.4 to 5.3.6. The NFCS-FB[3] found that almost one-third of women of reproductive age (16–35 years) were anaemic on the basis of haemoglobin concentration, although moderate and severe anaemia was relatively uncommon. C-reactive protein levels, a positive acute-phase response protein and, thus, a marker of inflammation, were elevated in 10–15% of women. This indicates that the prevalence of mild anaemia, based on haemoglobin levels alone, was somewhat overestimated in this survey. During inflammation, cytokines inhibit the transfer of iron from the storage sites, which inhibits haemoglobin production for as long as the inflammation persists, despite adequate iron stores.[74] However, nationally, one out of five women had a poor iron status as indicated by serum ferritin levels < 30 μg/L; Gauteng, Mpumalanga and Limpopo were worst affected.

SANHANES-1 (2012)[7] and SADHS 2016[6] reported anaemia data for both men and women. SANHANES-1 reported a prevalence of anaemia among all participants (≥ 15 years) of 17.5%, with mild, moderate, and severe anaemia of 11.6%, 5.3% and 0.6%, respectively. Men aged 35–44 years had the highest mean haemoglobin (14.9 g/dL) and the lowest prevalence of anaemia (7.0%), while those 65 years and older had the lowest haemoglobin (13.7 g/dL)) and the highest anaemia prevalence (25.9%). Women had almost double the prevalence (22%) when compared to men (12.2%). In women of reproductive age (16–35 years), the mean haemoglobin level was 12.8 g/dL, and anaemia prevalence was 23.1%.[7] Using the WHO guidelines,[75] 9.6% of women were found to present with iron deficiency anaemia (ferritin < 15 ng/mL and haemoglobin < 12 g/dL), while 5.6% were iron depleted (ferritin < 15 ng/ml and haemoglobin > 12 g/dL). Overall, 12.3% of the anaemia was shown to be attributed to causes other than iron deficiency (ferritin ≥ 15 ng/mL and haemoglobin ≤ 12 g/dL). Ferritin, like CRP, is also a positive acute-phase response protein, and as this survey could not control for inflammation, the prevalence of iron depletion or deficiency may have been somewhat underestimated. The drop in haemoglobin levels after the age of 65 years was not as apparent in women in this survey. Women from KwaZulu-Natal, Limpopo and Mpumalanga had the highest rates of anaemia.

For women of reproductive age, SANHANES-1[7] showed a drop of 21.4% in national anaemia rates based on haemoglobin levels, and a drop of 65.6% in the prevalence of low serum ferritin levels, compared to the NFCS-FB in 2005.[11] SADHS 2016,[6] however, reported similar anaemia rates in women in this age group as the NFCS-FB in 2005. In the 2016 survey, haemoglobin levels, adjusted for altitude and smoking status, indicated anaemia among 31% of women and 17% among men aged 15 and older.[6] The proportion of women with any anaemia was higher in the reproductive age group (33%) than in women aged 55 years and older (25%). Older men, however, were more likely to be anaemic than younger men,[6] similar to what was reported in SANHANES-1.[7]

By population group, anaemia prevalence was highest among Black African men and women, respectively, in both SANHANES-1[7] and the SADHS 2016.[6] In SADHS 2016, anaemia prevalence was lowest in the White population.[6] Whites and Asian Indians were, however, underrepresented in these surveys. By geographical area, SANHANES-1[7] found that anaemia was more prevalent among urban than rural men, but the trend was not evident in women (NFCS-FB[3] and SANHANES-1[7]).

Regional studies in men confirmed the high prevalence of anaemia among men over the age of 60 years, ranging from 35% to 42%.[62,76–79] In two of these studies, anaemia was also high among elderly women (41% to 43%).[62,79] More research is necessary to assess the causes and solutions for anaemia in the elderly. THUSA[71] also showed the trend towards higher anaemia prevalence in urban compared to rural dwellers.

Iodine status

Iodine status is summarised from Tables 5.3.7 to 5.3.9. During the reference period, only the NFCS-FB[3], THUSA[71] and the WHO Sage Survey[80] reported on urinary iodine levels. The fortification baseline[3] found that the national median UI concentration of women was 176.8 µg/L and concluded that South Africa had virtually eliminated severe to moderate iodine deficiency. Overall, 17.5% of women were found to have a mild iodine deficiency (sub-optimal levels), whereas excessive intakes were particularly concerning for the Northern Cape at 83.3% (notably though, n=24).[3] In the rest of the provinces, excessive intakes ranged from 16.1% in Mpumalanga to 37% in the Eastern Cape. Nationally, four out of 10 women had a UI concentration in the excessive category of iodine status, which needs to be addressed as iodine excess may have serious health consequences.[3] Yet, since 2005, only the THUSA study[71] and the WHO Sage Wave 2[80] reported on iodine levels in South African adults. The THUSA study found that urban participants (n=131) had higher urinary iodine levels (161 µg/L) than rural participants (n=171) (93 µg/L), while 21% had iodine levels < 50 µg/L. The WHO Sage found that in a nationally representative sample, 35% of men (n=109) and 41% of women (n=348) had urinary iodine levels < 100 µg/L.[80] None of these studies reported on iodine excess, leaving an important research gap.

Folic acid and vitamin B12 levels

Only five studies reported data for folic acid (Tables 5.3.10 and 5.3.11) (normal serum levels: 2–20 ng/mL; normal red blood cell levels: 140 to 960 ng/mL). Data collected in 1998 among 25 to 55-year-old women (n=127) in tribal KwaZulu-Natal reported serum levels below 3 ng/mL in 8% of participants.[46] The NFCS-FB collected data in 2005[3] on women aged 16–35 years. On the basis of mean serum (31.7 nmol/L or 14 ng/mL) and red blood cell folic acid concentrations, the NFCS-FB[3] showed that folic acid status was uniformly adequate throughout all nine provinces (Table 5.3.10). Based on consumption patterns of green leafy vegetables across provinces at the time, the report speculated that the 'normality of folate status in the country' may be the first indication that the programme to fortify maize, bread and bread flour with folic acid, was delivering benefits.[11] This conclusion, however, seemed to be in conflict with the findings for vitamin A, which is a fat-soluble vitamin as opposed to folic acid which is water soluble, and iron, which is a trace mineral as opposd to folic acid which is a vitamin, in the the NFCS-FB.[3] This emphasises the importance of monitoring and evaluating the fortification programme to achieve the intended benefit for the public at large.[3]

For the elderly, a study that collected data in 1993 (published in 2007, and therefore included in this review) reported very low mean levels of serum folic acid for 88 men (5.0 ± 2.5 ng/mL) and 99 women (6.0 ± 4.0 ng/mL) in a Coloured community on the Cape Flats.[41] Data collected in elderly Black participants in Sharpeville during 2004 found no folate deficiency in 18 men and 49 women.[62] Conversely, a study published in 2007 (date of data collection unknown) reported folic acid deficiency in 12.2% of men and 19.8% of women from peri-urban Cape Town.[41] The timeline may suggest that fortification decreased the prevalence of folic acid deficiency, but there is a paucity of studies to confirm that the folate fortification has the desired effect in women over 35 years, in men and in the elderly.

The same studies[41,62] on the elderly that reported folic acid levels also reported on vitamin B12 status, finding values of 332 to 458 pg/mL in these elderly participants. A threshold of 300 to 350 pg/mL is recognised as a marker for a desirable status in the elderly, while normal vitamin B12 levels are considered to be between 200 and 900 pg/mL.[81] Between 2% and 12% of the elderly in these studies presented with deficient levels of serum vitamin B12. Given the dependence of folic acid on vitamin B12 for activation through the methyl-homocysteine pathway, and the vital role that both these micronutrients play in brain function and dementia in the elderly,[81] more data are needed.

Vitamin D status

Over the reference period for this review, vitamin D status (Tables 5.3.12 to 5.3.14) has been assessed in only a handful of cross-sectional, regional studies, including PURE-North West (in women only),[82] AHA Free State,[83] Cape Flats study,[84] Gauteng Birth-to-Twenty cohort[85] and the METS study,[34] as well as a prospective longitudinal study among students at the University of Stellenbosch.[86] All of these studies were performed in urban settings. Mean 25(OH) vitamin D3 levels were lower in Black women than men when comparing across the reference tables. Only three of the studies assessed deficiency. Two were performed in urban Black populations and reported that 33%[82] and 35.1%,[34] respectively, had deficient levels when using the Endocrine Society cut-offs of < 20 ng/mL. The third was done on an elderly urban Coloured population and reported deficiency in 19.3% of men and 15.6% of women, using a cut-off of < 10 ng/mL for the elderly.[84]

Other micronutrients

Other micronutrients are reported in Tables 5.3.15 to 5.3.17. Only one study, among the peri-urban Black elderly in Gauteng,[62] reported zinc status, finding mean values of 62.4 (11.7) µg/dL in men (n=18) and 65.8 (7.9) µg/dL in women (n=49) (normal values: 70–150 µg/dL), as well as a high level of zinc deficiency (in 83.3% of men; in 69.4% of women).

This study was also one of only two studies that reported vitamin E levels, finding that one in five elderly had deficient levels (defined as <1.2 mg/dL).[62] The other, equally small study among 57 Black Africans and 25 Whites (focusing on the risk factors for colon cancer in Black Africans) (Table 5.3.16), found that White participants had significantly higher vitamin E levels than Black African participants, with the mean values for the Black Africans in the deficient range. Similarly, the study found that vitamin C levels were significantly higher in White than in Black African participants. The only other study that reported vitamin C levels were among Coloured elderly in the Western Cape[80] which found that 84% of men (n=48) and 62% (n=218) of women had deficient levels (< 0.6 mg/dL).

Blood lipid profiles

Lipid profiles were not included in the search string for this review but are summarised here (Tables 5.3.18 and 5.3.19), as 19 studies reported this data. However, there are most definitely many more studies reporting lipid profiles for South African adults in the reference period than were included in this review.

The 19 studies included one national survey (SANHANES),[7] 17 regional studies and one study on students.[87] Across age and ethnic groups in different provinces and different geographical areas, the median/mean serum total cholesterol levels ranged from 3.4 to 5.7

mmol/L for men, and from 3.4 to 6.3 mmol/L for women; LDL-cholesterol levels from 1.9 to 3.8 mmol/L for men, and from 2.0 to 4.6 mmol/L for women; and HDL-cholesterol from 0.64 to 1.68 mmol/L for men, and from 0.84 to 1.5 mmol/L for women. The mean/median serum triglycerides concentration ranged from 0.81 to 2.10 mmol/L for men, and 0.6 to 2.15 mmol/L for women.[7]

Cut-offs of normality for lipid profiles used in the studies varied slightly, as indicated in Tables 5.3.18 and 5.3.19, but were mostly serum total cholesterol ≤ 5.0 mmol/L, LDL-cholesterol ≤ 3.0 mmol/L, HDL-cholesterol ≥ 1.0 mmol/L, and triglycerides ≤ 1.7 mmol/L. Overall, the lipid profiles across all the studies reflected that total serum cholesterol, LDL cholesterol and triglyceride levels progressively increase with age, peaking in the older age groups, followed by a consistent overall decline after the age of 65 years.Mean HDL-cholesterol remains overall constant with age.

All studies showed that serum total and LDL cholesterol, as well as triglycerides, are overall higher in urban formal and upper urban settings than in rural settings. At the provincial level, SANHANES-1 recorded the highest prevalence of abnormal serum total cholesterol concentrations in the Western Cape (34.8%) and the lowest in Limpopo (10.9%). Black Africans had the lowest prevalence of abnormal serum total and LDL cholesterol, but had very high rates of abnormal HDL-cholesterol concentration. Although few of the studies included in this review reported the profiles of the Asian Indian population, those that did[7,24,48] found that one in two had abnormal total cholesterol, HDL and triglyceride profiles.

5.3.4 Dietary intakes

Data on dietary intake are summarised in Tables 5.4 to 5.7 (with macronutrient intakes in Tables 5.4.1–5.4.7; micronutrient intakes in Tables 5.5.1–5.5.5; dietary diversity in Table 5.6; and foods/food groups in Tables 5.7.1–5.7.5). Dietary data were collected as part of 72 of the studies that were published over the review period. Assessment of diet is complicated by the fact that different methods are used to obtain and present information. In surveys, these most often include the 24-hour recall method and quantified food frequency questionnaires (QFFQ). In the studies reviewed (summarised in Table 5.1), dietary intake was assessed using either a single 24-hour recall (n=12), two 24-hour recalls (n=2), three 24-hour recalls (n=3), four 24-hour recalls (n=1) or a QFFQ (n=9). Other methods included assessments of dietary diversity (n=10), dietary patterns (n=6), foods most consumed (n=18), eating patterns and dietary scores (n=18), dietary quality (n=3), dietary behaviour (n=2) and food security and hunger status (n=19). Food security and hunger status is reported in Chapter 3.

Nutrient intake

As previously mentioned, no national surveys have assessed the energy and nutrient intakes of South African adults. The PURE-NWP-SA study conducted in the North West province during 2005 and 2010 is the only international study with a South African component that has reported on energy and nutrient intake, while 14 regional studies on men, 17 on women and three studies on students have included energy and nutrient intake.

To quantify nutrient intake, 10 studies have used Foodfinder (software based on the South African food composition database and managed by the MRC), nine studies mentioned using the MRC food composition database and one the USDA food composition database. Two standards were used to evaluate adequacy, namely the older 1989 RDAs and the newer Dietary Reference Intakes (DRIs). Owing to the wide variety of cut-points used to evaluate adequacy (percentage of participants with intake below the recommended dietary allowance (RDA), below 67% of the RDA, or below the estimated average requirement (EAR)), and in an effort to improve the comparability of results of groups from different studies, the authors decided to tabulate the mean or median values of energy and nutrients and to compare them all to one cut-point, namely the estimated energy requirement (EER) for energy intakes, EAR for nutrient intakes of groups and Adequate Intake (AI) in cases where an EAR has not been set. It is important to note that the percentage below the EAR only provides an estimate of the proportion of the group with inadequate intake, but it does not detect individuals with inadequate intake.[88] This approach does, however, allow for comparisons between groups in terms of age, ethnicity and residence.

Energy and macronutrient intake

Data on energy and macronutrient intakes are summarised in Tables 5.4.1 to 5.4.7. In most publications, only means or medians are presented, limiting the ability of the authors to arrive at valid conclusions about the adequacy of energy and nutrient intakes.[89]

In light of the fact that almost no studies have reported the percentage of people in the group with intakes less than the EER for energy or the EAR for macronutrients, adequacy of mean energy intake of groups is compared to the EER.[90] The EER for active adults older than 19 years is 12,881 kJ/day for men and 10,093 kJ/day for women.[91] The total mean or median energy intakes of the men and women included in the reviewed publications fell below the EER, except for energy intake of urban women in the Free State,[92] urban men and women in the North West province in 2010,[93] women in rural KwaZulu-Natal,[94] and female students at the University of the North.[95]

The acceptable macronutrient distribution range (AMDR) for adults is 20–35% of total energy from fat (5–10% of energy from omega-6 PUFAs and 0.6–1.2% of energy from omega-3 PUFAS); 45–65% of total energy from carbohydrates; and 10–35% of total energy from protein.[91] It is further recommended that intakes of saturated fatty acids, trans fatty acids and cholesterol remain as low as possible while a nutritionally adequate diet is consumed.[91]

When the percentage of energy from macronutrients of studies published within the review period is considered, most mean or median values fell within the recommended ranges. It is unfortunate that the percentage of participants with intakes below the EARs is not often reported in published studies, since this would provide a more reliable picture of adequacy. Using mean or median values, no studies reported percentage energy from protein outside of the recommended range. A noteworthy observation, however, is the change in the percentage of energy from animal and plant protein that was observed in the PURE-NWP-SA study from 2005 to 2010.[93] In both urban and rural areas, the percentage energy from animal protein increased, while the percentage of energy from plant protein decreased in both men and women.[93]

The only groups that had intakes above 65% of total energy from carbohydrates were Black African men living in informal settlements, and Black African men and women on farms or in rural areas in the North West province (THUSA study);[96] rural Black African men and women from North West (PURE-NWP-SA study 2005);[93] older Black African men in peri-urban Cape Town; Black African men and women in rural KwaZulu-Natal (Empangeni study);[94] Black African women in rural KwaZulu-Natal (Ndunakazi study);[46] and Black African women in rural Limpopo (Ellisras Longitudinal Study).[97]

The mean or median percentage of energy from fat was generally lower among rural compared to urban participants. In most cases, the groups that had fat intakes below 20% of total energy were the same ones that had carbohydrate intakes that were higher than 65% of total energy. These included rural Black African men and women in North West (PURE-NWP-SA, 2005);[93] older Black African men in peri-urban Cape Town; and Black African men and women in rural KwaZulu-Natal (Empangeni study).[94] The only groups that had intakes above 35% of total energy from fat were urban Indian men and women from KwaZulu-Natal (Indian Coronary Heart Disease study[98] and Stanger study[24]).

The WHO recommends that added sugar intake should fall below 25g or 10% of total energy intake,[99] while the Institute of Medicine recommends no more than 25% of total energy intake.[91] Although no participants from any study published over the review period had a sugar intake above 25% of total energy, mean or median sugar intake was higher than 25g per day in participants from most studies, except for rural African Black men and women from Limpopo (DHDSS study);[100] rural Black African men from Limpopo (Ellisras);[97] and older Black African men from peri-urban Cape Town.[76]

No EAR has been set for total fibre intake. The AI for men from 14 to 50 years is 38 g/day and for men older than 50 years it is 30 g/day. For women the AI for fibre is 26 g/day (14–18 years); 25 g/day (19–50 years) and 21 g/day (older than 50 years).[91] In contrast to sugar intake, mean or median fibre intakes of both men and women were lower than the recommendation in all men. Only urban Black African women in the North West (PURE-NWP-SA, 2010)[93] and rural Black African women in KwaZulu-Natal[94] had intakes above the recommended 25 g/day for women.

The PURE-NWP-SA study is the only study that was repeated among the same population during the period of the review and data have been published for 2005 and 2010.[93] The results of this study verify a nutrition transition in the North West province, characterised by an increase in energy intake in both urban and rural groups. The results point to an increase in energy from animal protein that is accompanied by a decrease in energy from plant protein in both urban and rural participants. Furthermore, the increase in the percentage of energy contributed by total fat in rural men and women and urban men was accompanied by increases in the intake of saturated fat and mono-unsaturated fat. Finally, despite the fact that the percentage of energy from total carbohydrates decreased in rural participants, the intake of added sugar increased significantly in both men and women from urban and rural areas.[93]

Micronutrient intake

Fifteen (15) studies reported micronutrient intakes in women, of which 10 included men. Micronutrient intakes are summarised as the mean/median intakes of vitamins and minerals and electrolytes in Tables 5.5.1 to 5.5.5. Adequacy is only presented for studies that reported the percentage of participants with intakes below the EAR (or AI, where an EAR does not exist), which is the recommended method of analysis.[101] Large percentages of individuals fell below recommendations for most micronutrients, reflecting a diet of low quality.

Micronutrients included in the National Food Fortification Programme

The fortifying of maize meal and wheat flour with vitamin A, thiamine, riboflavin, niacin, vitamin B6, folic acid, iron and zinc became mandatory in 2003 when the NFFP was implemented.[70] Notably, eight studies[49,62,95,96,100,102–104] used the FoodFinder Software, based on the South African Food Composition database (SA FCT), to convert food intake data to micronutrients. As this software was released before 2003, the database did not include the fortified values for maize and bread. Instead, users had the option to manually add the fortified values to the database. Unfortunately, most studies do not indicate whether this was done or not. The rest of the studies[39,76,84,105–107] in the reference period used the SA FCT (presumably the most recently updated version). The latter implies that studies with data collection after 2003, which were analysed with FoodFinder, may not be comparable to those with data collection after 2003 which used the latest version of the SA FCT. One study[94] used an application based on the United States Food Composition database, which makes the data incomparable.

No national representative data for micronutrient intakes exist for the reference period, presumably because the methodology that requires a QFFQ or multiple 24-recalls is challenging to implement on the scale of such a survey. The PURE-NWP-SA study,[106] which collected data post-fortification in the North West province in 2005 and 2010, is the only source of longitudinal data and showed improvement in intakes between 2005 and 2010 for all micronutrients. The study also showed a higher intake of micronutrients (with a lower prevalence of inadequate intakes) in the urban compared to rural population (with a higher prevalence of inadequate intakes).[105,106] Thus, it is clear that micronutrient intakes may vary significantly with location and geographical area; however, conclusions regarding the effect of the food fortification programme on the micronutrient status of adults in South Africa are difficult to draw from the available data.

To further complicate the comparison, some studies reported vitamin A as μg retinol equivalents (RE), as it is expressed in the SA FCT. Those studies that expressed vitamin A intake as μg only, presumably refer to RE. One study[94] expressed vitamin A intake as μg retinol activity equivalents (RAE), where 1 mg RAE = 1 mg retinol, 12 mg beta-carotene, and 24 mg alpha-carotene or beta-cryptoxanthin. The RAE for dietary provitamin A carotenoids in foods is twice as much as retinol equivalents (RE), whereas the RAE for preformed vitamin A in foods is the same as RE.[91]

Studies that presumably reported in μg RE found that vitamin A intake ranged from 253–1185 μg in men and 175–2105 μg in women, with the highest levels in younger individuals and those living in urban areas (Table 5.5.2). The prevalence of inadequate intakes ranged from 5.5–100% in men and 3.1–89% in women, even after the initiation of the fortification programme in 2003, indicating that pockets of the population may still be at high risk of vitamin A deficiency. The same holds for all the micronutrients, as very similar patterns of dietary intake and variance in the prevalence of inadequacy are evident in Tables 5.5.1 to 5.5.3 across the studies included for the reference period. As micronutrients are essential and interdependent to sustain a wide variety of biochemical pathways in the body, sub-optimal intakes and deficiencies contribute to a myriad of health problems, including non-communicable diseases and increased susceptibility to infectious diseases.

The prevalence of inadequate intakes of calcium and potassium was universally high across all strata represented in the studies included for the reference period. Mean/median dietary intakes for calcium and potassium are presented in Tables 5.5.4 and 5.5.5. Notably, EAR values for calcium were first published in 2011; before that, calcium requirements were based on AI.[108] Thirteen (13) studies reported calcium intakes in women (ranging from 116 to 690 mg/day) and 10 in men (ranging from 229 to 620 mg/day). The highest levels of intake were reported in peri-urban communities in the Free State[107] and in elderly in long-term care facilities in the Western Cape,[109] and the lowest in peri-urban and informal settlements in the Vaal Region of the GP.[102] Calcium intakes were also lower in rural compared to urban dwellers.[106,110] The low calcium intakes are in agreement with the low milk intakes that were reported for South African adults, especially Black Africans (Tables 5.7.2 and 5.7.3) and could be related to the fact that milk and dairy products are relatively expensive commodities. Inadequate potassium intakes of 90–100% in studies that reported these may reflect low fruit and vegetable intakes which are evident in the analysis of dietary patterns in other sections of this review.

5.3.5 Dietary diversity

Data on dietary diversity are summarised in Table 5.6. Ten (10) studies reported on dietary diversity, two national surveys and eight regional studies. The national studies[7,111] and one regional study[112] applied one 24-hour recall to determine the number of food groups out of nine that had been consumed during the previous day, while two regional studies counted the food groups out of 12.[112,113] Two studies from Gauteng based dietary diversity on a 7-day FFQ (total number of food groups out of nine) as well as a food variety score (count of food items within nine food groups).[114–116] One study used one 48-hour recall to count the number of food groups out of 10.[117] The earlier Embo study from KwaZulu-Natal (2004–2005) employed a tool based on a food group variety score (mean number of food types out of five food groups that a household consumed during the previous month);[118] while the Letaba study assessed food availability and variety through inventory and direct observation.[119]

The South African Social Attributes Survey (SASAS) was conducted in 2011 among more than 3000 participants.[111] The mean dietary diversity score (DDS) of the total group was 4.02 and the percentage of participants with a DDS < 4 (low) was 38.3%. The highest percentages of participants with a low score were from Limpopo (61.8%) followed by the Eastern Cape (59.6%). As standard of living improved, so too did mean dietary diversity (2.93 for low living standard, 3.84 for medium living standard and 4.72 for high living standard).[111] The SAHNANES-1 employed the same methodology and found similar results, with a mean DDS of the total group at 4.2, and 39.7% having a DDS below 4 (low).7 Mean dietary diversity was highest in White participants (5.6) and lowest in Black African and Indian participants (4.0 and 4.1, respectively). The highest percentage of participants with a low DDS were from Limpopo (65.6%) and North West (61.3%). In terms of living area, those from an urban formal residence had a higher mean dietary diversity (4.7) than those from all other areas (3.8 for urban informal, 3.6 for rural formal and 3.3 for rural informal).[7] The regional Gauteng RENEWAL study (2008) also used nine food groups from a 24-hour recall and reported similar results, with a mean dietary diversity of 4.1 and a low DDS in 36.8% of participants.[112]

The two Gauteng studies that employed a 7-day FFQ to determine dietary diversity reported that 55.1% of elderly participants from Sharpeville (mean DDS of 3.4)[115] and 16.2% of participants in the Vaal area[116] had a low dietary diversity (<4). The 2016 Khayelitsha and Mitchells Plain survey reported a mean DDS of 3.7.[29]

In terms of food variety, the KwaZulu-Natal, Embo study reported that participants had eaten 8.8 and 8.7 different starchy foods; 4.95 and 5.8 different vegetables and fruits; 5.0 and 5.3 different animal foods and fish; 1.6 and 2.2 different fats; and 0.9 and 1.1 different legumes during the months of November 2004 and March 2005.[118] Another study directly observed a maximum of only 15 different foods out of a possible 46 in households from two villages in Letaba.[119]

5.3.6 Dietary patterns

Dietary patterns in the context of this review refer to food groups and foods most consumed, eating patterns and dietary scores, dietary quality and dietary behaviour. Food intake data are often presented in an unclear way and not in enough detail, making it difficult to interpret and to compare the results of different studies.[120] This limitation was evident in the studies published over the review period and limits the conclusions that can be made. Data on dietary patterns are summarised in Tables 5.7.1 to 5.7.5.

Food groups most consumed

Data on food groups most consumed are summarised in Table 5.7.1. Six studies reported on the food groups most consumed by South African adults, including the SASAS national survey[111] and five regional surveys in Gauteng,[103,112] the Free State,[117] KwaZulu-Natal,[112] the Western Cape[29] and the Eastern Cape.[113] All, except one study (48-hour recall),[117] used a 24-hour recall to collect information on food group consumption. The lists of food groups mostly included nine food groups, while two used 10 food groups[117] and 12 food groups.[29]

The SASAS survey determined what percentage of the sample consumed > one food from each of nine food groups and reported that almost all participants (99% or more) from all groups consumed one or more foods from the cereals, roots and tubers group. The low LSM group had lower intake from all food groups (except for cereals and legumes), while the highest LSM group had the highest in each group (except for legumes and nuts).[111] All regional studies found that the starchy food group (cereals, roots, tubers, grains, maize) were eaten by the highest percentage of all participants. In both regional studies that differentiated between living area, a higher percentage of participants from urban formal areas consumed at least one item from each of the listed food groups than participants from urban informal or rural areas, except for the legumes, nuts and seeds group in both studies,[112,117] and green leafy vegetables in one study.[117] The percentage of participants who consumed one or more foods from the listed food groups was much lower in the study undertaken in Khayelitsha and Mitchells Plain[29] compared to the RENEWAL study conducted in urban Gauteng[112] and the Nelson Mandela Bay study conducted among consumers at five shopping malls in Nelson Mandela Bay.[113]

Foods most consumed

Data on foods most consumed are summarised in Table 5.7.2. Seventeen (17) studies included an assessment of the foods most consumed by South African adults. These were based on information from FFQs, single or repeated 24-hour recalls and observation of foods in households. Some considered the frequency of foods consumed per day,[28,100] per two days[121] or per week,[73] foods consumed by weight by 10%[46,122] or 85%[96] and more of the sample, foods consumed by weight,[60,61,114,123,124] foods most liked to least liked,[67] and foods consumed per food group.[113]

It is important to note that the vast majority of studies reporting on foods consumed by South Africans over the review period were conducted among Black African South Africans (no national surveys determined the frequency of food consumption). Only two studies also included Coloured participants,[28,60] while another two also included White participants[28,73] (the sample size was only 29 in one and not defined in the other). In the sample of mostly Black South Africans, differences were evident in the foods most consumed between males and females, as well as between the different strata of urbanisation. It was not possible to compare studies that were conducted early on in the review period with those conducted later in the review period, since none were repeated and all were quite heterogeneous.

In terms of the total group of mostly Black African South Africans included in the studies published over the review period, food consumption was generally characterised by the consumption of relatively limited and similar foods by different groups. Maize meal and bread were by far the most frequently consumed staple foods, followed by rice. Three studies also listed the cooked porridge, mabella.[79,93,95] The starchy foods, samp[28,67] and samp and beans (KwaZulu-Natal and Free State),[46,49,122,123] as well as potatoes[46,114,122,125] were also mentioned.

In all groups, sugar and tea were very frequently consumed. The frequent consumption of sugar-sweetened beverages such as carbonated/fizzy drinks, cordial squash and fruit juice was recorded in a large number of both urban and rural studies,[28,44,46,60,67,104,114,122,123] with sweets,[28,44] cake and biscuits,[60] and jam[44,100] also listed as frequently consumed foods in some studies.

In a number of studies, flesh foods such as meat, chicken and fish were not recorded as most consumed foods, but when they were, chicken was the most consumed animal protein in most studies,[28,44,46,60,67,114,119,122,125] followed by red meat,[44,49,60] mostly beef.[46,104,114,122] In the North West[96] and Vaal area,[104] boerewors was also mentioned. Eggs were included in the lists of most consumed foods in most studies except those in North West and KwaZulu-Natal. Other protein foods included fish (pilchards),[49,60,67] peanut butter,[44,46,60,67,100] and legumes,[28,60] including dried[46,49,100,122] and tinned beans.[125]

In all groups, the frequent intake of milk and milk products was relatively low (except among those who lived on farms and in upper-class urban areas in THUSA[96]). When milk was consumed, it was usually in small amounts (e.g. used in tea and sometimes coffee[123]). Some studies included non-dairy creamer on the list of commonly consumed foods.[28,46,60,100,122] The consumption of cultured milk (amasi)[28,125] or the non-dairy fermented maize drink (mageu[114] or mahewu[46,49]) was reported in some studies.

In general, fruit and vegetables were not frequently consumed (higher prevalence in those from the from an upper urban population). The vegetables that were eaten included cooked onions and tomatoes (often eaten as a stew, relish or gravy),[46,49,96,104,125] cabbage[28,46,49,96,114,122] and green leafy vegetables such as morogo,[100] imifino[46] or spinach[28,67,114,122,125] (described as cooked with potato, onion and sunflower oil by some[49]), while fruits that were mentioned included apples,[28,46,96,114,123] bananas[28,46,96,123] and oranges.[46,49,104,114]

Added fats and oils were listed as a frequently consumed food in very few studies. The most popular forms of fat used for food preparation were sunflower oil[96] and hard margarine.[28,96,104] Frequent consumption of crisps/chips was recorded in two studies.[44,60]

The THUSA study and the AHA-FS study differentiated between the foods most frequently consumed by men and women.[60,96] Although the foods consumed by men and women from the Free State were quite similar, the THUSA showed that women consumed more maize meal than men, while men consumed more bread, sugar and sugar-sweetened beverages and fruit than women.

In terms of urban rural differences, the THUSA study has provided the most useful information on foods mostly consumed by participants from five strata of urbanisation in the North West province between 1996 and 1998.[96] Intakes of maize meal porridge and bread were much higher among participants from rural areas, informal settlement areas and middle-class urban areas than among participants from upper-class urban areas. Compared to other strata, more participants from upper urban areas frequently consumed milk and red meat. All groups consumed little added fat, with fewer participants from rural and farm areas consuming fat than those from informal settlements, middle urban and upper urban areas. Although more people living on farms frequently consumed added sugar than those from the upper urban areas, the consumption of sweets, cakes and cold drinks was lowest in the rural and farm strata.[96]

Two more recent studies also included participants from urban areas. These included the HealthKick study undertaken among caregivers of primary school children in the Western Cape[44] and consumers visiting shopping malls in Nelson Mandela Bay.[113] The HealthKick participants reported frequent consumption of processed meats, mixed vegetables, breakfast cereals, sweets, crisps, jam,[44] and cheese[28] while those from Nelson Mandela Bay reported frequently consuming sweets, spices, condiments, beverages, oils and fats.[113]

Dietary scores and eating patterns

Data on dietary scores and eating patterns are summarised in Table 5.7.3. Two national surveys, two international studies with a South African component and 14 regional studies assessed eating patterns in adult South Africans. Based on a FFQ (not validated), the SANHANES-1 was the only survey to calculate fat, sugar and fruit and vegetable intake scores.[7] A 24-hour recall was completed as part of the SADHS of 2016 to determine eating patterns of adult South Africans,[6] with a focus on the intake of fruit and vegetables, sugar-sweetened beverages, fried foods, fast foods, salty snacks and processed meat. Other studies obtained information on eating patterns from FFQs or questionnaires.

Fat, fried foods, fast foods, salty snack and processed meat intake

At the national level, SANHANES-1 reported a moderate mean fat score of 7.3 (7.4 in males and 7.2 in females), with nearly one out of five participants (18%) having a high fat score (11–20). The mean fat score was lowest in the older participants (5.5) and in those from rural areas (5.6), with 23.1% of participants from urban formal areas having a high fat score. The mean fat score ranged from 5.1 in the Eastern Cape to 9.2 in Gauteng. The highest percentage of low fat users (0–5) were Black Africans (36.8%).[7] When asked how often they ate fried foods, fast foods, salty snacks and processed meats, 10% of SADHS 2016[6] participants reported eating fried foods every day, with 37% eating them at least once a week. Two (2) percent reported eating fast food every day, while 18% ate fast foods at least once a week. Thirteen (13) percent reported eating salty snacks every day (29% at least once a week) and 14% ate processed meats every day (29% at least once a week). Daily consumption of all of these foods decreased with age (32% of 15–19 years olds ate salty snacks every day compared to only 4% of those 65 years and older), but increased with household wealth, while more participants from urban than non-urban areas consumed them. The consumption of salty snacks on a daily basis ranged from 20% in the Western Cape to 9% in KwaZulu-Natal, while the consumption of processed meats ranged from 20% in Gauteng to 6% in the Northern Cape.[6] A study conducted among students in Health Sciences at the University of the Free State found that 42.9% of students reported eating fats, oils and sweets in large quantities.[126]

As with the SANHANES-1 and the SADHS, the HSFSA study (2013) included participants from all four ethnic groups. The percentage of participants who ate high-fat foods every day ranged from 38.8% of White males to 63.8% of Black African males, and from 24.9%

of White females to 63.2% of Black African females.[26] The percentage of participants who ate high-salt foods every day ranged from 35.9% of White males to 67.4% of Black African males, and from 26% of White females to 66.8% of Black African females.[26]

The HealthKick study showed that the mean intake of high-fat foods among school educators in the Western Cape was 1.9 times per day (2.1 for males and 1.8 for females),[28] while the intake of energy-dense snacks was 1.4 times per day for both males and females. In terms of processed (high-salt) foods, the mean intake was 2.7 times per day (2.8 for males and 2.5 for females).[28] In terms of caregivers, the mean daily intake of high fat foods was 2.6 times per day for males and 2.3 times per day for females. The intake of high-fat foods was higher in participants classified as obese (2.5 times per day) than in participants classified as obese than in those classified with a normal weight for height (2.3 times per day), as was the intake of energy-dense foods (2.8 times per day for both men and women and 2.9 in obese group). Processed foods high in salt were consumed 4.0 times per day for males and 3.7 for females (3.9 in obese and 3.7 in normal weight).[44] Similarly, a study from Nkonkobe in the rural Eastern Cape found that the intake of fast foods reported as "always consumed" was much higher in particpants classified as obese than in those classified with a normal weight for height (48.5% vs. 21.2%).[127] Lastly, a study among students from the University of the Witwatersrand (Table 5.7.5) found that 52.6% of students classified as obese bought fried foods four or more times per week compared to only 16.0% of students classified as having normal weight for height".[128]

Sugar and sugar-sweetened beverage intake

The SAHNANES-1 reported a national mean sugar score of 3.0 (moderate).[7] As with the fat score, the mean sugar score decreased with age (only 10.7% of those 65 years of age and older had a high sugar score of 6–8) and more rural participants had a low sugar score than participants from urban formal areas (58.4% vs. 33.8%). The highest percentage of high sugar users was in Gauteng (28.0%) and the lowest in the Eastern Cape (7.7%). The highest percentage of high sugar users were Whites (21.1%) and the lowest Indians (16.1%).[7] More than one-third of the total SADHS 2016 group (36%) indicated that they had consumed sugar-sweetened beverages during the previous day or night.[6] The percentage of participants who had consumed sugar-sweetened beverages declined with age (44% in the 20–24 years group and 19% in the 65 years and older group). More Whites drank fruit juice (24%) than those in other groups, while more Coloured and Black African participants consumed sugar-sweetened beverages (38% and 36%, respectively). More men than women drank sugar-sweetened beverages (40% vs. 33%). In terms of provincial distribution, the consumption of sugar-sweetened beverages ranged from 45% in the North West to 29% in the Eastern Cape, while the consumption of fruit juice ranged from 19% in the Western Cape (19%) to 11% both in Limpopo and the Free State. A higher percentage of participants from urban than non-urban areas consumed sugar-sweetened beverages and fruit juice.[6]

In the STOP-SA survey (2015–2016), the largest percentage of participants (82.0%) reported consuming more than five servings of SSBs per week, with 28.7% consuming more than 10 servings per week. A higher proportion of participants who were < 39 years (90.7%) consumed more than five servings of SSBs per week compared to those who were > 40 years (77.3%). Those who were food secure were more likely to consume more than 10 servings of SSBs per week compared to those who were food insecure (38.1% vs 22.5%).[35] A study conducted among health professionals from KwaZulu-Natal also reported frequent consumption of sweet foods (60%), SSBs (55%) and fruit juice (57%),[129] as did a study among university students in Pretoria where the mean daily teaspoons of sugar from daily SSB consumption were 5.8 and 20% of students consumed more than 10 teaspoons of sugar from SSBs per day.[130]

Some regional studies have reported lower consumption of SSBs. These include the AWI-GEN Agincourt site (2015, 2016) survey, where median SSB intake of two drinks per week, and juice intake one day per week, were reported in both males and females.[65] Furthermore, the mean intake of SSBs among participants in the Africa Wits—INDEPTH study (2014, 2016) was 0.3 servings per day for both males and females.[29]

Fruit and vegetable intake

The surveys that were conducted over the review period confirmed low to moderate consumption of fruit and vegetables in South African adults. The mean national SANHANES-1 fruit and vegetable score was 3.8 (moderate).[7] One-quarter of the participants (25.6%) had a low score and 29% had a high score. The highest number of participants with a low fruit and vegetable score were those in rural formal areas (36.7%) and the lowest in the urban formal areas (18.8%). The highest percentage of participants with a low fruit and vegetable score were from the Eastern Cape (38.2%) and the lowest from Gauteng (15.4%). More Whites (9.0%) had four or more fruits per day than Black African consumers (3.9%).[7]

Of the total group of participants included in the SADHS of 2016 as part of the SADHS of 2016, 59% of adults reported that they had consumed vegetables during the previous day or night, while 49% reported that they had consumed fruit.[6] The proportion of participants who consumed fruit and vegetables was similar across all age groups. Daily fruit consumption ranged from 71% in Whites to 46% in Black Africans, while vegetable consumption ranged from 84% in Whites to 57% in Black Africans. More women than men consumed fruit (51% and 45%, respectively) and vegetables (64% and 52%, respectively). Daily fruit consumption ranged from 64% in the Western Cape to 32% in the Northern Cape, while vegetable consumption ranged from 69% to 46%, respectively, in the same provinces. The percentage of participants who consumed fruit and vegetables was higher in urban areas than in the non-urban areas.[6]

Fruit and vegetable intake was also assessed as part of the WHO-SAGE wave 1 (2007–2008).[131] The majority of participants (68.4%) reported consuming less than five servings of fruit and vegetables per day, with the highest prevalence of inadequate intake in the group being 80 years and older (70.1% of men and 77.9% of females), those from rural areas (75.1%) and those in the lowest household wealth category (75.3%).[131] In the STOP-SA survey (2015–2016), the largest percentage of participants reported weekly intake of vegetables (77.8%) and fruit (72.5%),[35] while in the HSFSA study (2013), the percentage of participants who ate more than five servings of fruit and vegetables per day, ranged from 45.1% of Coloured males to 54.9% of Indian males, and from 48.5% of Coloured females to 64% of Black African females.[26]

In the HealthKick study, the mean number of times per day that school educators in the Western Cape consumed fruit and vegetables, were low at only 1.9 times per day (1.7 for males and 2.0 for females).[28] The mean daily fruit and vegetable intake of caregivers was higher than for educators at 2.6 times per day for men and 2.9 times per day for females. Interestingly, the intake of fruit and vegetables was higher in participants classified as obese (3.0 times per day) than in participants classified as having normal weight for height (2.6 times per day).[44] Similar results for fruit intake were reported in the Nkonkobe study in the Eastern Cape, with 55.4% of obese participants "always" eating fruit compared to 38.9% of normal-weight participants. In contrast, the intake of vegetables reported as "never consumed" was much higher in obese individuals than in normal-weight participants (85.7% vs. 42.9%).[127]

Other studies that have reported low intakes of fruits and vegetables include a study among health professionals from KwaZulu-Natal who reported rarely eating fruits (77%) and vegetables (73%);[129] the Africa Wits—INDEPTH study (2014, 2016), where the mean intake of fruit and vegetables among participants was only 1.3 servings per day for both males and females;[129] the AWI-GEN Agincourt site (2015, 2016) study, where the median vegetable and fruit consumption was very low at four servings per week for vegetables and three servings per week for fruit;[65] and the Letaba study that reported daily vegetable intake in only 15.6% of participants and daily fruit intake in only 8.8% of participants.[119]

Low fruit and vegetable intakes have also been reported in South African students. A study from the University of Fort Hare found that 97.5% of students ate less than three servings of vegetables per day and 42.2% less than two servings of fruit per day.[132] Similarly, a study from the University of the Free State reported that 98.1% of students in Health Sciences ate less than three servings of vegetables per day and 58.4% less than two servings of fruit per day.[126]

5.3.7 Dietary quality

Three studies published over the review period have assessed dietary quality (Table 5.7.4). These include the PURE-NWP-SA study,[105] the Embo study[118,133] and the Bt20 study.[134]

The PURE-NWP-SA study adapted the Diet Quality Index score developed by Thiele *et al.* (for micronutrient adequacy) as well as the Healthy Diet Indicator (for CVD risk) to calculate a percentage of the possible total score.[105] The Diet Quality Index ranged from 72% in rural men and women to 84% in urban men and women, while the Healthy Diet Indicator ranged from 72% in rural men and women to 76% in urban women and 77% in urban women. Although the two diet quality scores measured different aspects of diet quality, the agreement between scores was good. Compared to the rural groups, both scores indicated better diet quality in the urban groups (despite increased cardiovascular disease risk).[105]

The Embo study developed household food intake strata using the Household Food Intake Index and Nutritional Adequacy Ratios to determine dietary quality.[118] Based on this approach, good agreement was found in the percentage of households that were classified as having an inadequate food intake based on the Household Food Intake Index and the Nutritional Adequacy Ratio.[118] Food quality was measured using food count and later using five food groups, namely, starchy foods, vegetables and fruits, animal-sourced foods, fats and legumes.[118] The food intake categories developed using both the Household Food Intake Index and Nutrition Adequacy Ratios were regressed to respective dietary diversity for each round. Higher quantities of starchy foods, fruits and vegetable, and legumes were found to be necessary for households to have adequate levels of food intake. In all food groups, households with adequate food intake were found to have the highest diversity, followed by households with moderate and inadequate food intake.[118]

The Bt20 study investigated whether the Diet Inflammatory Index is associated with markers of risk for Type 2 Diabetes and whether this association is mediated by adiposity and/or low-grade inflammation in women from the Bt20 plus cohort. The authors concluded that a pro-inflammatory diet might aggravate the effects of obesity and increase the risk of developing diabetes.[134]

5.4 DISCUSSION

At the beginning of the millennium, a review about diet, physical activity and obesity in the Black population of South Africa by Bourne *et al.* (2002)[9] confirmed the findings of Vorster *et al.* (1997),[1] describing a nutrition transition characterised by shifts in dietary intake from the traditional diet to a more Western diet and increased prevalence of overweight and obesity, especially among Black women.[9] The results of the current review confirm these earlier findings and note that since the time that they were published, the prevalence of overweight and obesity has increased even further and that the diets of South Africans have deteriorated even more.

5.4.1 Anthropometry

The report on the nutritional status of South Africans from 1975–1996 by Vorster *et al.* (1997) showed that both undernutrition and overnutrition were prevalent amongst adults in South Africa, with certain areas characterised by pockets of high prevalence of severe undernutrition and others by high prevalence of obesity, especially among Black African and Coloured women.[1] The findings over the current review period (1997–2019) indicate a dramatic increase in the percentage of adults that are overweight and obese. The proportion of women that are overweight and obese is of particular concern, as is the increase in prevalence amongst younger women.

The reviews focusing on prevalence, pathogenesis and health consequences of obesity in South Africa that have been published by Kruger *et al.* (2005)[12] and Van Der Merwe and Pepper (2006)[13] confirm the findings of the current review that a number of factors play a role in the differences, including location (geographical as well as urban vs. rural), physical activity (not assessed in the current review), age and ethnicity.

At the beginning of the review period, the SADHS of 1998 showed that the prevalence of obesity was higher in urban areas than in rural areas.[4] Since that time, it has become apparent that rural women are catching up to their urban counterparts.[12] In addition, the persistence of underweight in certain groups and micronutrient deficiency (based on very limited data) confirms that a triple burden of malnutrition is still present in South Africa.

Although poor diet and sedentary lifestyles are primarily responsible for the high prevalence of obesity in South Africa, especially among Black women, the misperception that obesity is a sign of a superior state of health and wellbeing and is not associated with health risks still exists in South Africa.[13] Interventions aimed at addressing this incorrect perception are urgently required.

5.4.2 Biochemical indicators

As mentioned, only a limited number of studies reported on the biochemical variables of nutritional status and focused mainly on vitamin A and iron status. Overall, the prevalence of vitamin A deficiency showed improvement in most provinces since the inception of the fortification programme,[3] although follow-up data are necessary for Limpopo, Mpumalanga and the Northern Cape.[3] Anaemia still affects one in three women of reproductive age (16–35 years) and almost one in five men age 15 and older, particularly in urban areas.[3,6,7] Black Africans are worst affected, although more data are needed for Whites and Asian Indians. In the elderly, the prevalence of anaemia is consistently high (around 40%).[62,76–79]

Conversely, the NFCS-FB[3] indicated that by 2005 South Africa seemed to have virtually eliminated severe to moderate iodine deficiency across all provinces, with about one in five women still presenting with mild iodine deficiency (sub-optimal levels), and lower iodine status in rural compared to urban areas. Of concern is that, nationally, 40% of women, particularly in the Northern Cape, presented with UI concentration in the excessive category of iodine status, which may have negative health consequences.[3] There is, however, a paucity of data since 2005 regarding iodine status of South African adults.

While serum folic acid levels were generally adequate in the NFCS-FB of 2005[3] and in the few subsequent studies,[62] there is a paucity of studies to confirm that the folate fortification has had the desired effect in women over 35 years, in men and in the elderly.[41] More data are also needed to assess the prevalence of low levels of serum vitamin B12 suggested by the small number of studies that reported on vitamin B12 status in the elderly[81]

Very few studies reported on other micronutrients, generally finding low levels in the elderly. This holds true for vitamin D status (which was also lower in Black African women than in men),[34,82,83,85] for zinc status,[62] for vitamin E status[62] and for vitamin C status.[80]

5.4.3 Dietary intakes

The data on diet over the review period indicate a further worsening of the nutrition transition to an unhealthy, Westernised way of eating. This conclusion has been confirmed in the findings of other reviews and secondary analysis of data published within the review period before[10] and after[11,14–16] the mandatory fortification of staple foods with micronutrients in 2003.

Energy and macronutrient intake

The two earlier reviews on dietary intake of South Africans by Bourne *et al.*[9] (1940–1990) and Vorster *et al.*[1] (1975–1996) concluded that although diets of Black African South Africans met prudent dietary guidelines, there had been a shift over time towards the Western diet, characterised by decreased carbohydrate and fibre intakes and higher fat and animal protein intakes, while the percentage of energy from plant protein decreased significantly. Higher intakes of carbohydrates and lower intakes of sugar were reported in rural Black participants compared to other groups. Interestingly, fibre intakes in Blacks Africans from both urban and rural areas were lower than fibre intakes in other ethnic groups.

Data on energy intake over the review period indicate that for the most part, the energy intakes of men and women included in the reviewed publications fell below the EER for active individuals (12,881 kJ/day for men and 10,093 kJ/day for women[91]) and the percentage of energy from macronutrients of studies published within the review period fell within the recommended ranges. These findings need to be interpreted with caution since they are closely linked with the limitations associated with the assessment and presentation of data related to nutrient adequacy.[89] Ideally, the percentage of people in the group with intakes less that the EER for energy or the EAR for macronutrients is necessary to make sense of the findings and these data are very seldom reported in published studies where only means and medians are usually reported (especially for macronutrients). In this regard, more valuable insights are probably provided by information related to intake of foods and eating patterns.

Micronutrient intake

Mandatory fortification of maize meal and wheat flour was introduced in South Africa in 2003. The data summarised for the reference period in this review show that large percentages of individuals fell below recommendations for most micronutrients, suggesting a diet of poor quality. Furthermore, micronutrient intakes may vary significantly with location and geographical area,[105,106] while methodological constraints restrict the availability of nationally representative data for individual micronutrients. Thus, clear conclusions regarding the effect of the food fortification programme on the micronutrient status of adults in South Africa are difficult to draw from the available data. The available data do show a very high prevalence of inadequate intakes of calcium and potassium across all strata, which warrants further investigation and addressing, as these micronutrients are not part of the fortification programme.

5.4.4 Dietary diversity and dietary patterns

As previously mentioned, most studies that investigated the frequency of food groups or foods consumed by South African adults were conducted among Black Africans. It was not possible to compare studies that were conducted early on in the review period with those conducted later in the review period since none were repeated and all were quite heterogeneous. Based on this limited data, the diets of Black African adults can be described as restricted in terms of the range of foods that are consumed, with maize meal and bread by far the most commonly consumed staple foods. Overall, the intake of maize meal porridge and bread was higher in participants from rural areas than from urban areas, while their fat intake was lower. In North West, the THUSA study reported that intakes of maize meal porridge and bread were also higher in participants from informal settlement areas and middle-class urban areas than in participants from upper-class urban areas. Those from upper-class urban areas also consumed more milk and meat than those in other groups.[96] Although milk and fruit and vegetables were sometimes listed, most studies have shown that the amounts consumed were small. In those who used milk, it was often added to tea and coffee (coffee creamers are also often used). In a number of studies, vegetables were often consumed as a relish or gravy made with tomato and onion. Although more people living on farms frequently consumed added sugar than those from the upper-class urban strata, the consumption of sweets, cakes and cold drinks was lowest in the rural and farm strata.[96]

Fortunately, two national surveys[6,7] and a number of other studies have provided important information on the intake of fruit and vegetables, SSBs, fried foods, fast foods, salty snacks and processed meat.

The review of Ronquest-Ross et al. (2014)[15] provides national data about the most significant changes in food items consumed from 1994–2012. This review is based on food balance sheets and the Euromonitor International© Passport that depicts food items consumed (kg per capita per annum). Changes in the food items that were consumed in larger quantities from 1994–2012 included fats and oils, animal protein foods (chicken and meat), sauces, dressings and condiments, sweet and savoury snacks, and SSBs. Although the results for the review were generated using a methodology that was not applied in any of the included studies, the findings are similar to those of the current review.

A landmark study by Afshin et al. (2019)[135] evaluated the consumption of foods and nutrients across 195 countries and quantified the impact of inadequate intake on NCD mortality and morbidity. Globally, high intakes of sodium, low intakes of whole grains, and low intakes of fruits were identified as the leading dietary risk factors for deaths and disability-adjusted life years globally. Studies of this nature highlight the important contribution of a healthy diet in preventing obesity and its co-morbidities.

Fat, fried food, fast food, salty snack and processed meat consumption

Recent research confirms the association between the intake of ultraprocessed food, obesity and non-communicable diseases.[136] Overall, the results of the studies over the review period point to an increased intake of foods high in fats, oils, and sweet and savoury snacks that contain sugar and salt. Furthermore, an increase in the proportion of processed and packaged food high in fat (vegetable oils) has been observed.

The results of the SANHANES-1 show that 18% of the total group of South Africans had a high fat score (11–20), with the lowest fat score identified in the older participants (5.5) and in those from rural areas (5.6). About one-quarter (23.1%) of participants from urban formal areas had a high fat score and the highest percentage of low fat users (0–5) were Black Africans (36.8%).[7]

Ten (10) percent of all participants in the SADHS of 2016 reported eating fried foods, fast foods, salty snacks and processed meats every day,[6] with 37% eating them at least once a week. The results of SANHANES-1 show that 28.3% of South Africans reported that they ate out weekly. Convenience foods and foods eaten away from home are generally high in fat and low in fibre.[136]

Fast food was eaten at least once a week by 18% of particpants in the most recent SADHS. Thirteen (13) percent reported eating salty snacks every day (29% at least once a week) and 14% ate processed meats every day (29% at least once a week). Daily consumption of all of these foods decreased with age, but increased with household wealth, while more participants from urban than non-urban areas consumed them.[6]

Sugar and SSB consumption

Consumption of added sugars is directly related to an increased risk of obesity and non-communicable diseases.[135] An increased intake of sugar and SSBs was evident in participants in the studies published over the review period. As with the fat score, the mean sugar score decreased with age in SANHANES-1 participants and more rural participants had a low sugar score compared to participants from urban formal areas. The highest percentage of high sugar users were Whites (21.1%) and the lowest Indians (16.1%).[7] More than one-third of the total SADHS 2016 group (36%) indicated that they had consumed SSBs during the previous day or night.[6] The percentage of participants who had consumed SSBs also declined with age. More Whites drank fruit juice (24%) than those in other groups, while more Coloured and Black African participants consumed SSBs (38% and 36%, respectively). More men than women drank SSBs (40% vs. 33%). A higher percentage of participants from urban than non-urban areas consumed SSBs and fruit juice.[6]

In an attempt to address the high prevalence of non-communicable diseases in South Africa, the South African Department of Health has implemented regulations aimed at compelling the food and beverage industry to reduce salt and sugar consumption in South Africans. The effects of this legislation will only become evident in the future.

Fruit and vegetable consumption

The regular consumption of fruit and vegetables forms the foundation of a healthy diet.[137] It is well known that an inadequate intake of vegetables and fruit increases the risk of micronutrient deficiencies. The surveys that were conducted over the review period confirmed low to moderate consumption of fruit and vegetables in South African adults.

One-quarter of the SANHANES-1 participants (25.6%) had a low fruit and vegetable score and 29% had a high score. The highest number of participants with a low fruit and vegetable score were those in rural formal areas (36.7%) and the lowest in the urban formal areas (18.8%). More Whites (9.0%) had four or more fruits per day than Black African consumers (3.9%).[7] Of the total group interviewed as part of the SADHS of 2016, 59% of adults reported that they had consumed vegetables during the previous day or night, while 49% reported that they had consumed fruit.[6] Fruit and vegetable intake was similar across all age groups. Daily fruit consumption ranged from 71% in Whites to 46% in Black Africans, while vegetable consumption ranged from 84% in Whites to 57% in Black Africans. More women than men consumed fruit and vegetables. Fruit and vegetable consumption was highest in the Western Cape and lowest in the Northern Cape. The percentage of participants who consumed fruit and vegetables was higher in urban areas than in rural areas.[6]

The nutritional consequence of these food consumption shifts has contributed to the increased prevalence of overweight and obesity which have been described earlier. This problem is further exacerbated by the fact that a healthy diet is largely unaffordable for most.[138]

5.5 LIMITATIONS OF THE CURRENT REVIEW

The following limitations are acknowledged:

In many cases, the tools, cut-points and standards referred to in the included publications were developed internationally. Their validity and reliability may be limited in populations and ethnic groups other than the ones for which they were developed.

The quality of data collected in all studies included in a review of this nature cannot be assured. Although all identified studies were included in the current review, it may be argued that studies with very small sample sizes or those that used inappropriate assessment methods should have been excluded. The authors decided to include them in order to provide a holistic picture of the work that has been done over the review period, but their data have not been taken into account in the conclusions.

The population of South Africa may not be fully represented in the studies that have been included. In many cases, studies are conducted in communities chosen for a specific reason (e.g., specific age group, communities of interest or the most vulnerable within communities). For this reason, the contribution of national and large surveys has been prioritised in the conclusions.

As noted throughout the review, nutrient intake data depend on the methodology that is applied in both the collection and presentation of data. Means or median nutrient intakes of a group do not always reflect individual or majority intakes. The quality of the food composition software and databases that are used may introduce an additional source of bias.

Health and nutritional status is largely influenced by levels of physical activity, which was not assessed in this review.

5.6 CONCLUSION

This review, as a follow on from the review by Vorster et al. (1997), demonstrates the continuation of the obesity transition in South Africa with the majority of adult women (three out of five) and a high proportion of adult men (two out of five) being overweight and/or obese whilst underweight almost disappearing in women (<5% in all provinces) whilst still prevalent in men albeit in less than 20% of men. Although no national dietary data is available for the period of review, the localised studies repeatedly demonstrated diets that are restricted in terms of variety, in particular with regards to fruit, vegetables and dairy products. Both dietary diversity and dietary quality appear to be higher in populations with higher wealth. Unfortunately, concurrent with these improvements consumption of nutrients of concern such as sugar, sodium and saturated fat seems to become excessive in these same populations whilst rural populations and older people report lower consumption of sweets, snacks and sugary sweetened beverages. It has been hypothesised that the food environment with which individuals grow up has long lasting implications for their future food choices. This may explain the lower consumption of sweets, snacks and sugary beverages by older people as these products (and other ultra-processed products) were only introduced to the market in the 1980s. On the other hand this scenario is a cause for concern given the already high prevalence of overweight and obesity in the younger adults who have only ever experienced a food milieu that promotes obesity. The dietary changes associated with stage four of the nutrition transition fuel the obesity transition and include changes in food purchases (less fresh and more processed foods including ultra-processed products), eating meals outside of the home, specifically convenience and fast foods which is practiced at least once a week by almost four out of ten adults and regular snacking on sweet and/or salty snack foods (including beverages) daily (by almost 20%) or weekly (by almost 40%) of adults. Owing to the major impact of nutrition on health, regular and reliable assessment of dietary intake through nutritional surveys are critical to guide and monitor interventions to prevent and manage nutrition related non-communicable diseases.

5.7 REFERENCES

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5.8 TABLES

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Table 5.1: Studies related to the nutritional status of SA adults: published 1997–2019

(Nutritional status refers to food intake, nutrient intake, anthropometry, blood/urine levels of nutrients, dietary diversity, dietary quality, dietary patterns, food security)

Study	Publications	Data collection timeframe	Site of study	Area	Study design	Study population, sampling and sample size	Gender	Ethnicity	Variables assessed
NATIONAL SURVEYS									
South African Demographic and Health Survey (SADHS) 1998	SADHS Report, 1998[4] Puoane *et al.*, 2002[139] Joubert *et al.*, 2007[140] Peer *et al.*, 2013[141]	1998	All 9 provinces of SA	U NU	Cross-sectional study	Multistage probability sampling was used to obtain a nationally representative sample ≥15 yrs; **Sample size:** 17 500 (12 247 HH)	M F	B W C I/A	**Anthropometry:** BMI, WC, HC, WHR, MUAC **Other:** Blood pressure, lifestyle factors, reported NCD
SA Food Consumption Survey (NFCS 1999)	Labadarios *et al.*, 2005[2]	1999	All 9 provinces of SA	UF UI RF T	Cross-sectional study	Multistage probability sampling was used to obtain a nationally representative sample of children; **Sample size:** 2894 for food security analysis	F	B W C I/A	**Food security status:** Based on CCHIP hunger index
SA National Database Survey	Senekal *et al.*, 2003[66]	n/d	All 9 provinces of SA	U R	Cross-sectional study	2 100 adults 18–65 yrs was randomly selected from SA National Database of consumers to proportionally represent all ethnic groups and to include at least one small town and one city from each of the 9 provinces; **Sample size:** 554 returned mailed survey	M F	B W C I/A	**Dietary data:** Intake of high-fat food items, meal patterns, diet behaviour (based on a self-reported questionnaire) **Anthropometry:** BMI (based on self-reported weight and height)
Stress and Health Study (SASH) (part of the World Mental Health Survey)	Sorsdahl *et al.*, 2011[142]	2002 to 2004	All 9 provinces of SA	U R	Cross-sectional study	Two-stage probability sampling was used to obtain a nationally representative sample ≥18 yrs; targeted HH and migrant labourer group quarters; **Sample size:** 4 185	M F	B W C I/A	**Food security status:** Based on a single-item household food insufficiency measure
South African Demographic and Health Survey (SADHS) 2003	SADHS Report, 2007[5]	2003	All 9 provinces of SA	U NU	Cross-sectional study	Multistage probability sampling was used to obtain a nationally representative sample of adults ≥15 yrs; **Sample size:** 19 865 (from 7756 HH)	M F	B W C I/A	**Dietary data:** Micronutrient scores (based on 30-item FFQ), fat intake score (based on 7 questions from the N-index) **Anthropometry:** BMI, WC, HC, WHR **Other:** Blood pressure, lifestyle factors, reported NCD

Table 5.1 Continued

Study	Publications	Data collection timeframe	Site of study	Area	Study design	Study population, sampling and sample size	Gender	Ethnicity	Variables assessed
NATIONAL SURVEYS									
SA Food Consumption Survey Fortification Baseline (NFCS-FB)	Department of Health, 2007[3] Labadarios *et al*., 2008[143]	2005	All 9 provinces of SA	UF UI RF T	Cross-sectional study	Three stage probability sampling was used to obtain a nationally representative sample of children 1–9 yrs and women of reproductive age (16–35 yrs) living in the same HH; **Sample size:** 2 403 females ≥16 yrs	F	B W C I	**Anthropometry:** BMI **Laboratory analysis:** Vitamin A, serum and red cell folate, zinc, haemoglobin, serum ferritin, CRP, urinary Iodine **Food security status:** Based on CCHIP hunger index
South African Social Attitudes Survey (SASAS)	Labadarios *et al*., 2011[111] Steyn and Labadarios, 2011[145–146] Steyn *et al*., 2011[146]	2009	All 9 provinces of SA	UF UI RF T	Cross-sectional study	3 827 sampling units were randomly selected to complete a nutrition module during the 2009 SASAS to render a nationally representative sample ≥16 yrs; **Sample size:** 3 827	M F	B W C I/A	**Dietary intake:** Purchasing behaviour of street foods and fast foods **Dietary diversity score:** Counting 9 food groups based on 1 x 24 hour recall
National Income Dynamics Study (NIDS) Waves 1,2,3,4, and 5	Data available from South African Labour and Development Research Unit, University of Cape Town http://www.nids.uct.ac.za/ Ardington and Case, 2009[37] Ardington and Gasealahwe, 2012[38] Cois *et al*., 2015[147]	2008 2010 2012 2014 2017	All 9 provinces of SA	U R	Cross-sectional study	Two-stage probability sampling was used to obtain a nationally representative sample of children and adults ≥18 yrs, **Sample size:** for adults at baseline: 10687 females and 7992 males	M F	B W C I/A	**Anthropometry:** BMI, WC **Other:** Lifestyle factors
South African National Health and Nutrition Examination Survey (SANHANES-1)	Shisana *et al*., 2013[7] Labadarios *et al*., 2014[148] Mchiza *et al*., 2015[149] Parker *et al*., 2018[69] Mchiza *et al*., 2018[150] McHiza *et al*., 2019[151]	2012	All 9 provinces of SA	UU MU IS F R	Cross-sectional study	Multi-stage disproportionate, stratified cluster sampling was used to obtain a nationally representative sample ≥15 yrs; **Sample size:** 25 532 (8 168 HH)	M F	B W C I/A	**Dietary data:** Fat, sugar, fruit and vegetable intake scores **Dietary diversity score:** Counting 9 food groups based on validated unquantified 1 x 24-hour recall **Food security status:** Based on the CCHIP hunger index **Anthropometry:** BMI, WC, WHR **Laboratory tests:** Vitamin A, haemoglobin, serum ferritin, lipid profile, HbA1c, cotinine **Other:** Lifestyle factors, blood pressure, step test, pulse rate, self-reported NCDs

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Table 5.1 Continued

Study	Publications	Data collection timeframe	Site of study	Area	Study design	Study population, sampling and sample size	Gender	Ethnicity	Variables assessed
NATIONAL SURVEYS									
South African Demographic and Health Survey (SADHS), 2016	Omotayo *et al.*, 2019[152]	2016	All 9 provinces of SA	U NU	Cross-sectional study	Two-stage probability sampling was used to obtain a nationally representative sample ≥15 yrs; **Sample size:** 11 083 HH, 12 132 participants	M F	B W C I/A	**Dietary data:** Intake of fruit, vegetables, SSB and fruit juice, fried foods, fast foods, salty snacks, and processed meats (based on 1 x 24-hour recall) **Anthropometry:** BMI, WC, WtHR **Laboratory tests:** Haemoglobin, HbA1c **Other:** Blood pressure, lifestyle factors, self-reported NCD
SA General Household Survey (GHS)	Omotayo *et al.*, 2019[152]	2016	All 9 provinces of SA	U R	Cross-sectional study	Stratified two-stage sampling targeted all legally recognized HH members (usual residents) in the nine provinces; **Sample size:** 21 218 HH, 2 604 participants	M F	B W C I/A	**Food security status:** Based on the GHS-tool
INTERNATIONAL SURVEYS WITH A SA COMPONENT									
HelpAge International	HelpAge International Africa REGIONAL Development Centre Report, 2004[32] Kimokoti and Hamer, 2008[21]	1995	All 9 provinces of SA	U R	Cross-sectional study	Secondary analysis of Stats SA 1995 Income and Expenditure Survey targeted HH in 24 urban centres to obtain a nationally representative sample; **Sample size:** 7 194 HH headed by persons aged ≥60 yrs; 21 510 HH headed by persons <60 yrs	M F	B W C I/A	**Dietary intake:** Food intakes, number of meals per day (based on an IFFQ) **Food security status:** Food poverty rate based on a basic subsistence diet calculated as the cost of purchasing a very low-cost food ration **Anthropometry:** BMI, MUAC
Prospective Urban and Rural Epidemiology - North West Province arm (PURE-NWP)	Schutte *et al.*, 2012[153] Dolman *et al.*, 2013[105] Richter *et al.*, 2014[33] Vorster *et al.*, 2014[154] Ware *et al.*, 2014[155] Sotunde *et al.*, 2015[156] Kruger *et al.*, 2016[157] Kruger et al., 2017[158] Chikowore *et al.*, 2017[159] Wentzel-Viljoen *et al.*, 2018[93] Wentzel-Viljoen *et al.*, 2018[106] Wright *et al.*, 2019[159]	2005 and 2010	NWP	U R	10-year longitudinal cohort study with nested cross-sectional studies	Multistage sampling was used in two rural and two urban settings to recruit healthy black adults, 35–70 yrs from 6000 randomly selected HH; **Sample size:** 1 710 **2005:** detailed nutrient intakes of 1858 were available **2010:** 1 275 followed up	M F	B	**Dietary data:** Energy, macronutrient (including fatty acids), micronutrient, added sugar, fibre, and alcohol intakes (based on 135-item culture-sensitive QFFQ; Analysis: SAMRC Food Composition Database; adequacy: % with values <EAR or AI) **Dietary quality scores** **Anthropometry:** BMI, WC, HC, WtHR, MUAC, ASM, BMD **Laboratory tests:** Lipid profile, hs-CRP, fasting blood glucose, HbA1c, 25(OH)D3, PTH, HIV, CRP-genes **Other:** Blood pressure, lifestyle factors

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Table 5.1 Continued

Study	Publications	Data collection timeframe	Site of study	Area	Study design	Study population, sampling and sample size	Gender	Ethnicity	Variables assessed
INTERNATIONAL SURVEYS WITH A SA COMPONENT									
World Health Organization Study of Global Ageing and Adult Health (WHO-SAGE) Wave 1: 2007-2008 Wave 2: 2014-2015	Peltzer *et al.*, 2011[161] Phaswana-Mafuya *et al.*, 2012[162] Wu *et al.*, 2015[131] Oyebode *et al.*, 2015[163] Basu *et al.*, 2013[164] Charlton *et al.*, 2016[165] Charlton, *et al.*, 2018[80]	2007 to 2008 and 2014 to 2015	All 9 provinces of SA	U R	Cross-sectional study nested in Cohort study	**Wave 1:** Multistage-stage probability sampling was used to obtain a nationally representative samples in six countries–from each household one randomly selected individual aged 18–49 yrs and all individuals aged ≥50 yrs; **Sample size (SA):** 4 223 ≥18 yrs; 3 840 ≥50 yrs; Urine was collected from 1 200; **Wave 2:** 2 887 ≥50 yrs; Urine was collected from 875	M F	B W C I/A	**Dietary data:** Fruit and vegetables intake (based on typical daily intake questionnaire) **Anthropometry:** BMI, WC, HC, WHR **Laboratory tests:** Urinary iodine **Other:** Blood pressure, smoking, alcohol, PA
Prospective Urban and Rural Epidemiology - Cape Town arm (PURE-CP)	Egbujie *et al.*, 2016[166]	2009 to 2010	EC: Rural Mount Frere WC: Langa	U R	10-year longitudinal cohort study with nested cross-sectional studies	Multistage sampling was used in a purposefully selected urban community, and single-staged cluster sampling in a purposefully selected rural community to recruit healthy black adults, 35–70 yrs; **Sample size:** 1 942	M F	B	**Anthropometry:** BMI (presented per NCD category) **Other:** Body image score, blood pressure
Modelling the epidemiologic transition study (METS)	Durazo-Arvizu *et al.*, 2014[34] Atiase *et al.*, 2015[167]	2010 to 2011	WC: SA cohort located at/near Khayelitsha, Cape Town	U	Cross-sectional study	Adults, 25–45 yrs, was drawn from the Vitamin D Ancillary Study, **Sample size:** 500 (SA)	M F	B	**Anthropometry:** BMI, BAI, FFM, FM **Laboratory tests:** 25(OH)D, fasting blood glucose, fasting insulin, leptin, adiponectin **Other:** Blood pressure, PA measurement (by accelerometer)
Weight underestimation study (nested in PURE-CP study)	Okop *et al.*, 2019[168]	2014 to 2015	EC: Rural Mount Frere WC: Langa	U R	Cross-sectional study nested in longitudinal cohort study	Existing PURE-CP study cohort participants, 35–78 yrs, who were interviewed during the 4 year follow-up survey (2014-2015) were included. Sample size: 920	M F	B	**Anthropometry:** BMI, WC, body fat %

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Study	Publications	Data collection timeframe	Site of study	Area	Study design	Study population, sampling and sample size	Gender	Ethnicity	Variables assessed
INTERNATIONAL SURVEYS WITH A SA COMPONENT									
Slow, Stop or Stem the tide of Obesity in the People of South Africa study (STOP-SA study) (nested in METS and PURE-CP study)	Okop *et al.*, 2019[35]	2015 to 2016	EC:Rural Mount Frere WC: Langa and Khayalitsha	U R	Longitudinal cohort study	Data from existing METS and PURE-CP studies were combined; **Sample size:** 800 at follow-up with recorded baseline weights and SSB intake data (247 METS; 553 PURE-CP)	M F	B	**Dietary data:** Intake of SSB (including fruit and vegetable juices), meat, snacks and 'take-away', and fruits and vegetables (based on an IFFQ) **Food security status:** Based on single question used as binary variable) **Other:** Body image perception
REGIONAL SA STUDIES									
Indian coronary heart disease study (I-CHD study)	Wolmarans *et al.*, 1999[98]	1984 to 1986	KZN: Durban metropolitan area	U	Cross-sectional study	Multistage-stage probability sampling of HH was used to recruit adults, 15–69 yrs; **Sample size:** 776	M F	I	**Dietary data:** Intake of energy, macronutrients, fatty acids classes, sugar per 4200 kJ, cholesterol per 4200 kJ and fibre, and nutrient ratios (based on 1 x 24-hour dietary recall; analysis with 1981 MRC Food Composition Tables; adequacy: % with <67% of RDA)
Community-based intervention: The Coronary Risk Factor study among whites (CORIS-W): 12-year post-baseline results	Steyn *et al.*, 1997[169] (*CORIS Baseline*[170] *took place in 1979; an intervention was introduced, and in 1983 4-year follow-up took place)*	1991	WC: Swellendam and Robertson (intervention) compared to Riversdale (control)	R	Cross sectional study nested in a quasi-experimental study	Random sampling of white participants, 15–64 yrs, for the 1991 resurvey in the three towns, 12 years after the baseline study; **Sample size:** 1620	M F	W	**Anthropometry:** BMI **Laboratory tests:** Lipid profile **Other:** Blood pressure, smoking
Coronary Heart Disease Risk Factor Study in the African Population of the Cape Peninsula Study (CORIS-A)	Steyn *et al.*, 1997[171] Steyn, *et al.*, 1998[172]	1990	WC: Cape Peninsula residential and informal settlements	PU IS	Analytical study nested in a community based descriptive study	Multistage-stage probability sampling of HH was used to recruit adults, 15–64 yrs; **Sample size:** 986	M F	B	**Dietary intake:** Keys dietary score (based on 1 x 24-hour recall) as measure of atherogenicity of diet **Anthropometry:** BMI **Laboratory tests:** Lipid profile **Other:** Blood pressure, smoking
Black Risk Factor Study (BRISK study)	Vorster *et al.*, 1998[173]	1990	WC: Cape Peninsula: Guguléthu, Langa, Nyanga, New Cross-roads, KTC, Old Crossroads and Khayelitsha	PU IS	Cross sectional study	Multistage stratified proportional sampling of HH was used to obtain community representative sample of black adults, 15–64 yrs; **Sample size:** 799	M F	B	**Anthropometry:** BMI **Laboratory tests:** Lipid profile, fibrinogen **Other:** Blood pressure, smoking

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Table 5.1 Continued

Study	Publications	Data collection timeframe	Site of study	Area	Study design	Study population, sampling and sample size	Gender	Ethnicity	Variables assessed
REGIONAL SA STUDIES									
Cape Town black elderly study (nested in BRISK study)	Charlton *et al.*, 2001[30]	1990	WC: Cape Town	PU IS	Cross-sectional study nested in BRISK study	Stratified proportional subsample of equal numbers of males and females, ≥60 yrs, were drawn from the BRISK study; **Sample size:** 148	M F	B	**Dietary data:** Energy, macronutrient, micronutrient and cholesterol intakes, food groups (based on 1 x 24h recall; analysis with 1991 MRC Food Composition Tables; adequacy: % with <67% of RDA) **Anthropometry:** BMI, MUAC, fat % (skinfolds)
Cape Flats study (nested in BRISK study) Part of the International Union of Nutritional Sciences (Committee on Nutrition and Ageing) cross-cultural studies on food habits and health in later life	Charlton *et al.*, 1997[174] Charlton *et al.*, 1997[175] Charlton *et al.*, 1998[176] Charlton *et al.*, 1998[84] Charlton *et al.*, 2001[30]	1993	WC: Cape Flats area, Cape Town		Cross-sectional analytical study	Two-stage cluster sampling of HH were used to obtain community representative sample of 200 free-living adults, ≥65 yrs, of mixed ancestry; **Sample size:** 200	M F	C	**Dietary data:** Energy, macronutrient (including fatty acids), micronutrient, added sugar, alcohol and fibre intakes (based on a validated QFFQ; analysis with 1991 MRC Food Composition Tables; adequacy: % with values <67% of RDA) **Anthropometry:** BMI, WC, WHR **Laboratory tests:** haematological indices, serum ferritin, vitamin B12, serum folate, 25(OH)D, electrolytes, blood proteins, liver enzymes **Other:** PA
Colon cancer in Africans study	O'Keefe *et al.*, 1999[73]	n/d	EC: Keiskamma-hoek KZN:Manguzi MP:Khayelitsha	U PU R	Cross-sectional study	Middle-aged volunteers were recruited from rural Black African and urban Black African and White communities; **Sample size:** 96	M F	B W	**Dietary data:** Energy, macronutrient, micronutrient intakes. (based on an IFFQ, 72-hour dietary recall; analysis with 1991 MRC Food Composition Tables; adequacy: % of RDA) **Anthropometry:** BMI, MUAC, TSF **Laboratory tests:** Vitamin A, vitamin C, vitamin E, fatty acids, lipid profile
Mamre study	Steyn *et al.*, 2004[31]	1996	WC: Mamre, Cape Town	P U	Cross-sectional study	Two-stage cluster sampling of HH was used to recruit people of mixed ancestry, ≥15 yrs; **Sample size:** 974	M F	C	**Anthropometry:** BMI, WC, WHR **Laboratory tests:** Lipid profile, oral glucose tolerance tests **Other:** Blood pressure, PA

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Study	Publications	Data collection timeframe	Site of study	Area	Study design	Study population, sampling and sample size	Gender	Ethnicity	Variables assessed
REGIONAL SA STUDIES									
West Coast villages elderly study	Charlton *et al*., 2001[39]	1997	WC: St Helena Bay and Velddrif	R	Cross-sectional study	Convenience sampling from an address list was used to recruit adults, of mixed ancestry; ≥55 yrs; **Sample size:** 152	M F	C	**Dietary data:** Energy, macronutrient, micronutrient, alcohol and fibre intakes (based on a QFFQ; analysis with 1991 MRC Food Composition Tables; adequacy: % with values <67% of RDA) **Anthropometry:** BMI, WC, WHR **Laboratory tests:** Fasting blood glucose, S-cholesterol, urinary sodium, urinary potassium **Other:** Blood pressure, PA, urinary-N
Dikgale Health and Demographic Surveillance System study, Limpopo (DHDSS-Limpopo)	Steyn *et al*., 2001[100]	1997-1998	LP:DHDSS site - covers 15 rural villages, 40 km north-east of Polokwane	R	Cross-sectional study	200 dwellings were randomly selected in order to interview the head of each HH, ≥20 yrs; **Sample size:** 210 in winter; 163 available for follow-up in summer	M F	B	**Dietary data:** Energy, macronutrients and micronutrient intakes, most frequently consumed foods (based on 4 x 24-hour recalls–two in the winter and two in summer, 8 months later; analysis with SA Foodfinder Dietary Software; adequacy:% with values <100% RDA); **Anthropometry:** BMI
	Alberts *et al*., 2005[50]	n/d			Cross-sectional study	Of the possible 5800 adults (≥30 yrs) in the villages, 2106 completed interviews and had clinical measurements taken. **Sample size:** 2106 (1391 provided blood sample)	M F	B	**Anthropometry:** BMI, WC, WHR **Laboratory tests:** Fasting blood glucose, lipid profile, liver enzymes **Other:** Blood pressure
The Transition and Health during Urbanisation of South Africans (THUSA) study	James *et al*., 2000[177] Vorster *et al*., 2000[178] Kruger *et al*., 2002[179] MacIntyre *et al*., 2002[96] Oosthuizen *et al*., 2002[55] Vorster *et al*., 2005[56] Kruger *et al*., 2005[71] Kruger *et al*., 2012[180] Macintyre *et al*., 2012[110]	1996 and 1998	NWP 37 randomly selected sites representing the NWP health districts	UU MU IS F R	Cross-sectional study	Multistage sampling of HH was used recruit apparently healthy Black African adults (1996: 15–65 yrs; 1998: added ≥65 yrs; **Sample size:** 1751	M F	B	**Dietary data:** Energy, macronutrients, micronutrients, alcohol and fibre intakes, most frequently consumed foods (based on 145 item QFFQ; analysis with SA Foodfinder Dietary Software; adequacy assessed by comparing to the United States RDA and Food and Agriculture Organisation safe level of intake) **Anthropometry:** BMI **Laboratory tests:** Vitamin A, lipid profile, fibrinogen, haematological indices, iron status

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Table 5.1 Continued

Study	Publications	Data collection timeframe	Site of study	Area	Study design	Study population, sampling and sample size	Gender	Ethnicity	Variables assessed
REGIONAL SA STUDIES									
Ndunakazi study	Oelofse *et al.*, 1999[45] Faber and Kruger, 2005[46]	1998	KZN: Ndunakazi rural village ±60 km north-west of Durban	R (T)	Cross-sectional study	Convenience sampling of women, 25–55 yrs, one per household, recruited through community-based growth monitoring points; **Sample size:** 187 (127 mothers)	F	B	**Dietary data:** Energy and macronutrient intakes (based on 24-hour dietary recall; analysis with 1991 MRC Food Composition Tables and expressed per BMI category); most frequently consumed foods (based on an IFFQ) **Anthropometry:** BMI **Laboratory tests:** Haematological indices, iron status, vitamin B12 and red cell folate, Vitamin A
Yenza study	Mfenyana *et al.*, 2006[57]	1999	EC: Engcobo, Umtata	PU R	Cross-sectional study	Multistage sampling of at least 10 HH from each administrative area and informal settlement was used to recruit adults ≥15 yrs; **Sample size:** 2 049 (4 608 HH)	M F	B	**Anthropometry;** BMI **Other:** Blood pressure, smoking
Women's Health Study	Hattingh *et al.*, 2008[58] Hattingh *et al.*, 2008[92] Hattingh *et al.*, 2008[107] Hattingh *et al.*, 2013[123] Ekoru *et al.*, 2018[181]	2000	FS: Mangaung	PU	Cross-sectional study	Multistage sampling of HH was used to recruit 500 premenopausal women in two age groups, 25–34 yrs and 35–44 yrs; **Sample size:** 500	F	B	**Dietary data:** Energy, macronutrients and micronutrient intakes, most frequently consumed foods (based on validated QFFQ; analysis with 1991 MRC Food Composition Tables adequacy: % with <67% of RDA;) **Anthropometry:** BMI, WC, HC, WHR **Laboratory tests:** Fasting blood glucose, fasting insulin, lipid profile
WC fruit factory study	Wolmarans *et al.*, 2003[40]	n/d	WC: Fruit-packing factory 70 km north of Cape Town	R	Cross-sectional study	Convenience sampling was used to recruit female factory workers, 18–55 yrs. All 700 were invited to participate in the study, and 48.8% volunteered; **Sample size:** 338	F	C	**Dietary data:** Consumption of red meat, chicken and fish **Anthropometry:** BMI **Laboratory tests:** Haematological indices, Iron status, CRP

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Table 5.1 Continued									
Study	**Publications**	**Data collection timeframe**	**Site of study**	**Area**	**Study design**	**Study population, sampling and sample size**	**Gender**	**Ethnicity**	**Variables assessed**
REGIONAL SA STUDIES									
Cape Town peri-urban study	Charlton *et al.*, 2005[182] Charlton, *et al.*, 2007[41]	n/d	WC: Cape Town	PU	Cross-sectional study	Social groups and institutions for the elderly were targeted to recruit adults ≥60 yrs; **Sample size:** 285	M F	B	**Dietary data:** Energy, macronutrients, micronutrients and sugar intake (based on 1 X 24-hour recall; analysis with 1991 MRC Food Composition Tables; adequacy:% with values <67% of RDA) **Anthropometry:** BMI, MUAC **Laboratory tests:** vitamin C, serum folate, vitamin B12, haematological indices, indices of iron status, lipid profile **Other:** Mini-Nutritional Assessment (MNA) score, DETERMINE risk score
Ubombo study	Motala *et al.*, 2008[68] Motala *et al.*, 2011[47]	2005	KZN: Ubombo district	R	Cross-sectional study	Cluster sampling of HH, chosen at random from the geographic information system map, was used to recruit adults ≥15 yrs; **Sample size:** 1 025	M F	B	**Anthropometry:** BMI, WC, WHR **Laboratory tests:** Lipid profile **Other:** Oral glucose tolerance test
NWP farm workers study	Kruger *et al.*, 2006[183]	2002 to 2003	NWP: Ventersdorp Potchefstroom:3 farm schools in 2 districts, and farming communities	F	Cross-sectional study	Farm workers and their families from three commercial farms near Ventersdorp were invited to participate in the study to recruit adults ≥18 yrs; **Sample size:** 136.	M F	n/d	**Anthropometry:** BMI **Other:** Perceptions regarding alcohol
FS farm workers study	Kruger *et al.*, 2008[184]	n/d	FS: Fouriesburg		Cross-sectional study throughout five seasonal periods	Female farm workers, 18–57 yrs, from 17 HH on a selected farm (Oranje farm) were invited to participate in the study; **Sample size:** 13	F	n/d	**Food security status and coping mechanisms** based on standardised FCS index (food consumption-related coping strategy instrument)
Embo study	Msaki and Hendricks, 2013[118] Msaki and Hendricks, 2014[133]	2004 and 2005	KZN: Embo (poor rural farming community)	R F	Cross-sectional study (consecutive surveys in 2004 and 2005)	Randomly selected HH **Sample size:** 200 female HH heads	F	B	**Dietary quality:** HH food intake strata were developed using matrices obtained from the Household Food Intake Index and Nutritional Adequacy Ratios. Food quality was measured based on food count, and on 5 food groups (starchy foods, vegetables and fruits, animal sourced foods, fats, and legumes)

Table 5.1 Continued

Study	Publications	Data collection timeframe	Site of study	Area	Study design	Study population, sampling and sample size	Gender	Ethnicity	Variables assessed
REGIONAL SA STUDIES									
Vaal Area Integrated Nutrition Program (INP): Sharpeville Elderly Care-facility based study	Oldewage-Theron, *et al.* 2008[62] Oldewage-Theron and Kruger, 2008[114] Oldewage-Theron, *et al.*, 2008[185] Oldewage-Theron and Kruger, 2009[186] Oldewage-Theron *et al.*, 2009[77] Oldewage-Theron *et al.*, 2010[72] Oldewage-Theron *et al.*, 2015[78] Otitoola *et al.*, 2015[187] Oldewage-Theron *et al.*, 2018[188] Jamshidi-Naeini *et al.*, 2019[189] Saha *et al.*, 2019[190]	2004 to 2016	GP: Sharpeville	PU	Prospective Cohort study With nested cross-sectional and intervention studies	Elderly adults, ≥60 yrs, were randomly selected for the survey from an alphabetical list of names provided by a day- care centre for the elderly in Sharpeville **Sample size:** 88 to 208 (varied with nested studies)	M F	B	**Dietary data:** Energy, macronutrients and micronutrient, cholesterol, sugar, fibre, sodium intakes, most consumed foods, number of meals/day (based on 2 x structured 24-hour recalls, 1 month apart; analysis with SA Foodfinder Dietary Software; adequacy: % with values <EAR/AI); **Food variety score and consumption patterns** (based on an IFFQ); **Dietary diversity score** (based on 9 food groups) **Food security status:** Based on Household Food Insecurity Access Scale (HFIAS) **Anthropometry:** BMI **Laboratory tests:** Haematological indices, indices of iron status, serum zinc, vitamin A, vitamin E, serum folate, vitamin B12 fasting blood glucose, lipid profile
Vaal Area Integrated Nutrition Program (INP): Communities of Alexandra, Boipatong, Eatonside, Orange Farms	Oldewage-Theron *et al.*, 2005[102] Oldewage-Theron *et al.*, 2006[191] Oldewage-Theron and Kruger, 2011[192] Oldewage-Theron and Egal, 2013[193] Oldewage-Theron *et al.*, 2013[116] Oldewage-Theron *et al.*, 2014[116] Oldewage-Theron *et al.*, 2014[103]	2004 to 2019	GP: Vaal Area Alexandra, Boipatong, Eatonside, Orange Farms	IS	Longitudinal study with nested cross-sectional studies	Women, 19-90 yrs from randomly selected HH in four purposively selected settlements were recruited; data collected every year from 2004 until 2019 in February from one settlement / year; **Sample size:** 722 (varied with nested studies)	F	B	**Dietary data:** Energy, macronutrients and micronutrient, cholesterol, and fatty acids intakes (based on 3x 24-hour recall; analysis with SA Foodfinder Dietary Software; adequacy: % with values <EAR/AI) **Food variety score** (based on IFFQ) **Dietary diversity score** (based on 9 food groups) **Food security status:** Based on Cornell Hunger Scale, Maxwell food-based coping strategies **Anthropometry:** BMI **Laboratory tests:** Lipid profile **Other:** Blood pressure
Vaal Area Integrated Nutrition Program (INP): Communities of Alexandra, Boipatong, Eatonside, Orange Farms	Acham *et al.*, 2012[124] Acham *et al.*, 2012[194]	2004 to 2019	GP: Vaal Area Alexandra, Boipatong, Eatonside, Orange Farms	IS	Cross-sectional study	Random selection of 260 HH to recruit adult participants ≥19 yrs **Sample size:** 224	M F	B	**Dietary data:** Daily iron intake (based on a QFFQ) most frequently consumed foods based on 24-hour recall; analysis with SA Foodfinder Dietary Software; adequacy: % with values <EAR/AI) **Laboratory tests:** Haematological indices, iron status

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Study	Publications	Data collection timeframe	Site of study	Area	Study design	Study population, sampling and sample size	Gender	Ethnicity	Variables assessed
REGIONAL SA STUDIES									
Somerset-West elderly study	Marais *et al.*, 2007[195]	n/d	WC: Somerset-West	U	Cross-sectional study	Elderly, ≥60 yrs were randomly selected from four homes for the elderly; **Sample size:** 210	M F	n/d	**Dietary data:** Energy, macronutrients, micronutrients (based on food served minus plate waste); micronutrients expressed as % of EAR/AI) **Anthropometry:** BMI, MUAC (presented as M&F combined) **Other:** Mini-Nutritional Assessment (MNA) score, DETERMINE risk score
Ga-Rankuwa study	Li *et al.*, 2007[196]	2005	GP: Ga-Rankuwa, 35 km north of Pretoria	PU	Cross-sectional study	Door-to-door census sample of working-age adults, 18–40 yrs **Sample size:** 604	M F		**Dietary data:** Energy and macronutrients intakes (based on 1 x 24-hour recall, method of analysis not indicated) **Anthropometry:** BMI, WHR **Other:** Blood pressure, PA, smoking, alcohol intake
Khayelitsha study	Malhotra *et al.*, 2008[42]	2005	WC: Khayelitsha	PU	Cross-sectional study	650 HH were randomly selected from six purposefully selected areas to recruit women ≥18 yrs. **Sample size:** 638	M F	B	**Anthropometry:** BMI, WC **Others:** PA
Cape Town urban study	Jennings *et al.*, 2009[197]	n/d	WC: Cape Town	U	Cross-sectional study	Adult females recruited from church groups, community centres, and universities and through the regional press **Sample size:** 103 normal-weight and 122 obese participants	F	B	**Anthropometry:** BMD **Laboratory tests:** Fasting blood glucose, fasting insulin, free fatty acids, lipid profile

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Study	Publications	Data collection timeframe	Site of study	Area	Study design	Study population, sampling and sample size	Gender	Ethnicity	Variables assessed
REGIONAL SA STUDIES									
HealthKick study	Senekal *et al.*, 2015[43] Seme *et al.*, 2017[28]	2007	WC: School districts of the Cape Town Metropole North, Cape Winelands, Overberg	U R	Cross-sectional study	One education district in an urban and one in rural setting were purposively selected, and 50 schools in each area were randomly selected (83 schools participated) to recruit primary school educators of grade 4–6 children; primary caregivers of grade 4 children from 25 of the schools were also recruited; **Sample size:** 517 educators; 175 caregivers	B F	B W C	**Educators:** **Dietary data:** Frequency of poor and healthy food choices (based on self-administered 36 category IFFQ), meal patterns **Anthropometry:** BMI, WC **Fingerpick tests:** Random blood glucose, random cholesterol **Other:** Blood pressure, reported NCD
	De Villiers *et al.*, 2018[44]						B F	B C	**Caregivers:** **Dietary data:** Frequency of poor and healthy food choices focusing specifically on foods/drinks/snacks associated with the development/prevention of obesity, diabetes and other reported NCDs (based on IFFQ) **Anthropometry:** BMI **Other:** PA
Mariannhill Study	De Villiers *et al.*, 2018[44]	2007	KZN: Mariannhill area, Pinetown	PU	Cross-sectional study	Caregivers of 400 randomly selected grade 6 and 7 learners were recruited. **Sample size:** 394	F	B	**Dietary data:** Ten most frequently reported food items over a 2-day recall period (based on repeated 24-hour dietary recalls)
REGIONAL Network on AIDS, Livelihoods and Food security status (RENEWAL) Study	Drimie *et al.*, 2013[112]	2008	GP: Johannesburg	UF UI	Cross-sectional study	Three suburbs in the dense inner city - one peripheral urban, one informal settlement and one inner-city area - were purposively selected to recruit adult HH heads **Sample size:** 487	M F	B	**Dietary diversity score:** Based on 9 food groups (using 1 x 24-hour recall)

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Study	Publications	Data collection timeframe	Site of study	Area	Study design	Study population, sampling and sample size	Gender	Ethnicity	Variables assessed
REGIONAL SA STUDIES									
Stanger Study	Naicker *et al.*, 2015[24]	2008	KZN: Stanger	U	Cross-sectional study	Apparently healthy Indians, 35–55 yrs, were randomly selected according to inclusion and exclusion criteria, from a homogenous Indian community, **Sample size:** 250	M F	I	**Dietary data:** Energy and macronutrient intakes (based on QFFQ for one-month recall period; analysis with FoodFinder 3® dietary analysis software) **Dietary quality deficiency index and excess index** **Anthropometry:** BMI, WC (using ethnic specific cut-offs) **Laboratory analysis:** Fasting blood glucose, lipid profile
Phoenix Lifestyle Project	Prakaschandra *et al.*, 2016[48] Prakaschandra *et al.*, 2016[25]	2007 to 2008	KZN: Suburb of Phoenix, Durban	U	Cross-sectional study	Two-stage cluster sampling of HH was used to recruit adults, 15–64 yrs; **Sample size:** 1 428	M F	I	**Anthropometry:** BMI **Laboratory tests:**: Fasting blood glucose, insulin, lipid profile **Other:** Blood pressure, smoking
Assuring Health for All in the Free State (AHA-FS)	Van Zyl *et al.*, 2010[198] Van Zyl *et al.*, 2012[59] Gaziano *et al.*, 2013[199] Lategan *et al.*, 2014[200] Walsh and Van Rooyen, 2015[201] Lategan *et al.*, 2016[83] Kruger *et al.*, 2017[158] Ekoru *et al.*, 2018[181] Tydeman-Edwards *et al.*, 2018[60] Jordaan *et al.*, 2020[202]	2007	FS: Trompsburg, Philippolis, Springfontein	R	Cross-sectional, study	In rural areas, all households in the Black and Coloured townships were eligible to participate, and in urban areas multistage proportional cluster sampling was used to recruit adults, 25–64 yrs **Sample size:** 553 R; 419 U	M F	B C	**Dietary data:** Most frequently consumed foods (based on 1 x 24-hour recall and short IFFQ) **Food security status data:** Based on CCHIP hunger index **Anthropometry:** BMI, WC, BAI, WtHR **Laboratory tests:** Haematological indices, iron status, fasting blood glucose, lipid profile, 25(OH)D
		2008 to 2009	FS: Mangaung	PU					
Qwa-Qwa Integrated Nutrition Project (INP)	Oldewage-Theron *et al.*, 2012[125] Oldewage-Theron *et al.*, 2014[61]	2008 to 2009	FS: QwaQwa	R	Cross-sectional study	Data extracted from a baseline survey that included adults, 21 - 60 yrs from 271 HH; **Sample size:** 383 (dietary intake), 207 (anthropometry), 104 (indices of iron status)	M F	B	**Dietary data:** Energy, macronutrients and micronutrients (based on 3 x 24h recalls analysis with SA Foodfinder Dietary Software) **Food security status data:** Based on frequency of shortages of money for the purchasing of food or clothing, and number of meals eaten per day **Anthropometry:** BMI **Laboratory studies:** Indices of iron status

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Study	Publications	Data collection timeframe	Site of study	Area	Study design	Study population, sampling and sample size	Gender	Ethnicity	Variables assessed
REGIONAL SA STUDIES									
Agincourt Health and Socio-Demographic Surveillance System (HDSS) Study	Nawrotzki *et al.*, 2014[203]	2004 to 2010	MP: Agincourt HDSS site	R	Longitudinal study	Food security status module in 2004, 2007, and 2010, provides the core data for the present analyses. **Sample size:** 8 147 HH	M F	B	**Food security status score:** Based on single question: "How often in the last month did your household NOT have enough to eat?"
Umlazi Study	Mkhize *et al.* 2013[49]	2009 to 2010	KZN: Umlazi	PU	Cross-sectional study	Adults ≥ 60 yrs recruited by public announcements in 12 wards of Umlazi, **Sample size:** 270	M F	B	**Dietary data:** Energy, macronutrients, micronutrients intakes (based on 3 x 24-hour recalls; analysis with SA Foodfinder Dietary Software; adequacy evaluated as % with values <100% of EAR/AI), most frequently consumed foods (based on IFQQ) **Anthropometry:** BMI
Agincourt Health and Socio-Demographic Surveillance System (HDSS) and Soweto study	Prioreschi *et al.*, 2017[64]	2011	MP: Rural Agincourt HDSS of Bushbuckridge municipality, GP: Urban Greater Soweto	U R	Cross-sectional study	Women, 18–23 yrs, were randomly selected, in the rural area from the 2011 Agincourt HDSS database; and in the urban area, from the Birth-to-Twenty plus (BT20+) cohort of females who participated in the Young Adult Survey. **Sample size:** 1 506	F	B	**Anthropometry:** BMI **Other:** Body image satisfaction, eating attitudes, PA
The cardiovascular risk in black South Africans (CRIBSA) Study	Peer *et al.*, 2014[204] Steyn *et al.*, 2016[205]	2008 to 2009	WC: Cape Town: Langa, Guguletu, Crossroads, Nyanga, Khayelitsha	U	Cross-sectional study	Sampling frame was based on the 1990 study using proportional sampling of HH to recruit adults, ≥25 yrs; **Sample size:** 1099	M F	B	**Dietary data:** Energy, macronutrients (including fatty acid classes), micronutrients (based on 1 x 24-hour dietary recall; analysis with SA Foodfinder Dietary Software; adequacy: % with values <EAR or AI;) **Anthropometry:** BMI (presented per blood pressure category) **Laboratory tests:** Fasting blood glucose, lipid profile **Other:** Glucose tolerance test

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Table 5.1 Continued

Study	Publications	Data collection timeframe	Site of study	Area	Study design	Study population, sampling and sample size	Gender	Ethnicity	Variables assessed
REGIONAL SA STUDIES									
Empangeni study	Sheehy *et al.*, 2014[122] Kolahdooz *et al.*, 2013[94]	2011	KZN: 6 villages around Empangeni	R	Cross-sectional study	HH were randomly selected from area maps to recruit adults, ≥19 yrs who were main food preparers and shoppers for their HH; **Sample size:** 137	M F	B	**Dietary data:** Energy, macronutrients, micronutrients and fatty acid intakes (based on 2 x 24-hour dietary recalls; analysis with Nutribase version 9 software based on the UDSA National Nutrient Database for Standard Reference Release; adequacy evaluated as % with values <DRI); **Most frequently consumed foods** (subsample n=79) **Other:** smoking, reported NCD and HIV, dietary supplement use
Dikgale HDSS Study (1)	Maimela *et al.*, 2016[51] Ntuli *et al.*, 2015[52]	2011 to 2012	LP: Dikgale HDSS centre: 15 villages close to one another, 40 km north-east of Polokwane	R	Cross-sectional study	Permanent residents, ≥15 yrs, were randomly selected from the DHSS database **Sample size:** 2 981; 1 407 completed WHO STEPwise questionnaire, 815 provided blood samples	M F	B	**Dietary data:** Fruit and vegetable intakes (based on WHO STEPwise questionnaire) **Anthropometry:** BMI, WC **Laboratory tests:** Fasting blood glucose, lipid profile **Other:** Blood pressure, smoking, alcohol intake, PA
Limpopo Nurse's study	Goon *et al.*, 2013[53]	2011	LP: Vhembe and Capricorn districts	R Semi-R	Cross-sectional study	All nurses, 19–50 yrs, practising in Vhembe (rural) and Capricorn (semi-rural) districts, were invited to participate; **Sample size:** 153	M F	B	**Anthropometry:** BMI **Other:** PA
Birth to twenty (Bt20) participants and caregivers	George *et al.*, 2013[85] George *et al.*, 2014[27]	2011 to 2012	GP: Greater Johannesburg-Soweto metropolitan area	U	Cross-sectional study	Caregivers of the Bto20 cohort were contacted and asked if they had family members / neighbours (healthy adults, 18–70 yrs) that would be interested in participating in the study. **Sample size:** 717	M F	B I/A	**Dietary data:** Calcium, vitamin D intakes (based on 7d QFFQ) reported for males and females combined) **Anthropometry:** BMI, WC, WHR, body composition (DEXA) **Laboratory tests:** Serum 25(OH)D, serum calcium, serum Ca, PTH, total cholesterol, fasting blood glucose and insulin (HOMA), serum creatinine and alkaline phosphatase, inflammatory cytokines **Other:** Blood pressure, sun exposure, smoking, reported HIV, Oral glucose tolerance test
	Naidoo *et al.*, 2019[206]					23 year-olds in Bto20 cohort study. **Sample size:** 1540	M F	n/d	

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Table 5.1 Continued

Study	Publications	Data collection timeframe	Site of study	Area	Study design	Study population, sampling and sample size	Gender	Ethnicity	Variables assessed
REGIONAL SA STUDIES									
Birth to twenty (Bt20) participants and caregivers	Mtintsilana *et al.*, 2019[134]	2015 to 2016	GP: Greater Johannesburg-Soweto metropolitan area	U	Cross-sectional study	Caregivers of the Bto20 cohort, < 65 yrs were invited based on inclusion and exclusion criteria **Sample size:** 190	F	B	**Dietary data:** Dietary Inflammatory Index (DII) Scores (based on 7-day FFQ. **Anthropometry:** BMI, WC, (presented per E-DII scores)DEXA **Laboratory analysis:** Fasting blood glucose, fasting insulin, HbA1c, inflammatory cytokines **Other:** Oral glucose tolerance test
AWI-Gen Study (Africa Wits-INDEPTH partnership for Genomic Research)	Micklesfield *et al.*, 2018[129] Pisa *et al.*, 2018[63]	2011 to 2015	GP: Soweto	U	Cross-sectional study	Women, ≥40–55 yrs, were randomly recruited from caregivers in Bt20 study; men were recruited from the same communities where women lived and were age-matched; **Sample size:** 2 008-2 037 (differ per sub-study)	M F	b	**Dietary data:** Bread, fruit and vegetable and SSB (including fruit juices) intakes **Anthropometry:** BMI, WC, body composition (DEXA) **Others:** Blood pressure, smoking, alcohol, PA, sleep, reported HIV
Tugela Ferry irrigation scheme (TFIS) farmers study	Sinyolo *et al.*, 2014[207]	2012	KZN: Msinga REGIONAL municipality in the Mzinyathi District	R	Cross-sectional study	Stratified random sampling of farming HH was used to recruit adults, ≥18 yrs; **Sample size:** 186	n/d	n/d	**Food security status:** Based on the minimum per capita adult equivalent energy intake and adjusted using the consumer price index (CPI)
Health professionals study	Kunene *et al.*, 2017[208]	2012	KZN: Escort	R	Cross-sectional study	Convenience random sampling was used to recruit health professionals from a rural hospital; **Sample size:** 109	M F	B W C I/A	**Dietary data:** Food choices, types and drinks; intake of breakfast, lunch and dinner (based on dietary and eating habits questionnaire)
Discovery Vitality members study	Kolbe-Alexander *et al.*, 2013[209] Lambert and Kolbe,2013[210]	2012	SA: Cities	U	Cross-sectional study	Discovery Vitality members of 68 companies that hosted a worksite health and wellness day for their staff were included; **Sample size:** 6 532	M F	B W C I/A	**Dietary data:** Fruit and vegetable intake **Anthropometry:** BMI **Finger-prick tests:** Cholesterol **Others:** Blood pressure, PA, smoking
Heart and Stroke Foundation of South Africa (HSFSA) study	Peer *et al.*, 2018[211] Peer *et al.*, 2018[26]	2013	WC EP KZN FS GP	U R	Cross-sectional study	Adults, ≥ 18 yrs, self-selected for CVD screening, at screening sites situated within urban and semi-urban settings. **Sample size:** 7 711	M F	B W C I/A	**Dietary data:** Intake of fruit and vegetables, foods high in salt and fats (based on HSFSA's "Cardiovascular Health Check" form) **Anthropometry:** BMI

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Table 5.1 Continued

Study	Publications	Data collection timeframe	Site of study	Area	Study design	Study population, sampling and sample size	Gender	Ethnicity	Variables assessed
REGIONAL SA STUDIES									
Dikgale HDSS Study 2 Africa Wits-INDEPTH Baseline at Dikgale HDSS site for cohort data for Phase 2 of the AWI-Gen Study	Mashinya *et al.*, 2018[54]	2014, 2016	LP: DHDS site of 15 villages, situated 40 km north-east of Polokwane	R	Cross-sectional baseline study for longitudinal cohort study	Permanent residents, 40–60 yrs, were randomly selected from the DHDSS database; **Sample size:** 1 143	M F	B	WHO Steps questionnaire **Dietary data:** Bread, fruit and vegetable and SSB (including fruit juices) intakes **Anthropometry:** BMI **Others:** PA, smoking, alcohol, reported HIV status
KZN (INK) Peri-urban elderly study	Naidoo *et al.*, 2015[212]	n/d	KZN: Inanda, Ntuzuma KwaMashu (INK)	PU IS	Cross-sectional study	Two-staged proportional sampling of HH was used to recruit adults, ≥60 yrs; **Sample size:** 1 008	M F	B C	**Food security status score:** Based on single question **Anthropometry:** BMI, MUAC (presented per nutritional category) **Other:** Mini-Nutritional Assessment (MNA) score, reported NCD, depression scores
Bloemfontein elderly study	Robb *et al.*, 2017[213]	2014	FS: Mangaung	UU PU	Cross-sectional study	All adults, ≥ 60 yrs, permanently residing in two purposefully selected long-term care facilities (in a higher and a lower socio-economic community, respectively) were invited to participate, **Sample size:** 124	M F	n/d	**Dietary data:** Number of full meals/day, fluid intake, number of portions per food group per day (based on a structured questionnaire) **Nutritional risk:** Mini-Nutritional Assessment (MNA) score **Anthropometry:** BMI, MUAC
AWI-GEN Agincourt site study	Wagner *et al.*, 2018[65]	2015 to 2016	MP: Agincourt Health and Socio-Demographic Surveillance System site	R	Cross-sectional	A random sample of adults, 40–60 yrs was drawn from the 2013 Agincourt HDSS database; **Sample size:** 1388	M F	B	**Dietary data:** Intake of carbohydrates (as juice, SSB and bread) **Anthropometry:** BMI **Others:** PA, smoking, alcohol consumption, sleep, reported HIV status, reported NCD
Establishing Adult Reference Intervals for Selected Analytes in SA (EARISA) Study	Phatlhane *et al.*, 2016[214]	2014	WC	n/d (U)	Cross-sectional study	Adults, 18–76 yrs were randomly selected from the EARISA databases (students, hospital and laboratory staff) **Sample size:** 651	M F	B W C	**Dietary data:** Frequency of consumption of meat and vegetables **Laboratory tests:** Haematological indices, indices of iron status, hsCRP

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Table 5.1 Continued

Study	Publications	Data collection timeframe	Site of study	Area	Study design	Study population, sampling and sample size	Gender	Ethnicity	Variables assessed
REGIONAL SA STUDIES									
HAALSI Study (Health and Aging in Africa: Longitudinal Studies of an INDEPTH Community) Program	Reiger *et al.*, 2017[215] Chang *et al.*, 2018[216] Payne *et al.*, 2018[79] Kobayashi *et al.*, 2019[217] Kobayashi *et al.*, 2020[218]	2014 to 2015	MP: Agincourt Health and Socio-Demographic Surveillance System (AHDSS) site	R	Cross-sectional study	All adults, ≥ 40 yrs, who were permanent residents of the AHDSS site in MP were visited at home and invited to participated in the study; **Sample size:** 5059 (2731 ≥ 60 yrs) 4499 provided analysable blood samples	M F	B	**Dietary data:** Food consumption by expenditure **Anthropometry:** BMI (presented for M&F combined) **Laboratory tests:** Haematological indices, CRP, fasting blood glucose and lipid profile **Other:** Random blood glucose levels
Richards Bay, Dundee, and Harrismith study	Chakona *et al.*, 2017[117]	2014 to 2015	KZN: Richards Bay, Dundee, Harrismith	U PU R	Cross-sectional study	Multistage proportional sampling of HH was used to recruit women, 15–49 yrs; **Sample size:** 554 (Richards Bay:183, Dundee:173, and Harrismith:198)	F	B	**Dietary diversity score:** Based on standard 1 x 48-hour recall technique (adopted from FAO) across two seasons: minimum dietary diversity for WRA (MDD-W Diets) **Food security status:** Based on Household Food Insecurity Access Scale (HFIAS)
Nkonkobe Municipality of the Eastern Cape Study	Otang-Mbeng *et al.*, 2017[127]	2015	EC: Alice, Fort Beaufort, Middledrift and Seymour in Nkonkobe Municipality	R U	Cross-sectional study	Adult residents, 21–70 yrs were recruited (sampling not explained) **Sample size:** 118	M F	B	**Dietary data:** Intake of fast foods, fruit, vegetables and food preparation methods (based on validated questionnaire) **Anthropometry:** BMI (only stratified per behavioural category) **Others:** PA, smoking, alcohol intake
Letaba study	Mbhenyane *et al.*, 2017[119]	n/d	LP: Two villages, one township and one rural town of Greater Letaba Municipality, Mopani District	R	Cross-sectional study	Multi-stage cluster sampling of HH was used to recruit adult women, 19–45 yrs; **Sample size:** 160 (40 participants from each of the four locations)	F	B	**Dietary data:** Dietary patterns, dietary diversity (based on a standardised questionnaire based on the 11 SAFBDGs) **Anthropometry:** BMI
Ellisras longitudinal study (ELS)	Mashiane *et al.*, 2018[67] Sekgala *et al.*, 2018[97] Sekgala *et al.*, 2018[219] Sebati *et al.*, 2019[220]	2015	LP: 42 dispersed settlements, 70 km from Ellisras	R (T)	Longitudinal study with nested cross-sectional studies	Proportional cluster sampling of HH was used to recruit young adults, 18–30 yrs; **Sample size:** 624 - 742 (varied across sub-studies)	M F	B	**Dietary data:** Energy , macronutrient, and fibre intakes (total, soluble, and insoluble fibre intake), most frequently consumed foods (based on 2 x 24-hour recalls) **Anthropometry:** BMI, WC, WHR, fat % (skinfolds) **Laboratory tests:** Fasting blood glucose, lipid profile **Other:** Blood pressure

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Table 5.1 Continued

Study	Publications	Data collection timeframe	Site of study	Area	Study design	Study population, sampling and sample size	Gender	Ethnicity	Variables assessed
REGIONAL SA STUDIES									
Khayelitsha and Mitchells Plain Survey 2016	Dinbabo *et al.*, 2019[29]	2016	WC: Khayelitsha and Mitchells Plain	U	Cross-sectional study	Two-stage cluster sampling targeting HH to recruit adults, ≥18 yrs; **Sample size:** 1500 with BMI measurements	M F	n/d	**Dietary Diversity Score (DDS):** 12 food groups based on the 36 food choices reported by participants, Food patterns **Anthropometry:** BMI
Nelson Mandela Bay study	de Bruin and Gresse, 2018[113]	2017	EC: Nelson Mandela Bay	U	Cross-sectional study	Stratified convenience sampling was used to recruit consumers, ≥18 yrs, at five shopping malls; **Sample size:** 480	M F	B W C I/A	**Dietary diversity score** (based on 12 food groups assessed by 1 x 24-hour recall)) **Food availability**
Farm Worker Food security status (FWFS) study	Devereux and Tavener-Smith, 2019[221]	2017 to 2018	NC	F	Cross-sectional study	Non-random and purposive sampling of farm worker HH was used to recruit adult women who were HH heads; **Sample size:** 200	F	n/d	**Food security status data:** Based on Months of Adequate Dietary Diversity Index (DDI);Household Food Provisioning (MAHFP), Household Food Insecurity Access Scale (HFIAS) and Coping Strategies Index (CSI)
STUDIES ON SA STUDENTS									
University of the North study 1	Steyn *et al.*, 2000[95] Steyn *et al.*, 2000[222]	1994	NP (LP)	U R	Cross-sectional study	All first years who attended an orientation session **Sample size:** 431, Anthropometry, dietary questionnaires and knowledge tests was obtained for 115	F	B	**Dietary data:** Energy, macronutrients, micronutrient, fibre, sugar intakes (based on QFFQ; analysed with Foodfinder Dietary Analysis Software; adequacy: % with values <67% of RDA) **Anthropometry:** BMI, WC,WHR **Laboratory tests:** Haematology, iron studies, lipid profile, Fasting blood glucose **Other:** Blood, pressure, psychological health
SA University students study	Wassenaar *et al.*, 2000[223]	1994 to 1995	n/d KZN		Cross-sectional study	A convenience sample of 628 students accessible to the authors were recruited for a self-administrated survey **Sample size:** 520 females	F	B	**Anthropometry:** BMI based on self-reported weight and height **Other:** Eating Disorder Inventory
University of the North study 2	Pelzer, 2001[224]	n/d	NP (LP)		Cross-sectional study	Black University students from non-health courses were chosen from randomly selected classes; **Sample size:** 793	M F	B	**Anthropometry:** Self-recorded height and weight **Other:** Healthy dietary practices, nutrition knowledge

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Table 5.1 Continued

Study	Publications	Data collection timeframe	Site of study	Area	Study design	Study population, sampling and sample size	Gender	Ethnicity	Variables assessed
STUDIES ON SA STUDENTS									
University of KwaZulu- Natal study	Peters *et al.*, 2006[225]	2004	KZN		Cross-sectional study	All 1st yr medical students attending a nutrition module were included; **Sample size:** 231	M F	n/d	**Anthropometry:** BMI, body fat % (by peer-measurements)
University of Cape Town study	Cilliers, Senekal and Kunneke, 2006[226]	n/d	WC		Randomized control trial	Resident students attending an information session were invited to participate **Sample size:** 360	F	n/d	**Anthropometry:** BMI, WC, body fat % **Other:** Blood pressure, smoking, self-concept, body shape, eating attitudes
University of Limpopo study	Bodiba *et al.*, 2008[227]	2004	LP		Focus groups	Convenience sampling was used to recruit 25 students each from 3 purposefully selected faculties; **Sample size:** 75	F	n/d	**Anthropometry:** BMI **Other:** Self-concept, roles of society and media
University of Stellenbosch study 1	Van Niekerk and Barnard, 2009[228]	2003, 2004 and 2005	WC		Cross-sectional study	Female students were recruited at university gymnasium **Sample size:** 941	F	n/d	**Anthropometry:** BMI **Other:** Motivators for PA, smoking
University of Stellenbosch study 2	Smith and Essop, 2009[87]	n/d	WC Stellenbosch		Cross-sectional study	Students were recruited during student practical sessions **Sample size:** 166	M F	n/d	**Anthropometry:** BMI, WC, WHR **Laboratory tests:** Fasting blood glucose, lipid profile **Other:** Blood pressure, pulse rate
University of Fort Hare study	Van den Berg *et al.*, 2012[132]	2008	EP		Cross-sectional study	All 200 nursing students were invited to participate **Sample size:** 161	M F	B	**Dietary intakes:** Energy intakes (based on 3 x 24-hour recalls) food groups, dietary patterns (based on IFFQ) **Anthropometry:** BMI, WC, WHR
University of Pretoria, SA Police Service study	Du Toit *et al.*, 2012[229]	2010	GP		Cross-sectional study	Students from the UP and trainees from the Police Service were recruited (sampling not described) **Sample size:** 286	M F	n/d	**Anthropometry:** BMI **Other:** Blood pressure, cardiac stress index
University of the Free State study 1	Van den Berg *et al.*, 2013[126]	2011	FS		Cross-sectional study	Systematic sampling from the admissions list obtained from the institution Students in Faculty of Health Sciences was used to recruit undergraduate students **Sample size:** 161	M F	B C W I/A	**Dietary data:** Macronutrients, food group and dietary patterns (based on usual daily intake and FFQ) **Anthropometry:** BMI, WC

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Table 5.1 Continued									
Study	**Publications**	**Data collection timeframe**	**Site of study**	**Area**	**Study design**	**Study population, sampling and sample size**	**Gender**	**Ethnicity**	**Variables assessed**
STUDIES ON SA STUDENTS									
University of KwaZulu Natal study	Kassier and Veldman, 2013[230]	2012	KZN		Cross-sectional study	2nd-4th 2 students on financial aid recruited using student email addresses, posters on campus and word of mouth **Sample size:** 269	M F	n/d	**Dietary diversity data:** based on FFQ **Food security status data:** Household Food Insecurity Access Scale (HFIAS) **Anthropometry:** BMI
University of the Free State study 2	Van den Berg and Raubenhaumer, 2015[231]	2013	FS Bloemfontein: Main, South and QwaQwa Campuses	U R	Cross-sectional study	Online survey made available to all students registered in 2013 **Sample size:** 1413	M F		**Food security status:** Based on USDA 8 question tool
University of Venda study	Malepe *et al.*, 2015[232]	2013	LP		Cross-sectional study	Purposive sampling was used to select 100 Sport Science students (25 in each of 4 level); **Sample size:** 100 participants	M F		**Anthropometry:** BMI
Walter Sisulu University study	Nkeh-Chungag *et al.*, 2015[223]	2015	EC	PU	Cross-sectional study	Convenience sample recruited from resident students **Sample size:** 216	M F		**Anthropometry:** BMI, WC, Visceral fat %, WHR, WHtR **Other:** Blood pressure
University of Pretoria study 2	Madiba *et al.*, 2018[130]	2015	GP		Cross-sectional study	All students registered in Dental School were invited to participate **Sample size:** 301	M F		**Dietary data:** SSB intake (based on IFFQ) **Anthropometry:** BMI
University of the Witwatersrand study	Gradidgea and Cohen, 2018[128]	n/d	GP		Cross-sectional study	Convenience sample recruited from female undergraduates **Sample size:** 110	F		**Dietary data:** Behaviour regarding buying food from vendors **Anthropometry:** BMI, WC, HC,
Stellenbosch University study 3	Visser *et al.*, 2019[86]	2016	WC		Prospective, longitudinal study with 6 months follow-up	Random two stage sampling of students form Faculty of Medicine and Health Sciences **Sample size:** 242	M F		**Dietary data:** vitamin D intake (based on FFQ) **Anthropometry:** BMI **Laboratory tests:** 25(OH) vit D **Other:** lifestyle

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ANTHROPOMETRY

Table 5.2.1: Anthropometry of adult males

MALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	BMI						WC			WHR	WtHR	MUAC
							Mean (SD/SE) or Median (range) or (95% confi-dence interval)	% Underweight < 8.5 kg/m^2	% Normal weight ≥18.5; <25 kg/m^2	% Overweight ≥25; <30 kg/m^2	% Obese ≥30 kg/m^2	% Above normal ≥25 kg/m^2	Mean (SD/SE) or Median (range) or (95% confi-dence interval)	% At risk ≥94 cm	% At high risk ≥102 cm	% At risk ≥ 0.10 (*≥0.9	% At risk ≥ 0.5	Mean SD or Median SE/range
SA NATIONAL SURVEYS																		
SADHS 1998 SADHS Report, 1998[4]	1998	15–24				1796	21.1 (0.11)	21.3	67.5	8.4	2.7	*11.1*			1.2	2.9		26.2 (0.11)
		25–34				1103	23.4 (0.18)	8.5	62.9	20.7	7.8	*28.5*			5.5	4.2		28.7 (0.15)
		35–44				990	25.0 (0.20)	8.5	52.8	24.9	12.8	*37.7*			11.7	7.0		29.5 (0.15)
		45–54				678	25.3 (0.25)	9.2	45.2	28.1	17.3	*45.4*			17.5	12.2		30.0 (0.21)
		55–64				510	25.2(0.24)	9.1	47.5	28.3	14.4	*42.7*			18.4	14.9		29.2 (0.24)
		≥65				482	24.4 (0.28)	9.9	47.7	28.5	13.9	*42.4*			18.0	16.8		28.4 (0.24)
			B			4191	23.0 (0.10)	14.0	60.8	17.1	7.8	*24.9*			5.9	6.5		27.7 (0.09)
			C			628	24.1 (0.23)	11.4	56.6	22.1	9.2	*31.3*			8.8	5.2		28.3 (0.19)
			W			536	26.2 (0.27)	4.7	38.4	36.1	20.8	*56.9*			30.8	14.7		31.2 (0.23)
			A/I			189	23.1 (0.38)	16.6	50.7	23.7	9.0	*32.7*			12.1	11.2		29.2 (0.38)
				WC		706	24.9 (0.24)	5.8	55.3	25.3	13.1	*38.4*			11.9	8.7		29.2 (0.19)
				EP		750	23.6 (0.16)	11.5	57.6	20.5	10.1	*30.6*			7.8	5.3		27.9 (0.15)

Table 5.2.1 Continued

MALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	BMI: Mean (SD/SE) or Median (range) or (95% confidence interval)	BMI: % Underweight < 8.5 kg/m^2	BMI: % Normal weight ≥18.5; <25 kg/m^2	BMI: % Overweight ≥25; <30 kg/m^2	BMI: % Obese ≥30 kg/m^2	BMI: % Above normal ≥25 kg/m^2	WC: Mean (SD/SE) or Median (range) or (95% confidence interval)	WC: % At risk ≥94 cm	WC: % At high risk ≥102 cm	WHR: % At risk ≥ 0.10 (*≥0.9	WtHR: % At risk ≥ 0.5	MUAC: Mean SD or Median SE/range
SA NATIONAL SURVEYS																		
				NC		132	22.5 (0.29)	23.1	54.3	14.4	7.6	*22.0*			8.7	5.8		27.2 (0.32)
				FS		439	22.5 (0.25)	18.8	56.7	16.3	8.1	*24.4*			11.8	6.5		26.9 (0.23)
				KZN		1047	23.8 (0.21)	11.1	56.8	21.4	10.4	*31.8*			8.5	10.2		28.7 (0.23)
				NWP		544	22.3 (0.22)	17.5	61.4	15.4	5.5	*20.9*			9.8	8.9		28.1 (0.22)
				GP		1060	24.0 (0.27)	9.7	58.5	21.1	10.2	*31.3*			9.6	6.5		28.7 (0.24)
				MP		366	22.5 (0.29)	16.9	59.1	16.6	7.5	*24.1*			6.8	3.9		27.7 (0.32)
				NP		706	22.3 (0.25)	19.7	57.9	16.0	6.2	*22.2*			4.8	6.8		27.1 (0.27)
					U	4191	24.0 (0.12)	10.8	55.5	22.2	11.1	*33.3*			10.9	8.1		28.8 (0.11)
					NU	628	22.5 (0.11)	16.4	61.4	15.6	6.3	*21.9*			5.8	6.2		27.2 (0.12)
					A-U	536	23.6 (0.15)	11.8	59.4	18.8	9.6	*28.4*			6.8	7.1		28.3 (0.12)
					A-NU	189	22.3 (0.12)	16.7	62.6	15.0	5.5	*20.5*			4.8	5.8		27.0 (0.12)
SA National Database Senekal *et al.*, 2003[66]	n/d	18-65	B	ALL	ALL	77	25.6 (6.96)	15.9	34.8	29.0	20.3	*49.3*						
			C			40	25.4 (4.17)	2.9	51.4	25.7	20.0	*45.7*						
			W			112	26.2 (6.51)	4.5	39.1	41.8	14.6	*56.4*						
			A/I			32	23.8 (4.27)	19.4	45.2	25.8	9.7	*35.5*						

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Table 5.2.1 Continued

MALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	BMI: Mean (SD/SE) or Median (range) or (95% confidence interval)	BMI: % Underweight < 8.5 kg/m²	BMI: % Normal weight ≥18.5; <25 kg/m²	BMI: % Overweight ≥25; <30 kg/m²	BMI: % Obese ≥30 kg/m²	BMI: % Above normal ≥25 kg/m²	WC: Mean (SD/SE) or Median (range) or (95% confidence interval)	WC: % At risk ≥94 cm	WC: % At high risk ≥102 cm	WHR: % At risk ≥ 0.10 (*≥0.9)	WtHR: % At risk ≥ 0.5	MUAC: Mean SD or Median SE/range
SA NATIONAL SURVEYS																		
SADHS 2003 SADHS Report, 2007[5]	2003	15–24				1086	21.2 (0.17)	20.3	68.2	9.7	1.8	*11.5*			0.9	3.1		
		25–34				702	23.8 (0.28)	8.4	60.9	20.9	9.8	*30.7*			3.0	7.2		
		35–44				569	24.6 (0.32)	8.3	52.2	26.6	12.9	*39.5*			8.0	6.8		
		45–54				418	24.9 (0.33)	8.4	45.9	31.9	13.8	*45.7*			8.4	7.3		
		55–64				282	24.5 (0.38)	9.9	48.0	29.0	13.1	*42.1*			11.5	11.4		
		≥65				218	24.7 (0.40)	9.3	44.7	32.0	14.0	*46.0*			9.4	11.4		
			B			2720	22.9 (0.13)	13.3	59.5	20.1	7.1	*27.2*			3.0	5.1		
			C			256	24.4 (0.89)	11.5	52.4	21.3	14.9	*36.2*			7.7	8.2		
			W			203	26.3 (0.94)	4.9	47.0	25.1	23.0	*48.1*			26.5	22.1		
			A/I			82	24.8 (0.36)	10.1	45.2	33.7	10.9	*44.6*			11.7	6.7		
				WC		331	24.1 (0.38)	9.2	52.7	23.6	14.5	*38.1*			7.3	6.8		
				EP		355	23.2 (0.67)	10.9	63.8	16.5	8.8	*25.3*			5.2	4.7		
				NC		58	21.8 (0.29)	25.7	55.1	13.8	5.4	*19.2*			4.2	3.7		
				FS		217	22.6 (0.34)	18.0	60.0	13.5	8.6	*22.1*			3.0	3.6		
				KZN		734	24.5 (0.26)	4.1	55.0	31.9	9.0	*40.9*			3.9	7.4		

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Table 5.2.1 Continued

MALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	BMI						WC			WHR	WtHR	MUAC
							Mean (SD/SE) or Median (range) or (95% confi-dence interval)	% Underweight < 8.5 kg/m²	% Normal weight ≥18.5; <25 kg/m²	% Overweight ≥25; <30 kg/m²	% Obese ≥30 kg/m²	% Above normal ≥25 kg/m²	Mean (SD/SE) or Median (range) or (95% confi-dence interval)	% At risk ≥94 cm	% At high risk ≥102 cm	% At risk ≥ 0.10 (*≥0.9	% At risk ≥ 0.5	Mean SD or Median SE/range
SA NATIONAL SURVEYS																		
				NWP		243	22.1 (0.26)	19.8	57.9	17.5	4.8	*22.3*			2.2	3.5		
				GP		865	23.5 (0.39)	14.3	55.9	20.2	9.7	*29.9*			7.3	9.3		
				MP		206	22.3 (0.28)	16.4	61.4	16.3	6.0	*22.3*			2.4	3.2		
				NP		268	22.9 (0.13)	19.5	64.9	11.0	4.6	*15.6*			4.0	4.3		
					U	2189	23.7 (0.21)	11.8	57.3	20.3	10.6	*30.9*			6.2	7.9		
					NU	1086	22.7 (0.15)	14.0	58.5	22.4	5.1	*27.5*			2.7	3.4		
					A-U	1673	23.1 (0.19)	13.0	60.3	18.7	8.1	*26.8*			3.1	6.1		
					A-NU	1047	22.7 (0.15)	13.9	58.3	22.5	5.3	*27.8*			2.8	3.6		
NIDS– Wave 1 Data available from South African Labour and Development Research Unit, University of Cape Town http://www.nids.uct.ac.za/	2008	≥18	B C W A/I	All	U R	7 992	21.1 (20.8–21.3)	73.6		16.1	10.2	*26.3*						

Table 5.2.1 Continued

MALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	BMI: Mean (SD/SE) or Median (range) or (95% confidence interval)	BMI: % Underweight < 8.5 kg/m²	BMI: % Normal weight ≥18.5; <25 kg/m²	BMI: % Overweight ≥25; <30 kg/m²	BMI: % Obese ≥30 kg/m²	BMI: % Above normal ≥25 kg/m²	WC: Mean (SD/SE) or Median (range) or (95% confidence interval)	WC: % At risk ≥94 cm	WC: % At high risk ≥102 cm	WHR: % At risk ≥ 0.10 (*≥0.9	WtHR: % At risk ≥ 0.5	MUAC: Mean SD or Median SE/range
SA NATIONAL SURVEYS																		
NIDS–Wave 2 Data available from South African Labour and Development Research Unit, University of Cape Town http://www.nids.uct.ac.za/	2010	≥18	B C W A/I	All	U R	5 411	22.2 (21.9–22.6)	69.1		19.5	11.5	31.0						
NIDS–Wave 3 Data available from South African Labour and Development Research Unit, University of Cape Town http://www.nids.uct.ac.za/	2012	≥18	B C W A/I	All	U R	6 395	22.4 (22.0–22.7)	71.0		18.7	10.3	29.0						
SANHANES-1 Shisana *et al.*, 2013[7]	2012	18–24				486	21.3 (20.8–21.9)	17.9	72.0	5.8	4.2	10.0			-	-		
		25–34				412	23.6 (22.8–24.4)	6.4	66.3	19.2	8.1	27.3			6.1	3.0		
		35–44				362	24.0 (23.3–24.8)	11.4	56.9	20.1	11.6	31.7			8.6	3.3		
		45–54				384	26.0 (24.8–27.3)	8.2	41.8	31.2	18.7	49.9			22.1	13.1		
		55–64				361	25.2 (24.1–26.4)	12.6	42.1	25.9	19.3	45.2			16.3	14.2		
		≥65				269	25.6 (24.9–26.3)	6.0	40.4	40.4	13.1	53.5		39.7	16.1	15.6		
			B			1753	23.4 (22.9–23.8)	12.9	58.6	19.1	9.4	28.5		17.4	8.0	5.1		

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Table 5.2.1 Continued

MALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	BMI Mean (SD/SE) or Median (range) or (95% confidence interval)	BMI % Underweight < 8.5 kg/m²	BMI % Normal weight ≥18.5; <25 kg/m²	BMI % Overweight ≥25; <30 kg/m²	BMI % Obese ≥30 kg/m²	BMI % Above normal ≥25 kg/m²	WC Mean (SD/SE) or Median (range) or (95% confidence interval)	WC % At risk ≥94 cm	WC % At high risk ≥102 cm	WHR % At risk ≥ 0.10 (*≥0.9	WtHR % At risk ≥ 0.5	MUAC Mean SD or Median SE/range
SA NATIONAL SURVEYS																		
			C			548	24.4 (23.3–25.3)	12.4	50.3	22.1	15.1	37.2		25.7	12.0	8.4		
			W			65	-	-	-	-	-	-		-	-	-		
			A/I			137	23.7 (22.1–25.3)	32.6	27.7	32.2	7.6	39.8		36.9	24.3	24.9		
				WC		412	25.0 (24.1–25.9)	8.1	48.9	26.9	16.1	43.0		29.8	12.8	6.8		
				EP		369	22.9 (22.3–23.4)	13.5	62.2	17.1	7.2	24.3		14.0	5.5	3.9		
				NC		148	22.5 (21.4–23.6)	15.1	59.9	17.8	7.2	25.0		11.3	4.3	2.7		
				FS		225	22.5 (21.3–23.8)	13.9	60.8	19.5	5.8	25.3		17.6	9.6	6.3		
				KZN		384	23.5 (22.8–24.3)	13.8	54.6	23.7	7.9	31.6		18.2	8.6	9.0		
				NWP		273	21.8 (21.0–22.6)	23.6	60.1	9.0	7.3	16.3		15.3	8.2	10.1		
				GP		282	24.2 (23.1–25.3)	9.0	57.1	21.0	12.9	33.9		24.6	13.4	6.7		
				MP		287	24.2 (23.2–25.2)	8.7	60.9	17.4	13.0	30.4		17.6	7.9	5.3		
				LP		192	23.0 (22.0–24.0)	20.7	51.5	16.3	11.5	27.8		16.7	7.9	5.2		
					UF	1253	24.3 (23.6–24.9)	10.5	53.5	22.8	13.2	36.0		26.3	13.8	8.4		
					UI	282	23.0 (21.8–24.1)	17.0	60.7	16.1	6.3	22.4		8.7	3.2	3.4		
					RF	423	22.5 (21.8–23.2)	16.4	60.0	17.4	6.1	23.5		10.8	4.9	5.6		

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Table 5.2.1 Continued

MALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	BMI: Mean (SD/SE) or Median (range) or (95% confidence interval)	BMI: % Underweight < 8.5 kg/m²	BMI: % Normal weight ≥18.5; <25 kg/m²	BMI: % Overweight ≥25; <30 kg/m²	BMI: % Obese ≥30 kg/m²	BMI: % Above normal ≥25 kg/m²	WC: Mean (SD/SE) or Median (range) or (95% confidence interval)	WC: % At risk ≥94 cm	WC: % At high risk ≥102 cm	WHR: % At risk ≥ 0.10 (*≥0.9	WtHR: % At risk ≥ 0.5	MUAC: Mean SD or Median SE/range
SA NATIONAL SURVEYS																		
					RI	614	23.0 (22.5–23.5)	14.7	59.4	17.2	8.7	*25.9*		15.3	5.8	5.2		
NIDS–Wave 4 Data available from South African Labour and Development Research Unit, University of Cape Town http://www.nids.uct.ac.za/	2014	≥18	B C W A/I	All	U R	6 395	22.4 (22.1–22.7)	75.7		15.7	8.5	*24.2*						
SADHS 2016 SADHS Report, 2016[6]	2016	15–24				927	21.3	15.8	73.0	8.9	2.3	*11.2*		2.3	1.4		7.9	
		25–34				700	23.3	5.9	66.0	20.5	7.7	*28.2*		11.8	3.9		25.2	
		35–44				540	24.6	5.4	56.5	23.3	14.8	*38.1*		21.9	10.8		42.6	
		45–54				340	25.0	7.6	49.7	25.7	17.0	*42.7*		29.5	16.1		53.7	
		55–64				313	25.8	10.1	36.7	34.2	19.0	*53.2*		41.1	22.7		69.3	
		≥65				286	26.0	6.9	38.7	29.8	24.5	*54.3*		48.1	26.9		69.9	
			B			2663	23.2	9.8	62.8	18.7	8.7	*27.4*		15.3	7.2		31.0	
			C			207	24.2	11.6	48.0	26.7	13.7	*40.4*		31	17.2		49.5	
			W			175	29.1	1.2	24.1	35.3	39.3	*74.6*		62.2	40.7		73.6	
			A/I			60	25.9	9.7	41.8	26.5	22.0	*48.5*		23.2	11.2		50.0	
				WC		261	24.8	7.0	49.3	29.8	13.9	*43.7*		31.5	17.4		48.5	

Table 5.2.1 Continued

MALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	BMI						WC			WHR	WtHR	MUAC
							Mean (SD/SE) or Median (range) or (95% confi-dence interval)	% Underweight < 8.5 kg/m²	% Normal weight ≥18.5; <25 kg/m²	% Overweight ≥25; <30 kg/m²	% Obese ≥30 kg/m²	% Above normal ≥25 kg/m²	Mean (SD/SE) or Median (range) or (95% confi-dence interval)	% At risk ≥94 cm	% At high risk ≥102 cm	% At risk ≥ 0.10 (*≥0.9	% At risk ≥ 0.5	Mean SD or Median SE/range
SA NATIONAL SURVEYS																		
				EP		413	23.3	6.8	67.6	15.8	9.9	*25.7*		19	10.4		32.8	
				NC		68	23.3	19.2	49.2	16.7	14.8	*31.5*		24	13.7		37.3	
				FS		177	22.7	14.7	57.8	18.5	9.0	*27.5*		19.0	6.7		32.1	
				KZN		520	24.2	7.5	57.3	22.6	12.6	*35.2*		16.5	7.4		37.2	
				NWP		271	23.2	13.3	56.7	22.3	7.8	*30.1*		17.4	9.5		34.5	
				GP		848	23.8	8.4	58.1	20.7	12.8	*33.5*		31.5	10.7		34.9	
				MP		273	23.0	10.7	65.2	14.6	9.5	*24.1*		19	8.3		26.9	
				NP		276	22.8	12.1	62.8	18.7	6.5	*25.2*		24	6.0		31.6	
					U	2025	23.9	9.1	56.7	20.9	13.3	*34.2*		21.3	11.7		36.9	
					NU	1080	23.0	10.1	63.8	19.3	6.8	*26.1*		15	6.4		31.6	
NIDS– Wave 5 Data available from South African Labour and Development Research Unit, UCT http://www.nids.uct.ac.za/	2017	≥18	B C W A/I	All	U R	6002	22.5 (22.2–22.7)	75.8		16.1	8.0	*24.1*						

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Table 5.2.1 Continued

MALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	BMI: Mean (SD/SE) or Median (range) or (95% confidence interval)	BMI: % Underweight < 8.5 kg/m²	BMI: % Normal weight ≥18.5; <25 kg/m²	BMI: % Overweight ≥25; <30 kg/m²	BMI: % Obese ≥30 kg/m²	BMI: % Above normal ≥25 kg/m²	WC: Mean (SD/SE) or Median (range) or (95% confidence interval)	WC: % At risk ≥94 cm	WC: % At high risk ≥102 cm	WHR: % At risk ≥ 0.10 (*≥0.9)	WtHR: % At risk ≥ 0.5	MUAC: Mean SD or Median SE/range
INTERNATIONAL SURVEYS WITH A SA COMPONENT																		
HelpAge International Study HelpAge IRADC Report, 2004[32] Kimokoti and Hamer, 2008[21]	1995	≥ 60	All	All	U	n/d	24.0 (5.6)	26.0		25.5	14.7	*40.2*						27.5 (4.0) 21.2% at risk (<24cm)
PURE-NWP-SA Richter *et al.*, 2014[33]	2005				U R	393 333	20.0 (18.3–22.8) 19.7 (18.0–2.25)						74.3 (69.7–81.8) 74.5 (70.2–80.5)					
WHO-SAGE - Wave 1 Peltzer *et al.*, 2011[161] Wu *et al.*, 2015[131]	2007 2008	ALL 50-59 60-69 ≥70	B C W	I/A All	u r	1690		5.4 5.2 4.1 8.6	27.8 29.4 25.7 26.9	27.5 27.2 26.6 29.9	39.3 38.3 43.7 34.6	*66.8* *65.5* *70.3* *64.5*			25.1 20.2 32.9 25.9	56.7* 55.3* 61.2* 53.1*		
METS - SA Durazo-Arvizu *et al.*, 2014[34]	2010 2011	25–45	B	WC	U	232	22.4 (4.3)											
TOP-SA study Okop *et al.*, 2019[35] Okop *et al.*, 2019[168]	2014 2015	35–78	B	WC EC	U R	212	25.4 (5.0)				12.3	32.2	88.2 (17.0)					
REGIONAL SA STUDIES																		
CORIS-A study Steyn *et al.*, 1997[172]	1990	15–64	B	WC	PU IS	n/d	23.4	19	51.1	22	7.9	*29.9*						28.1
CT black elderly study Charlton *et al.*, 2001[30]	1990	≥60	B	WC	U	74	25.7 (5.1)				17.6							29.9 (3.9)

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Table 5.2.1 Continued

MALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	BMI						WC			WHR	WtHR	MUAC
							Mean (SD/SE) or Median (range) or (95% confidence interval)	% Underweight < 8.5 kg/m²	% Normal weight ≥18.5; <25 kg/m²	% Overweight ≥25; <30 kg/m²	% Obese ≥30 kg/m²	% Above normal ≥25 kg/m²	Mean (SD/SE) or Median (range) or (95% confidence interval)	% At risk ≥94 cm	% At high risk ≥102 cm	% At risk ≥ 0.10 (*≥0.9	% At risk ≥ 0.5	Mean SD or Median SE/range
REGIONAL SA STUDIES																		
Cape Flats study Charlton *et al.*, 2001[30]	1993	≥65	C	WC	U	104	24.2 (5.1)											
Colon cancer in Africans study O'Keefe *et al.*, 1999[73]	n/d	≥25	B Xhosa	EC MP KZN	R	11	22.9 (1.4)											26.9 (1.0)
			B Zulu		R	3	25.2 (1.2)											25.5 (2.5)
			B Swazi		R	4	28.8 (0.8)											30.6 (0.2)
			B		U	5	23.0 (2.3)											26.7 (1.5)
			W		U	14	22.7 (1.0)											-
Mamre study Steyn *et al.*, 2004[31]	1996	15–24	C	WC	PU	430	21.7 (4.3)		64.1	10.2	5.5	*15.7*	74.7 (9.9)		2.3	-		
		25–34					23.8 (4.1)		58.1	28.0	7.5	*35.5*	81.5 (9.5)		1.1	-		
		35–44					24.8 (4.7)		51.2	28.1	14.6	*42.7*	85.6 (11.4)		8.5	4.9		
		45–54					25.4 (6.0)		43.5	31.9	14.5	*46.4*	89.8 (13.1))		14.5	15.9		
		55–64					25.1 (5.2)		38.7	38.7	12.9	*51.6*	91.0 (12.2)		12.5	6.3		
		≥65					24.0 (4.0)		38.5	38.5	0.0	*38.5*	89.3 (12.5)		11.5	26.9		
West Coast villages study Charlton *et al.*, 2001[39]	1997	≥55	B	WC	R	41	24.6 (5.6)	9.8	46.3	29.3	14.6	*43.9*	26.3 (3.4)		15.2			

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Table 5.2.1 Continued

MALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	**BMI**						**WC**			**WHR**	**WtHR**	**MUAC**
							Mean (SD/SE) or Median (range) or (95% confidence interval)	% Underweight < 8.5 kg/m²	% Normal weight ≥18.5; <25 kg/m²	% Overweight ≥25; <30 kg/m²	% Obese ≥30 kg/m²	% Above normal ≥25 kg/m²	Mean (SD/SE) or Median (range) or (95% confidence interval)	% At risk ≥94 cm	% At high risk ≥102 cm	% At risk ≥ 0.10 (*≥0.9)	% At risk ≥ 0.5	Mean SD or Median SE/range
REGIONAL SA STUDIES																		
Dikgale HDSS, Limpopo Alberts *et al.*, 2005[50]	n/d	ALL	B	LP	R	499	23.2 (4.7)						83.7 (11.0)					
		30–34				61	21.5 (3.1)						77.7 (8.9)					
		35–44				88	22.5 (4.0)						81.8 (9.8)					
		45–54				100	23.8 (5.1)						84.2 (11.8)					
		55–64				117	23.8 (4.6)						85.6 (10.4)					
		≥65				133	23.4 (5.2)						85.9 (11.2)					
THUSA study Oosthuizen *et al.*, 2002[55] Vorster *et al.*, 2005[56]	1996 1998	15–65	B	NWP	UU	84	23.1 (22.2–24.0)		66.7	30.9	2.4	*32.4*				2.4*		
					PU	236	21.3 (20.8–21.8)		87.3	8.5	4.2	*12.7*				6.8*		
					IF	135	20.3 (19.7–20.9)		93.3	3.7	3.0	*6.7*				3.7*		
					F	117	20.6 (19.9–21.3)		90.6	6.0	3.4	*9.4*				2.6*		
					T	196	20.7 (20.2–21.3)		86.7	8.7	4.6	*13.3*				6.6*		
THUSA study Kruger et al, 2002[179]	1996 1998	15–65	B	NWP	ALL	710	21.1 (4.1)											
THUSA study Kruger *et al.*, 2012[180]	1996 1998	15–65	B	NWP	ALL	530	21.5 (4.1)											
Yenza study Mfenyana *et al.*, 2006[57]	1999	≥15	B	EC	PU, R	2072					15.2							

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Table 5.2.1 Continued

MALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	**BMI** Mean (SD/SE) or Median (range) or (95% confidence interval)	% Underweight < 8.5 kg/m²	% Normal weight ≥18.5; <25 kg/m²	% Overweight ≥25; <30 kg/m²	% Obese ≥30 kg/m²	% Above normal ≥25 kg/m²	**WC** Mean (SD/SE) or Median (range) or (95% confidence interval)	% At risk ≥94 cm	% At high risk ≥102 cm	**WHR** % At risk ≥ 0.10 (*≥0.9	**WtHR** % At risk ≥ 0.5	**MUAC** Mean SD or Median SE/range
REGIONAL SA STUDIES																		
CT peri-urban study Charlton *et al.*, 2007[41]	n/d	≥60	B	WC		53	24.0 (5.6)	19.2	47.1	25.5	13.7	*39.2*						27.5 (4.0)
Ubombo study Motala *et al.*, 2011[47]	2005	≥15	B	KZN	R	189	22.8 (6.9)			13.2	8.5	*21.7*		18.5	8.5	2.1		
Sharpeville elderly facility study Oldewage-Theron *et al.*, 2008[72]	2004	≥60	B	GP	PU	24	24.7 (6.5)	9.1	54.6	18.2	18.1	*36.3*						
Khayelitsha Study Malhotra *et al.*, 2008[42]	2005	All	B	WC	PU	107		7.5	52.3	15.0	18.7	*34.2*		23.4				
		18–34				33	21.6 (3.1)											
		35–54				43	26.0 (6.8)											
		>55				31	27.6 (8.9)											
HealthKick study: Educators Senekal *et al.*, 2015[43]	2007	18–65	B W C	WC	U R	196	28 ± 5.6			37.0	35.0	*72.0*	98 ± 14.2		38.0			
HealthKick study: Caregivers De Villiers *et al.*, 2018[44]		n/d	B C			20	24.6			30	20	*50*						
Stanger Study Naicker *et al.*, 2015[24]	2008	35–55	I	KZN	U	111				44.1	13.5	*57.6*		86				
Stanger Study Naicker *et al.*, 2015[24]	2008	35–55	I	KZN	U	111				44.1	13.5	*57.6*		86				

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Table 5.2.1 Continued

MALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	**BMI**						**WC**			**WHR**	**WtHR**	**MUAC**
							Mean (SD/SE) or Median (range) or (95% confi-dence interval)	% Underweight < 8.5 kg/m²	% Normal weight ≥18.5; <25 kg/m²	% Overweight ≥25; <30 kg/m²	% Obese ≥30 kg/m²	% Above normal ≥25 kg/m²	Mean (SD/SE) or Median (range) or (95% confi-dence interval)	% At risk ≥94 cm	% At high risk ≥102 cm	% At risk ≥ 0.10 (*≥0.9	% At risk ≥ 0.5	Mean SD or Median SE/range
REGIONAL SA STUDIES																		
Phoenix Life-style Project, Durban Prakaschandra *et al.*, 2016[48] Prakaschandra *et al.*, 2017[25]	2007 2008	ALL	I	KZN	U	377	24.6 (5.0)			31.8	13.5	*45.3*	88.8 (13.8)					
		15–24				54	21.6 (4.8)						78.0 (12.7)					
		25–34				50	24.84 (5.0)						87.5 (13.6)					
		35–44				68	25.4 (5.4)						90.5 (13.7)					
		45–54				81	25.9 (4.1)						93.1 (10.8)					
		55–64				114	24.3 (4.9)						90.6 (13.7)					
AHA-FS Study Van Zyl *et al.*, 2012[59] Tydeman-Edwards *et al.*, 2018[60]	2007	25–64	B C	FS	R	163	20.4	33.1	43.6	15.3	8.0	*23.3*		10.4	9.8			
	2008 2009				U	100	20.3	23.0	61.0	12.0	4.0	*16.0*		2.0	4.0			
Qwa-Qwa INP Oldewage-Theron *et al.*, 2014[61]	2008 2009	21–60	B	FS	R	20		30.0	45.0	15.0	10.0	*25.0*						
Umlazi Study Mkhize *et al.* 2013[49]	2009 2010	≥60	B	KZN	PU	46	-	4.0	43.0	34.2	18.8	*53.0*		-	26.0		47.9	
Dikgale HDSS Maimela *et al.*, 2016[51] Ntuli *et al.*, 2015[52]	2011 2012	ALL	B	LP	R	528		0.0	65.5	24.5	10.4	*34.9*						
		15–24								20.4	10.2	*30.6*						
		25–34								17.5	17.5	*35.0*						
		35–44								28.1	3.1	*31.2*						
		45–54								26.2	9.5	*35.7*						
		55–64								28.6	11.4	*40.0*						
		≥65								32.3	6.5	*38.8*						

Table 5.2.1 Continued

MALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	BMI						WC			WHR	WtHR	MUAC
							Mean (SD/SE) or Median (range) or (95% confidence interval)	% Underweight < 8.5 kg/m²	% Normal weight ≥18.5; <25 kg/m²	% Overweight ≥25; <30 kg/m²	% Obese ≥30 kg/m²	% Above normal ≥25 kg/m²	Mean (SD/SE) or Median (range) or (95% confidence interval)	% At risk ≥94 cm	% At high risk ≥102 cm	% At risk ≥ 0.10 (*≥0.9)	% At risk ≥ 0.5	Mean SD or Median SE/range
REGIONAL SA STUDIES																		
Limpopo Nurse's Study Goon *et al.*, 2013[53]	2011	≥19	B	LP	R, SR	49		2.0	24.5	30.6	42.8	*73.4*						
AWI-Gen Study Micklesfield *et al.*, 2018[129]	2011 2015	44–54	B	GP	PU	1027	24.2 (20.6–28.5)	10.3	44.5	27.5	17.6	*45.1*						
Bt20 caregivers study George *et al.*, 2014[85]	2011 2012	18–70	B	GP	U	181	23.3 (20.2, 27.3)											
			A/I			161	26.2 (23.7, 30.4)											
Bt20 caregivers study Naidoo *et al.*, 2019[206]	2012	23	B	GP	U	755	22 .0 (4.0)											
AWI-GEN SA Soweto Site Pisa *et al.*, 2018[63]	2011 2015	40–60	B	GP	U	1026	24.96 (5.65)											
Discovery Vitality study Kolbe-Alexander *et al.*, 2013[209]	2012	≥18	All	SA cities	U	635	26.6 (4.4)											
HSFSA study Peer *et al.*, 2018[211] Peer *et al.*, 2018[26]	2013	≥18	B	KZN WC GP EC FS	U PU	883	27.1 (5.4)	2.4	35.5	37.0	25.1	*62.1*						
			C			503	28.2 (5.3)	2.2	25.6	39.7	32.5	*72.2*						
			W			529	28.2 (4.9)	1.1	25.4	44.9	28.6	*73.5*						
			I			432	26.2 (5.3)	3.9	40.3	38.2	17.6	*55.8*						

Table 5.2.1 Continued

MALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	BMI: Mean (SD/SE) or Median (range) or (95% confidence interval)	% Underweight < 8.5 kg/m²	% Normal weight ≥18.5; <25 kg/m²	% Overweight ≥25; <30 kg/m²	% Obese ≥30 kg/m²	% Above normal ≥25 kg/m²	WC: Mean (SD/SE) or Median (range) or (95% confidence interval)	% At risk ≥94 cm	% At high risk ≥102 cm	WHR: % At risk ≥ 0.10 (*≥0.9	WtHR: % At risk ≥ 0.5	MUAC: Mean SD or Median SE/range
REGIONAL SA STUDIES																		
AWI-GEN SA Dikgale HDSS site Mashinya *et al.*, 2018[54]	2014 2016	40–60	B	LP	R	347	20.6 (18.9–24.3)	20	59	18	3	*21*						
AWI-GEN SA Soweto Site Pisa *et al.*, 2018[63]	2011 2015	40–60	B	GP	U	1026	24.96 (5.65)											
ELS study Mashiane *et al.*, 2018[67]	2015	18–30	B	LP	R	356		20.5	61.7	9.3	3.1	*12.4*						
Khayelitsha, Mitchells Plain study Dinbabo *et al.*, 2019[29]	2016	≥18	B C	WC	U Khay	107		14.56	23.79	16.99	44.66	*61.65*						
					U MitcP			15.95	26.23	22.95	36.07	*59.02*						
STUDIES ON SA STUDENTS																		
University of the North Pelzer, 2001[234]	n/d	18–25	B	LP		370				15.9	8.1	*24.0*						
University of Kwazulu Natal Peters *et al.*, 2006[225]	n/d	17–42	B	KZN		40	21.6 (3.7)											
University of Stellenbosch Smith and Essop, 2009[87]	n/d	n/d	n/d	WC		88	24.7 (4.3)							14				
University of Fort Hare Vd Berg *et al.*, 2012[132]	2008	18–42	B	EC		51		9.8	58.8	21.6	9.8	*31.4*						

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Table 5.2.1 Continued

MALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	BMI						WC			WHR	WtHR	MUAC
							Mean (SD/SE) or Median (range) or (95% confidence interval)	% Underweight < 8.5 kg/m²	% Normal weight ≥18.5; <25 kg/m²	% Overweight ≥25; <30 kg/m²	% Obese ≥30 kg/m²	% Above normal ≥25 kg/m²	Mean (SD/SE) or Median (range) or (95% confidence interval)	% At risk ≥94 cm	% At high risk ≥102 cm	% At risk ≥ 0.10 (*≥0.9	% At risk ≥ 0.5	Mean SD or Median SE/range
STUDIES ON SA STUDENTS																		
University of the Free State Vd Berg *et al.*, 2013[126]	2013	18–45	B W C A/I	FS		39		0	87.2			*12.8*		7.7				
University of Kwazulu Natal Kassier and Veldman, 2013[230]	2012	n/d	n/d	KZN		112	22.3 (3.2)											
Walter Sisulu University Nkeh-Chungag *et al.*, 2015[223]	2015	19–31	n/d	EC		74	25.2 (2.0)											
University of Stellenbosch Visser *et al.*, 2019[86]	2016	n/d	n/d	WC		121	24.9 (3.8)											

BMI ≥ 25 kg/m² was calculated for this review

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Table 5.2.2: Anthropometry of adult females

FEMALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	BMI						WC			WHR	WtHR	MUAC
							Mean (SD/SE) or Median (range) or (95% confi-dence interval)	% Underweight < 8.5 kg/m²	% Normal weight ≥18.5; <25 kg/m²	% Overweight ≥25; <30 kg/m²	% Obese ≥30 kg/m²	% Above normal ≥25 kg/m²	Mean (SD/SE) or Median (range) or (95% confi-dence interval)	% At risk ≥94 cm	% At high risk ≥102 cm	% At risk ≥ 0.10 (*≥0.9	% At risk ≥ 0.5	Mean SD or Median SE/range
SA NATIONAL SURVEYS																		
SADHS 1998 SADHS Report, 1998[4]	1998	15–24				2044	23.7 (0.13)	9.5	60.7	20.0	9.6	*29.6*			11.3	13.1		27.1 (0.10)
		25–34				1679	27.2 (0.18)	5.1	38.4	29.2	27.0	*56.2*			33.5	22.4		30.1 (0.14)
		35–44				1436	29.2 (0.21)	2.7	27.2	30.7	39.3	*70.0*			50.5	33.4		31.8 (0.17)
		45–54				1087	29.9 (0.27)	3.7	23.9	26.5	45.5	*72.0*			61.3	45.6		32.3 (0.20)
		55–64				895	29.8 (0.32)	2.7	25.6	25.6	46.1	*71.7*			64.0	49.8		32.4 (0.27)
		≥65				829	27.7 (0.32)	7.4	32.5	26.5	33.3	*59.8*			56.4	58.1		30.3 (0.23)
			B			6143	27.6 (0.12)	4.9	37.7	25.9	31.2	*57.1*			40.9	33.3		30.4 (0.09)
			C			800	27.0 (0.33)	9.9	36.1	25.3	28.5	*53.8*			43.8	36.2		29.3 (0.26)
			W			731	26.5(0.27)	2.9	44.2	27.4	25.5	*52.9*			39.1	20.4		30.2 (0.26)
			A/I			284	25.1 (0.40)	15.6	35.8	27.3	21.3	*48.6*			27.3	23.2		28.7 (0.36)
				WC		788	27.7 (0.32)	4.9	37.8	25.9	31.2	*57.1*			46.7	39.6		30.3 (0.29)
				EP		1130	27.0 (0.19)	5.8	38.8	25.7	29.7	*55.4*			39.6	32.8		29.8 (0.16)
				NC		166	26.1 (0.37)	12.5	37.5	24.9	24.8	*49.7*			37.2	34.2		28.7 (0.32)
				FS		517	26.9 (0.33)	7.0	37.9	26.0	29.2	*55.2*			41.4	28.5		29.5 (0.26)
				KZN		1554	28.5 (0.25)	5.4	31.2	27.4	35.4	*62.8*			43.9	36.7		30.6 (0.17)

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Table 5.2.2 Continued

FEMALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	BMI: Mean (SD/SE) or Median (range) or (95% confidence interval)	BMI: % Underweight < 8.5 kg/m^2	BMI: % Normal weight ≥18.5; <25 kg/m^2	BMI: % Overweight ≥25; <30 kg/m^2	BMI: % Obese ≥30 kg/m^2	BMI: % Above normal ≥25 kg/m^2	WC: Mean (SD/SE) or Median (range) or (95% confidence interval)	WC: % At risk ≥94 cm	WC: % At high risk ≥102 cm	WHR: % At risk ≥ 0.10 (*≥0.9	WtHR: % At risk ≥ 0.5	MUAC: Mean SD or Median SE/range
SA NATIONAL SURVEYS																		
				NWP		642	25.5 (0.24)	8.1	46.8	25.8	18.9	44.7			42.2	41.3		29.5 (0.22)
				GP		1842	28.2 (0.27)	3.4	34.3	26.6	35.6	62.2			42.9	22.2		31.2 (0.21)
				MP		500	26.9 (0.29)	4.9	43.8	24.9	25.8	50.7			32.2	26.8		29.7 (0.21)
				NP		831	25.4 (0.26)	7.2	48.7	24.0	20.1	44.1			28.4	34.2		29.2 (0.19)
					U	4886	27.8 (0.14)	5.0	35.6	26.0	33.2	59.2			42.6	29.1		30.6 (0.30)
					NU	3084	26.6 (0.15)	6.5	41.9	26.2	25.1	51.3			37.2	33.6		29.6 (0.29)
					A-U	3293	28.4 (0.17)	3.9	34.0	25.5	36.3	61.8			44.6	30.2		31.1 (0.13)
					A-NU	2850	26.6 (0.15)	6.0	42.0	26.5	25.3	51.8			36.6	37.0		29.6 (0.12)
SA National Database Senekal *et al.*, 2003[66]	n/d	18–65	B	ALL	ALL	72	29.76 (6.50)	3.6*	21.8*	29.0	20.3	49.3						
			C			62	29.12 (7.92)	14.8*	19.2*	21.3	44.7	66.0						
			W			31	25.82 (6.55)	11.6*	46.2*	24.0	18.2	42.2						
			A/I			128	24.50 (5.45)	18.5*	44.4*	18.5	18.5	37.0						
SADHS 2003 SADHS Report, 2007[5]	2003	15–24				1199	23.6 (0.02)	11.1	58.2	19.7	11.0	30.7			12.9	17.9		
		25–34				934	26.8 (0.25)	5.2	39.3	29.4	26.0	55.4			31.0	28.0		
		35–44				852	28.6 (0.31)	4.3	30.5	29.6	35.6	65.2			38.4	30.4		
		45–54				684	29.4 (0.40)	2.9	27.7	28.2	41.2	69.4			50.7	42.3		
		55–64				455	28.5 (0.46)	4.9	27.0	34.2	33.9	68.1			50.1	48.1		
		≥65				357	28.3 (0.46)	5.2	29.1	33.9	31.8	65.7			46.5	53.2		
			B			3687	27.2 (0.18)	5.6	38.2	27.7	28.5	56.2			34.2	31.9		

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Table 5.2.2 Continued

FEMALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	BMI						WC			WHR	WtHR	MUAC
							Mean (SD/SE) or Median (range) or (95% confi-dence interval)	% Underweight < 8.5 kg/m²	% Normal weight ≥18.5; <25 kg/m²	% Overweight ≥25; <30 kg/m²	% Obese ≥30 kg/m²	% Above normal ≥25 kg/m²	Mean (SD/SE) or Median (range) or (95% confi-dence interval)	% At risk ≥94 cm	% At high risk ≥102 cm	% At risk ≥ 0.10 (*≥0.9	% At risk ≥ 0.5	Mean SD or Median SE/range
SA NATIONAL SURVEYS																		
			C			438	26.4 (0.42)	12.1	35.8	25.7	26.5	*52.2*			36.1	36.1		
			W			236	25.0 (0.69)	4.9	57.0	24.4	13.7	*38.1*			25.9	24.0		
			A/I			110	26.6 (0.37)	5.7	35.1	34.4	24.8	*59.2*			24.6	33.5		
				WC		559	27.3 (0.42)	9.5	34.3	25.9	30.3	*56.2*			37.9	34.1		
				EP		527	27.9 (0.44)	3.2	63.7	28.2	31.9	*60.1*			34.7	27.6		
				NC		89	25.8 (0.28)	12.2	41.9	21.6	24.2	*45.8*			26.9	20.3		
				FS		298	26.4 (0.31)	7.6	42.8	23.3	26.2	*49.5*			31.4	29.5		
				KZN		831	26.9 (0.41)	3.2	39.3	33.0	24.5	*57.5*			32.0	48.8		
				NWP		361	26.4 (0.35)	8.0	42.6	25.1	24.4	*49.5*			32.9	27.2		
				GP		1025	27.5 (0.43)	5.6	36.1	28.2	30.1	*58.3*			39.5	27.7		
				MP		294	26.7 (0.36)	6.0	40.1	25.9	28.0	*53.9*			28.0	22.8		
				NP		496	25.6 (0.43)	9.1	45.0	24.2	21.8	*46.0*			26.0	28.0		
					U	2864	27.6 (0.22)	5.7	36.1	27.1	31.0	*58.1*			37.1	31.6		
					NU	1616	25.9 (0.18)	7.1	43.7	28.2	21.0	*49.2*			27.8	32.8		
					A-U	2161	28.1 (0.26)	5.1	34.0	27.1	33.8	*60.9*			39.1	31.0		
					A-NU	1526	25.9 (0.18)	6.3	44.2	28.6	21.0	*49.6*			27.2	33.2		
NFCS-FB Department of Health, 2007[3]	2005	15–35	All	All		2403	26.5 (26.2-26.7)	4.6	43.9	26.6	24.9	*51.5*						
				WC		254	27.5 (26.7–28.3)	5.9	35.4	26.0	32.7	*58.7*						
				EP		349	26.5 (25.5–27.6)	4.6	40.7	32.1	22.6	*54.7*						
				NC		48	-	-	-	-	-	*-*						
				FS		151	27.6 (25.6–29.6)	4.6	39.7	24.5	31.1	*55.6*						
				KZN		424	26.6 (25.9–27.3)	1.9	46.7	26.7	24.8	*51.4*						

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Table 5.2.2 Continued

FEMALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	BMI: Mean (SD/SE) or Median (range) or (95% confidence interval)	BMI: % Underweight < 8.5 kg/m²	BMI: % Normal weight ≥18.5; <25 kg/m²	BMI: % Overweight ≥25; <30 kg/m²	BMI: % Obese ≥30 kg/m²	BMI: % Above normal ≥25 kg/m²	WC: Mean (SD/SE) or Median (range) or (95% confidence interval)	WC: % At risk ≥94 cm	WC: % At high risk ≥102 cm	WHR: % At risk ≥ 0.10 (*≥0.9	WtHR: % At risk ≥ 0.5	MUAC: Mean SD or Median SE/range
SA NATIONAL SURVEYS																		
				NWP		193	25.7 (24.7 - 26.7)	5.2	49.2	20.7	24.9	*45.6*						
				GP		529	27.0 (26.5 - 27.5)	2.6	42.0	28.9	26.5	*55.4*						
				MP		189	25.7 (24.7 - 26.6)	5.8	46.0	27.5	20.6	*48.1*						
				NP		266	24.6 (23.9 - 25.3)	7.9	54.1	21.1	16.9	*38.0*						
					U	1352	26.8 (26.5-27.2)	4.3	42.6	26.3	26.8	*53.1*						
					R	1051	25.9 (25.5-26.4)	4.9	45.7	26.9	22.5	*49.4*						
					UF	1058	27.0 (26.5-27.4)	4.5	42.5	24.9	28.1	*52.9*						
					UI	294	26.5 (25.8-27.1)	3.4	42.9	31.6	22.1	*53.7*						
					RF	163	25.7 (24.4-27.0)	6.7	44.8	24.5	23.9	*48.5*						
					T	888	26.0 (25.5-26.6)	4.6	45.8	27.4	22.2	*40.6*						
NIDS–Wave 1 Data available from South African Labour and Development Research Unit, University of Cape Town http://www.nids.uct.ac.za/	2008	≥18	B C W A/I	All	U R	10 687	24.8 (24.5-25.1)	50.9		22.2	26.8	*49.0*						

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Table 5.2.2 Continued

FEMALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	BMI						WC			WHR	WtHR	MUAC
							Mean (SD/SE) or Median (range) or (95% confi-dence interval)	% Underweight < 8.5 kg/m^2	% Normal weight ≥ 18.5; <25 kg/m^2	% Overweight ≥ 25; <30 kg/m^2	% Obese ≥ 30 kg/m^2	% Above normal ≥ 25 kg/m^2	Mean (SD/SE) or Median (range) or (95% confi-dence interval)	% At risk ≥ 94 cm	% At high risk ≥ 102 cm	% At risk ≥ 0.10 (*≥ 0.9	% At risk ≥ 0.5	Mean SD or Median SE/range
SA NATIONAL SURVEYS																		
NIDS–Wave 2 Data available from South African Labour and Development Research Unit, University of Cape Town http://www.nids.uct.ac.za/	2010	≥18	B C W A/I	All	U R	7 887	26.3 (25.9–26.6)	44.4		23.8	31.7	55.5						
NIDS–Wave 3 Data available from South African Labour and Development Research Unit, University of Cape Town http://www.nids.uct.ac.za/	2012	≥18	B C W A/I	All	U R	8 936	26.4 (26.1–26.7)	45.1		25.4	29.5	54.9						
SANHANES-1 Shisana *et al.*, 2013[7]	2012	45–54				843	26.2 (25.6-26.7)	4.4	48.5	25.3	21.7	47.0			-	-		
		55–64				821	28.5 (27.8-29.1)	3.3	32.4	28.0	36.3	64.3		67.2	48.1	44.1		
		35–44				738	29.8 (29.0-30.6)	2.8	26.1	26.4	44.8	71.2		74.6	54.9	48.1		
		45–54				759	31.7 (30.7-32.6)	2.1	20.4	21.2	56.3	77.5		81.7	69.9	61.8		
		55–64				602	31.3 (30.4-32.1)	2.9	17.4	27.6	52.2	79.8		85.5	70.0	62.5		
		≥65				557	30.0 (29.0-31.1)	3.7	26.4	23.1	46.9	70.0		79.8	60.3	67.8		
			B			3308	29.0 (28.6-29.4)	3.6	31.6	24.9	39.9	64.8		67.6	51.1	45.7		
			C			1010	28.1 (27.4-28.8)	4.9	35.8	24.4	34.9	59.3		67.2	49.9	52.9		

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Table 5.2.2 Continued

FEMALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	BMI: Mean (SD/SE) or Median (range) or (95% confi-dence interval)	BMI: % Underweight < 8.5 kg/m²	BMI: % Normal weight ≥18.5; <25 kg/m²	BMI: % Overweight ≥25; <30 kg/m²	BMI: % Obese ≥30 kg/m²	BMI: % Above normal ≥25 kg/m²	WC: Mean (SD/SE) or Median (range) or (95% confi-dence interval)	WC: % At risk ≥94 cm	WC: % At high risk ≥102 cm	WHR: % At risk ≥ 0.10 (*≥0.9	WtHR: % At risk ≥ 0.5	MUAC: Mean SD or Median SE/range
SA NATIONAL SURVEYS																		
			W			79	-	-	-	-	-	-		-	-	-		
			A/I			213	26.5 (23.6-29.4)	16.4	28.4	22.8	32.4	55.2		79.5	54.1	64.8		
				WC		740	28.5 (27.8-29.2)	3.5	34.1	24.5	37.9	62.4		68.8	50.4	51.5		
				EP		596	28.6 (27.7-29.3)	5.2	31.3	21.7	41.8	63.5		65.1	51.1	46.1		
				NC		275	28.7 (26.9-30.6)	8.4	29.7	23.4	38.6	62.0		70.0	51.7	46.7		
				FS		361	29.6 (28.7-30.5)	3.5	32.8	20.7	43.0	63.7		64.0	50.2	43.1		
				KZN		693	29.5 (28.4-30.6)	5.3	25.5	25.2	44.0	69.2		69.0	53.6	50.0		
				NWP		569	27.0 (26.1-27.9)	7.8	38.2	22.3	31.7	54.0		61.9	43.5	50.9		
				GP		558	29.8 (28.9-30.7)	1.7	30.3	28.1	39.9	68.0		71.5	51.4	43.3		
				MP		505	28.3 (27.4-28.8)	5.2	32.7	26.2	35.8	62.0		71.6	49.4	49.6		
				LP		398	27.7 (27.0-28.4)	4.0	39.4	24.0	32.6	56.6		65.9	49.9	44.7		
					UF	2256	29.4 (28.8-30.0)	3.4	30.3	24.2	42.2	66.4		71.5	53.0	47.2		
					UI	579	28.5 (27.7-29.3)	6.0	30.9	27.9	35.3	63.2		63.9	47.4	46.7		
					RF	637	27.7 (26.8-28.7)	6.9	35.6	25.7	31.8	57.5		64.2	48.8	53.9		
					RI	1223	28.4 (27.8-28.9)	4.2	33.4	24.7	37.6	62.3		65.3	48.8	45.6		

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Table 5.2.2 Continued

FEMALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	BMI: Mean (SD/SE) or Median (range) or (95% confidence interval)	BMI: % Underweight < 8.5 kg/m²	BMI: % Normal weight ≥18.5; <25 kg/m²	BMI: % Overweight ≥25; <30 kg/m²	BMI: % Obese ≥30 kg/m²	BMI: % Above normal ≥25 kg/m²	WC: Mean (SD/SE) or Median (range) or (95% confidence interval)	WC: % At risk ≥94 cm	WC: % At high risk ≥102 cm	WHR: % At risk ≥ 0.10 (*≥0.9	WtHR: % At risk ≥ 0.5	MUAC: Mean SD or Median SE/range
SA NATIONAL SURVEYS																		
NIDS–Wave 4 Data available from South African Labour and Development Research Unit, University of Cape Town http://www.nids.uct.ac.za/	2014	≥18	B C W A/I	All	U R	9 040	27.3 (27.0–27.7)	42.6		23.8	33.6	*57.4*						
SADHS 2016 SADHS Report, 2016[6]	2016	15–24				1032	24.8	5.9	54.3	24.4	15.5	*39.8*		14.9	14.6		33.4	
		25–34				1009	29.0	2.1	31.4	29.1	37.3	*66.4*		21.8	39.1		62.8	
		35–44				780	30.8	1.8	20.8	24.8	52.6	*77.4*		20.9	52.2		74.1	
		45–54				676	31.7	0.7	17.4	24.9	57.0	*81.9*		21.3	61.6		83.4	
		55–64				553	31.5	2.2	16.5	26.7	54.5	*81.3*		18.7	62.9		83.9	
		≥65				592	30.4	1.5	23.1	29.6	45.8	*75.4*		18.5	64.8		87.9	
			B			4047	29.2	2.6	30.0	26.4	40.9	*67.4*		19.3	44.6		66.4	
			C			317	30.1	4.3	27.9	21.8	46.0	*67.8*		16.2	56.8		75.5	
			W			188	28.3	1.7	28.9	38.8	30.6	*69.4*		20.6	45.6		62.9	
			I/A			87	29.7	0.0	30.0	20.8	49.2	*70.0*		26.0	34.8		69.9	
				WC		415	30.6	2.3	24.3	25.9	47.5	*73.3*		14.6	59.0		77.1	
				EP		623	29.5	2.3	28.5	28.5	40.6	*69.2*		17.2	55.2		75.3	
				NC		106	27.9	8.2	30.0	26.8	35.0	*61.8*		17.7	48.7		70.3	
				FS		265	29.4	3.4	28.1	24.0	44.5	*68.5*		14.4	51.5		69.7	
				KZN		919	29.9	1.3	28.0	24.9	45.7	*70.6*		21.0	42.6		65.8	
				NWP		353	28.6	4.6	27.7	24.8	43.0	*67.8*		19.3	47.8		70.3	
				GP		1065	29.2	1.5	33.0	26.7	38.9	*65.6*		21.0	40.2		63.4	
				MP		393	28.0	3.8	34.2	28.5	33.5	*62.0*		18.9	34.2		55.3	

Table 5.2.2 Continued

FEMALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	BMI: Mean (SD/SE) or Median (range) or (95% confidence interval)	BMI: % Underweight < 8.5 kg/m²	BMI: % Normal weight ≥18.5; <25 kg/m²	BMI: % Overweight ≥25; <30 kg/m²	BMI: % Obese ≥30 kg/m²	BMI: % Above normal ≥25 kg/m²	WC: Mean (SD/SE) or Median (range) or (95% confidence interval)	WC: % At risk ≥94 cm	WC: % At high risk ≥102 cm	WHR: % At risk ≥ 0.10 (*≥0.9	WtHR: % At risk ≥ 0.5	MUAC: Mean SD or Median SE/range
SA NATIONAL SURVEYS																		
				NP		503	28.1	4.2	31.6	28.0	36.1	*64.2*		21.8	40.6		62.5	
					U	2863	29.6	2.2	29.4	26.3	42.2	*68.4*		18.8	45.3		66.7	
					NU	1773	28.6	3.3	30.5	26.9	39.2	*66.1*		20.0	45.4		67.4	
NIDS–Wave 5 Data available from South African Labour and Development Research Unit, University of Cape Town http://www.nids.uct.ac.za/	2017	≥18	B C W A/I	All	U R	8 461	27.9 (27.5–28.2)	41.0		24.3	34.6	*58.9*						
INTERNATIONAL SURVEYS WITH A SA COMPONENT																		
HelpAge International Study HelpAge IARDC Report, 2004[32] Kimokoti and Hamer, 2008[21]	1995	≥ 60	B C W A/I	All	U	230	33.1 (7.8)	3.5		20.5	65.1	*85.6*						33.9 (6.2) 4.8% at risk
PURE-NWP-SA Richter *et al.*, 2014[33]	2005				U	591	27.2 (22.3–32.6)						82.8 (73.2–92.7)					
					R	633	24.9 (20.8–30.7)						78.5 (69.3–89.3)					
WHO-SAGE - Wave 1 Peltzer *et al.*, 2011[161] Wu *et al.*, 2015[131]	2007 2008	ALL	ALL	ALL	SA	2146		3.6	19.3	24.6	52.5	*77.1*			66.0	69.5		
		50–59						2.2	17.7	24.3	55.9	*80.2*			64.6	66.6		
		60–69						4.2	17.1	21.4	57.2	*78.6*			68.2	69.6		
		≥70						5.8	26.3	29.8	38.1	*67.9*			66.1	75.7		
METS - SA Durazo-Arvizu *et al.*, 2014[34]	2014 2015	25–45	B	WC	U	268	31.9 (8.2)											

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Table 5.2.2 Continued

FEMALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	**BMI** Mean (SD/SE) or Median (range) or (95% confidence interval)	% Underweight < 8.5 kg/m²	% Normal weight ≥18.5; <25 kg/m²	% Overweight ≥25; <30 kg/m²	% Obese ≥30 kg/m²	% Above normal ≥25 kg/m²	**WC** Mean (SD/SE) or Median (range) or (95% confidence interval)	% At risk ≥94 cm	% At high risk ≥102 cm	**WHR** % At risk ≥ 0.10 (*≥0.9	**WtHR** % At risk ≥ 0.5	**MUAC** Mean SD or Median SE/range
INTERNATIONAL SURVEYS WITH A SA COMPONENT																		
STOP-SA study Okop *et al.*, 2019[168] Okop *et al.*, 2019[35]	2015 2016	35–78	B	EP WC	U R	588	33.8 (7.5)				59.2	84.1	102.0 (20.5)					
REGIONAL SA STUDIES																		
CORIS-A study Steyn *et al.*, 1998[172]	1990	15–64	B	WC	PU IS	n/d	27.8	3.7	25.5	36.4	34.4	*70.8*						30.6
CT black elderly study Charlton *et al.*, 2001[30]	1990	≥60	B	WC	PU IS	74	30.3 (6.9)					51.3						31.3 (5.0)
Cape Flats study Charlton *et al.*, 2001[30]	1993	≥65	C	WC	U	96	24.2 (5.1)					38.0						29.0 (4.3)
Colon cancer in Africans study O'Keefe *et al.*, 1999[73]	n/d	≥25	B Xhosa	EC MP KZN	R	26	25.4 (1.0)											31.2 (1.2)
			B Zulu		R	15	28.4 (2.3)											30.3 (1.4)
			B Swazi		R	6	30.9 (2.6)											31.5 (2.3)
			B		U	18	27.6 (1.0)											28.8 (1.3)
			W		U	15	23.6 (1.0)											-

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Table 5.2.2 Continued

FEMALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	**BMI**						**WC**			**WHR**	**WtHR**	**MUAC**
							Mean (SD/SE) or Median (range) or (95% confidence interval)	% Underweight < 8.5 kg/m²	% Normal weight ≥18.5; <25 kg/m²	% Overweight ≥25; <30 kg/m²	% Obese ≥30 kg/m²	% Above normal ≥25 kg/m²	Mean (SD/SE) or Median (range) or (95% confidence interval)	% At risk ≥94 cm	% At high risk ≥102 cm	% At risk ≥ 0.10 (*≥0.9	% At risk ≥ 0.5	Mean SD or Median SE/range
REGIONAL SA STUDIES																		
Mamre study Steyn *et al.*, 2004[31]	1996	15–24	C	WC	PU	140	22.6 (4.9)		12.9	12.9	10.0	*22.9*	70.8 (9.7)		7.1	2.9		
		25–34				112	27.8 (7.1)		25.0	25.0	32.1	*57.1*	82.0 (14.2)		26.8	9.8		
		35–44				105	27.8 (5.8)		33.3	33.3	31.4	*64.7*	84.0 (10.7)		33.3	17.1		
		45–54				90	30.2 (6.6)		26.7	26.7	47.8	*74.5*	90.5 (14.0)		51.1	32.2		
		55–64				63	30.4 (6.5)		28.6	28.6	50.8	*79.4*	93.2 (11.9)		71.4	55.6		
		≥65				36	28.9 (6.8)		25.0	25.0	41.7	*66.7*	91.5 (12.5)		61.1	44.4		
West Coast villages study Charlton *et al.*, 2001b[39]	1997	≥ 55	B	WC	R	104	29.6 (6.7)		24.0	26.0	46.1	*72.1*			66.7			
Dikgale HDSS, Limpopo Alberts *et al.*, 2005[50]	n/d	ALL	B	LP	R	1608	27.2 (6.2)						86.9 (12.8)			1.3		
		30–34				155	26.5 (7.0)						81.1(11.5)			2.4		
		35–44				342	27.9 (6.2)						85.4 (13.4)			9.2		
		45–54				323	27.9 (6.0)						88.1 (12.8)			4.1		
		55–64				375	27.9 (6.0)						88.1(12.9)			4.4		
		≥65				412	26.0 (6.0)						88.2 (11.8)			9.2		

Table 5.2.2 Continued

FEMALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	BMI: Mean (SD/SE) or Median (range) or (95% confidence interval)	BMI: % Underweight < 8.5 kg/m²	BMI: % Normal weight ≥18.5; <25 kg/m²	BMI: % Overweight ≥25; <30 kg/m²	BMI: % Obese ≥30 kg/m²	BMI: % Above normal ≥25 kg/m²	WC: Mean (SD/SE) or Median (range) or (95% confidence interval)	WC: % At risk ≥94 cm	WC: % At high risk ≥102 cm	WHR: % At risk ≥ 0.10 (*≥0.9	WtHR: % At risk ≥ 0.5	MUAC: Mean SD or Median SE/range
REGIONAL SA STUDIES																		
THUSA study Oosthuizen *et al.*, 2002[55] Vorster *et al.*, 2005[56]	1996 1998	15–65	B	NWP	UU	106	28.1 (26.7–29.4)		38.7	32.1	29.2	*61.3*				1.3		
					PU	292	28.0 (27.3–28.8)		38.6	25.0	36.3	*61.3*				9.2		
					IS	176	26.7 (25.7–27.7)		52.8	18.8	28.4	*47.1*				4.1		
					F	147	26.3 (25.2–27.4)		46.9	27.9	25.1	*53.0*				4.4		
					T	300	25.6 (24.8–26.3)		52.0	25.3	22.7	*48.0*				9.2		
THUSA study Kruger *et al.*, 2002[179]	1996 1998	15–65	B	NWP	ALL	989	26.9 (6.8)											
THUSA study Kruger *et al.*, 2012[180]	1996 1998	15–65	B	NWP	ALL	795	27.8 (7.0)											
Ndunakazi study Faber and Kruger, 2005[46]	1998	25–55	B	KZN	T	187			28.9	41.2	29.9	*71.1*						
Yenza study Mfenyana *et al.*, 2006[57]	1999	>15	B	EC	PU R	5390					26.7							
Women's Health Study Hattingh *et al.*, 2008[58]	2000	25–34	B	FS	PU	279		3.0*	39.1	30.1	23.3	*53.4*				16.5		
		35–44				217		11.9*	36.4	27.7	24.0	*51.7*				37.3		
WC fruit factory study Wolmarans *et al.*, 2003[40]	n/d	18–55	C	WC	R	338	29.0 (6.1)											
CT peri-urban study Charlton, *et al.*, 2007[41]	n/d	≥60	B	WC		230	33.1 (7.8)	2.2	7.4	20.0	65.4	*85.4*						33.9 (6.2)

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Table 5.2.2 Continued

FEMALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	BMI: Mean (SD/SE) or Median (range) or (95% confi-dence interval)	BMI: % Underweight < 8.5 kg/m²	BMI: % Normal weight ≥18.5; <25 kg/m²	BMI: % Overweight ≥25; <30 kg/m²	BMI: % Obese ≥30 kg/m²	BMI: % Above normal ≥25 kg/m²	WC: Mean (SD/SE) or Median (range) or (95% confi-dence interval)	WC: % At risk ≥94 cm	WC: % At high risk ≥102 cm	WHR: % At risk ≥ 0.10 (*≥0.9	WtHR: % At risk ≥ 0.5	MUAC: Mean SD or Median SE/range
REGIONAL SA STUDIES																		
Ubombo study Motala *et al.*, 2011[47]	2005	≥15	B	KZN	R	758	26.0 (6.5)			24.7	22.6	*47.3*	86.0 (13.4)	63.3	39.0	45.8*		
Sharpeville elderly facility study Oldewage-Theron *et al.*, 2008[72]	2004	≥60	B	GP	PU	148	31.1 (6.4)	0.0	16.2	29.7	54.1	*83.8*						
Khayelitsha Study Malhotra *et al.*, 2008[42]	2005	All	B	WC	PU	530		0.9	15.3	24.7	53.4	*78.1*	71.5					
		18–34				176	29.8 (6.1)											
		35–54				170	33.8 (8.3)											
		>55				79	31.6 (6.8)											
HealthKick study: Educators Senekal *et al.*, 2015[43]	2007	n/d	BWC	WC	U R	321	31 (7.8)		18.0	27.0	55.0	*62.0*		67.0				
HealthKick study: Caregivers De Villiers *et al.*, 2018[44]	2007	n/d	B C	WC	U	155			20.0	27.3	52.7	*80.0*						
Stranger study Naicker *et al.*, 2015[24]	2008	35–55	I	KZN	U	139				43.1	17.2	*60.3*				94		

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Table 5.2.2 Continued

FEMALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	**BMI**						**WC**			**WHR**	**WtHR**	**MUAC**
							Mean (SD/SE) or Median (range) or (95% confidence interval)	% Underweight < 8.5 kg/m²	% Normal weight ≥18.5; <25 kg/m²	% Overweight ≥25; <30 kg/m²	% Obese ≥30 kg/m²	% Above normal ≥25 kg/m²	Mean (SD/SE) or Median (range) or (95% confidence interval)	% At risk ≥94 cm	% At high risk ≥102 cm	% At risk ≥ 0.10 (*≥0.9	% At risk ≥ 0.5	Mean SD or Median SE/range
REGIONAL SA STUDIES																		
Phoenix Lifestyle Project Prakaschandra *et al.*, 2016[48] Prakaschandra *et al.*, 2017[25]	2007 2008	ALL	I	KZN	U	1001	29.1 (6.4)			32.1	39.9	*72.0*	95.4 (15.3)					
		15–24				77	24.5 (7.6)						82.3 (15.2)					
		25–34				101	29.4 (7.6)						94.8 (17.3)					
		35–44				227	29.5 (6.7)						95.9 (15.2)					
		45–54				342	29.6 (5.4)						97.2 (14.9)					
		55–64				254	29.5 (5.9)						96.9 (13.1)					
AHA-FS Study (rural) Van Zyl *et al.*, 2012[59] Tydeman-Edwards *et al.*, 2018[60]	2007 2009	25–64	B,C	FS	R U	319				25.1	41.1	*66.1*		19.4	48.6			
						207		0.9	31.2	26.0	41.9	*67.9*						
Qwa-Qwa INP Oldewage-Theron *et al.*, 2014	2008 2009	21–60	B	FS	R	207		0.9	31.2	26.0	41.9	*67.9*						
Umlazi Study Mkhize *et al.* 2013[49]	2009 2010	≥ 60	B	KZN	PU	224		4	14	21.9	60.1	*82.0*			83.0		87.4	
HDSS and Soweto study Prioreschi *et al.*, 2017[64]	2011	18–23	B	MP	R	476		5	56	23	16	*39*						
					U	492		7	47	29	17	*46*						

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Table 5.2.2 Continued

FEMALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	**BMI**						**WC**			**WHR**	**WtHR**	**MUAC**
							Mean (SD/SE) or Median (range) or (95% confidence interval)	% Underweight < 8.5 kg/m²	% Normal weight ≥18.5; <25 kg/m²	% Overweight ≥25; <30 kg/m²	% Obese ≥30 kg/m²	% Above normal ≥25 kg/m²	Mean (SD/SE) or Median (range) or (95% confidence interval)	% At risk ≥94 cm	% At high risk ≥102 cm	% At risk ≥ 0.10 (*≥0.9)	% At risk ≥ 0.5	Mean SD or Median SE/range
REGIONAL SA STUDIES																		
Dikgale HDSS Maimela *et al.*, 2016[51] Ntuli *et al.*, 2015[52]	2011 2012	ALL	B	LP	R	878												
		15–24								28.8	13.6	*42.4*		55.7				
		25–34								28.2	28.2	*56.4*		56.2				
		35–44								25.3	37.3	*62.6*		60.0				
		45–54								32.1	40.3	*72.4*		60.2				
		55–64								23.2	41.9	*65.1*		58.4				
		≥65								31.9	37.3	*69.2*		52.4				
Limpopo Nurse's Study Goon *et al.*, 2013[53]	2011	≥19	B	LP	R, SR	104		1.9	16.3	26	56.8	*82.8*						
AWI-Gen Study Micklesfield *et al.*, 2018[129]	2011 2015	44–54	B	GP	PU	1008	32.8 (28.5–37.5)	0.6	11.5	20.9	6.6	*27.5*						
Bt20 caregivers study George *et al.*, 2014[85]	2011 2012	18–70	B	GP	U	192	29.9 (24.3, 35.3)						95.0 (82.0, 105)					
			A/I			183	27.1 (23.0, 32.8)						93.0 (82.0, 103)					
Bt20 caregivers study Naidoo *et al.*, 2019[206]	2012	23	B	GP	U	785	26 (6)						81.6 (13.4)					
AWI-GEN SA Soweto Site Pisa *et al.*, 2018[63]	2011 2015	40–60	B	GP	U	982	24.96 (5.65)						98.46 (14.45)					
Discovery Vitality study Kolbe-Alexander *et al.*, 2013[209]	2012	≥18	All	SA cities	U	729	26.4 ± 6.1											

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Table 5.2.2 Continued

FEMALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	**BMI**						**WC**			**WHR**	**WtHR**	**MUAC**
							Mean (SD/SE) or Median (range) or (95% confi-dence interval)	% Underweight < 8.5 kg/m²	% Normal weight ≥18.5; <25 kg/m²	% Overweight ≥25; <30 kg/m²	% Obese ≥30 kg/m²	% Above normal ≥25 kg/m²	Mean (SD/SE) or Median (range) or (95% confi-dence interval)	% At risk ≥94 cm	% At high risk ≥102 cm	% At risk ≥ 0.10 (*≥0.9	% At risk ≥ 0.5	Mean SD or Median SE/range
REGIONAL SA STUDIES																		
HSFSA study Peer *et al.*, 2018[211] Peer *et al.*, 2018[26]	2013	≥18	B	KZN WC GP EC,FS	U SU	1884	32.1 (7.3)	0.7	17.5	23.8	58.0	*81.8*						
			C			1270	30.5 (6.6)	1.3	21.0	30.5	47.2	*77.7*						
			W			1070	27.3 (6.1)	2.6	38.6	31.7	*27.1*	*58.8*						
			I			806	27.6 (5.6)	2.5	31.7	25.8	29.9	*55.7*						
AWI-GEN SA Dikgale HDSS site Mashinya *et al.*, 2018[54]	2014 2016	40–60	B	LP	R	796	30.1 (25.2–35.8)	3	21	25	51	*76*						
AWI-GEN SA Soweto Site Pisa *et al.*, 2018[63]	2011 2015	40–60	B	GP	U	982	33.10 (6.97)						98.46 (14.45)					
AWI-GEN Agincourt site Wagner *et al.*, 2018[65]	2015 2016	40–60	B	MP	R	846	28.7 (24.2–33.2)											
ELS study Mashiane *et al.*, 2018[67]	2015	18–30	B	LP	R	372		8.6	42.5	23.1	25.8	*48.9*						
Khayelitsha, Mitchells Plain Dinbabo *et al.*, 2019[29]	2016	≥18	B C	WC	U Khay			14.75	26.23	22.95	36.07	*59.02*						
					U Mitch			16.67	23.23	26.77	33.33	*60.1*						

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Table 5.2.2 Continued

FEMALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	**BMI** Mean (SD/SE) or Median (range) or (95% confi-dence interval)	**BMI** % Underweight < 8.5 kg/m²	**BMI** % Normal weight ≥18.5; <25 kg/m²	**BMI** % Overweight ≥25; <30 kg/m²	**BMI** % Obese ≥30 kg/m²	**BMI** % Above normal ≥25 kg/m²	**WC** Mean (SD/SE) or Median (range) or (95% confi-dence interval)	**WC** % At risk ≥94 cm	**WC** % At high risk ≥102 cm	**WHR** % At risk ≥ 0.10 (*≥0.9	**WtHR** % At risk ≥ 0.5	**MUAC** Mean SD or Median SE/range
STUDIES OF SA STUDENTS																		
University of the North Steyn *et al.* 2000[29] Steyn *et al.* 200095	1994	18–25	B	LP		115	22.42 (3.85)			15.9	8.1	*22.9*	69.22 (7.86)			13.04		
UNISA Wassenaar *et al.*, 2000[223]	1994 1995	n/d	All	All		520	22.4											
University of the North Pelzer, 2001[224]	n/d	18–25	B	LP		423	22.4 (4.7)			14.4	8.7	*23.1*						
UKZN Peters et al 2006[225]	2004	17–42	B	KZN		97	22.6 (5.0)											
UCT: Cilliers, Senekal and Kunneke, 2006[226]	n/d	n/d	n/d	WC		360	21.8 (2.6)	7.2	81.9	10.0	0.8	*10.8*		5.3	1.7			
University of the North Bodiba *et al.*, 2008[227]	2004	n/d	n/d	LP		75		18.7	57.3	24.0								
Universiy of Stellenbosch Van Niekerk & Barnard, 2009[228]	2003 2005	n/d	n/d	WC		941	21.7											
University of Stellenbosch Smith and Essop, 2009[87]	n/d	n/d	n/d	WC		178	22.10 (3.10)						75.3 (9.1)		14			
University of Fort Hare Vd Berg *et al.*, 2012[132]	2008	18–42	B	EC		110		1.8	40.0	36.4	21.8	*58.2*						

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Table 5.2.2 Continued

FEMALES Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	BMI: Mean (SD/SE) or Median (range) or (95% confi-dence interval)	BMI: % Underweight < 8.5 kg/m^2	BMI: % Normal weight ≥18.5; <25 kg/m^2	BMI: % Overweight ≥25; <30 kg/m^2	BMI: % Obese ≥30 kg/m^2	BMI: % Above normal ≥25 kg/m^2	WC: Mean (SD/SE) or Median (range) or (95% confi-dence interval)	WC: % At risk ≥94 cm	WC: % At high risk ≥102 cm	WHR: % At risk ≥ 0.10 (*≥0.9	WtHR: % At risk ≥ 0.5	MUAC: Mean SD or Median SE/range
STUDIES OF SA STUDENTS																		
Univesity of the Free State Vd Berg *et al.*, 2013[126]	2013	18–45	All	FS		122		10.7	67.2			*22.1*			13.1			
Univesity of Kwazulu Natal Kassier and Veld-man, 2013[230]	2012	n/d	n/d	KZN		26.7	25.6 (5.3)											
Walter Sisulu University Nkeh-Chungag *et al.*, 2015[223]	2015	19–31	n/d	EC		142	26.1 (0.6)						77.9 (0.9)					
University of Pretoria Madiba *et al.*, 2018[130]	2015	17–42	n/d	GP		180		14	66	16	4	*20*						
WITS Gradidgea and Cohen, 2018[128]	n/d	n/d	n/d	GP		110	25.4 (4.63)						70.6 (18.2)					
Universiy of Stellenbosch Visser *et al.*, 2019[86]	2016	n/d	n/d	WC		121	24.2 (4.2)						78.9 (9.2)					

BMI ≥ 25 kg/m^2 was calculated for this review

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Table 5.2.3: Anthropometry of adults–males and females published as combined data

COMBINED **Antropometry per study**	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	BMI (%) Mean (SD) Mean SD/ SE or Median range 95%CI cm	BMI (%) Under Weight BMI < 18.5 kg/m2	BMI (%) Normal weight 18.5 ≥ BMI < 25 kg/m2	BMI (%) Over weight 25 ≥ BMI < 30 kg/m2	BMI (%) Obese ≥ 30 kg/m2	BMI (%) Above normal >25 kg/m2 Above normal >25 kg/m2	WC Mean SD /SE or Median range/95%CI cm
NIDS–Waves 1,2 and 3 Cois *et al*., 2015[147]	2008	≥18	BCW A/I	All	U R	8177	27.11 (0.09)	5.38	43.44	23.08	28.1	*51.18*	85.55
	2010					8184	27.70 (0.09)	4.47	37.55	25.24	32.73	*57.97*	
	2012					8728	27.79 (0.09)	2.59	38.03	27.53	31.85	*59.38*	
NIDS–Wave 1 Data available from South African Labour and Development Research Unit, University of Cape Town http://www.nids.uct.ac.za/	2008	19–24		All		2 079	23.5 (23.2–23.9)	69.5		19.6	10.9	*30.5*	
		25–34				2 199	25.8 (25.5–26.2)	53.8		24.4	21.8	*46.2*	
		35–44				1 966	27.7 (27.3–28.2)	40.2		25.2	34.6	*59.8*	
		45–94				1 687	28.8 (28.2–29.3)	37.3		23.7	38.9	*62.6*	
		≥55				2 136	28.4 (27.9–28.9)	37.8		26.9	35.3	*62.2*	
			B			15 621	22.9 (22.6–23.1)	61.4		19.5	19.1	*38.6*	
			C			2 360	24.0 (23.3–24.6)	61.1		17.2	21.8	*39.0*	
			W			499	25.7 (24.6–26.8)	36.1		32.9	31.1	*64.0*	
			A/I			199	23.4 (22.9–23.9)	58.3		23.1	18.6	*41.7*	
					U	7 830	24.0 (23.7–24.3)	56.4		20.5	23.2	*43.7*	
					R	10 849	22.2 (21.9–22.5)	63.7		19.0	17.3	*36.3*	
NIDS–Wave 2 Data available from South African Labour and Development Research Unit, University of Cape Town http://www.nids.uct.ac.za/	2010	19–24		All		1 455	24.6 (24.1–25.1)	59.9		23.0	17.2	*40.2*	
		25–34				1 597	26.4 (25.9–26.9)	45.1		26.9	27.9	*54.8*	
		35–44				1 514	28.4 (27.8–29.0)	35.6		25.6	38.8	*64.4*	
		45–94				1 305	29.3 (28.6–29.9)	32.5		25.3	42.2	*67.5*	
		≥55				1 712	28.4 (27.9–28.9)	36.0		27.0	37.0	*64*	
			B			11 536	24.3 (24.0–24.6)	54.3		22.3	23.4	*45.7*	
			C			1 400	24.4 (23.6–25.2)	58.6		18.1	23.2	*41.3*	
			W			234	26.9 (25.1–28.7)	36.8		34.6	28.6	*63.2*	
			A/I			128	23.8 (22.9–24.7)	56.3		24.2	19.5	*43.7*	

Table 5.2.3 Continued

COMBINED Antropometry per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	BMI (%) Mean (SD) Mean SD/ SE or Median range 95%CI cm	Under Weight BMI < 18.5 kg/m2	Normal weight 18.5 ≥ BMI < 25 kg/m2	Over weight 25 ≥ BMI < 30 kg/m2	Obese ≥ 30 kg/m2	Above normal >25 kg/m2 Above normal >25 kg/m2	WC Mean SD /SE or Median range/95%CI cm
					U	5 361	25.1 (24.6–25.5)	53.5		21.3	25.2	46.5	
					R	7 937	23.8 (23.5–24.1)	55.1		22.6	22.3	44.9	
NIDS–Wave3 Data available from South African Labour and Development Research Unit, University of Cape Town http://www.nids.uct.ac.za/	012	19–24		All		1 563	25.5 (24.9–26.1)	54.2		25.3	20.5	45.8	
		25–34				1 721	26.9 (26.5–27.4)	43.1		28.6	28.3	56.9	
		35–44				1 634	28.6 (28.0–29.1)	34.4		26.0	39.6	65.6	
		45–94				1 415	29.4 (28.8–30.0)	32.4		26.7	40.9	67.6	
		≥55				1 754	28.0 (27.6–28.4)	35.6		30.5	33.9	64.4	
			B			12 941	24.2 (24.0–24.5)	56.5		22.7	20.8	43.5	
			C			1 887	24.9 (24.3–25.4)	57.8		18.9	23.3	42.2	
			W			362	27.8 (26.8–28.8)	28.5		35.4	36.2	71.6	
			A/I			141	25.5 (25.0–26.0)	46.8		31.9	21.3	53.2	
					U	6 911	25.3 (24.9–25.7)	53.0		22.4	24.6	47.0	
					R	8 420	23.6 (23.3–23.9)	58.3		22.8	18.9	41.7	
NIDS–Wave 4 Data available from South African Labour and Development Research Unit, University of Cape Town http://www.nids.uct.ac.za/	2014	19–24		All		1 703	27.6 (27.1–28.0)	49.2		25.3	25.5	50.8	
		25–34				1 831	27.6 (27.1–28.0)	40.9		25.0	34.1	59.1	
		35–44				1 647	28.8 (28.2–29.4)	34.0		22.8	43.2	66.0	
		45–94				1 370	29.6 (28.9–30.2	31.0		25.0	43.9	68.9	
		≥55				1 522	28.1 (27.5–28.7)	36.0		27.3	36.7	64.0	
			B			13 228	24.8 (24.5–25.0)	57.3		20.5	22.2	42.7	
			C			1 923	25.4 (24.9–26.0)	56.5		17.3	26.2	43.5	
			W			320	28.2 (26.8–29.6)	29.1		31.9	39.1	71.0	
			A/I			152	24.4 (23.5–25.2)	50.7		27.6	21.7	49.3	
					U	7 471	25.7 (25.4–26.1)	53.7		20.7	25.6	46.3	
					R	8 152	24.2 (23.9–24.4)	59.2		20.6	20.6	41.2	

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Table 5.2.3 Continued

COMBINED **Antropometry per study**	Date of collection	Age (yrs)	Ethnicity	Province	Area	n (for BMI)	BMI (%) Mean (SD) Mean SD/ SE or Median range 95%CI cm	Under Weight BMI < 18.5 kg/m2	Normal weight 18.5 ≥ BMI < 25 kg/m2	Over weight 25 ≥ BMI < 30 kg/m2	Obese ≥ 30 kg/m2	Above normal >25 kg/m2 Above normal >25 kg/m2	WC Mean SD /SE or Median range/95%CI cm
NIDS–Wave 5 Data available from South African Labour and Development Research Unit, University of Cape Town http://www.nids.uct.ac.za/	2017	19–24		All		1 581	26.7 (26.1–27.2)	45.4		26.2	28.4	*54.6*	
		25–34				1 705	27.4 (26.9–27.9)	40.4		24.9	34.7	*59.6*	
		35–44				1 556	28.7 (28.1–29.2)	32.6		24.4	43.1	*67.5*	
		45–94				1 260	29.5 (28.9–30.2)	32.0		25.4	42.6	*68.0*	
		≥55				1 272	28.0 (27.4–28.6)	37.8		26.7	35.5	*62.2*	
			B			12 317	25.3 (25.0–25.5)	56.4		20.8	22.9	*43.7*	
			C			1 770	25.8 (25.3–26.3)	53.6		19.7	26.7	*46.4*	
			W			231	28.3 (26.8–29.7)	29.4		31.2	39.4	*70.6*	
			A/I			145	24.0 (22.9–25.1)	43.4		33.8	22.8	*56.6*	
					U	6 962	25.8 (25.5–26.2)	52.5		21.3	26.2	*47.5*	
					R	7 501	24.7 (24.4–25.0)	58.2		20.6	21.1	*41.7*	
Khayelitsha, Mitchells Plain Dinbabo *et al.*, 2019[29]	2016	≥18	B	WC	PU Khay	748		11.23		28.07	22.59	*38.09*	60.7
			C		U MitcP	754		10.74		29.71	23.08	*36.47*	59.6

BMI ≥ 25 kg/m² was calculated for this review

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BIOCHEMICAL MARKERS

Table 5.3.1: South African males: Vitamin A status

MALE Serum vitamn A levels per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SD) / (CI) S-retinol µmol/L	% with serum retinol levels within specific ranges < 0.36 µmol/L (<10 µg/dL)	≥0.36; <0.71 µmol/L (≥ 10; <20 µg/dL)	≥0.71; <1.07 µmol/L (≥20 ;<30 µg/dL)	≥1.07; <1.79 µmol/L (≥30; < 50 µg/dL)	With DEFICIENCY < 0.7 µmol/L (<20 µmol/dL)	≥1.79 µmol/L (≥50 µg/dL)
NATIONAL SURVEYS No data recorded													
INTERNATIONAL SURVEYS WITH A SA COMPONENT													
THUSA study Kruger *et al.*, 2005[71]	1996–1998	15–80	B	NWP	U	447						7 (1.9)	
					R	314						3 (1.0)	
REGIONAL SA STUDIES													
Sharpeville Elderly facility study Oldewage-Theron *et al.*, 2010[72]	2004	≥60	B	GP	PU	67	1.84 (0.50)			22.4		26.5	
STUDIES ON SA STUDENTS No data recorded													

Table 5.3.2: South African females: Vitamin A status

FEMALE: Serum vitamin A levels per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SD) / (CI)	% with serum retinol levels within specific ranges					
							S-retinol µmol/L	< 0.36 µmol/L (<10 µg/dL)	≥0.36; <0.71 µmol/L (≥ 10; <20 µg/dL)	≥0.71; <1.07 µmol/L (≥20 ;<30 µg/dL)	≥1.07; <1.79 µmol/L (≥30; < 50 µg/dL)	With DEFICIENCY < 0.7 µmol/L (<20 µmol/dL)	≥1.79 µmol/L (≥50 µg/dL)
NATIONAL SURVEYS													
NFCS-FB Department of Health, 2007[3]	2005	16–35	B	All		1834	*0.98 (0.95–1.01)*	6.4 (4.9–7.9)	20.8 (18.6–23.1)	35.6 (32.8–38.3)	32.6 (29.4–35.7)	*20.0*	4.6 (3.5–5.8)
			W	WP		200	*1.26 (1.15–1.36)*	1.5 (0.0–3.8)	7.5 (2.7–12.3)	31.0 (21.6–40.4)	47.5 (37.7–57.3)	*9.0*	12.5 (6.2–18.8)
			C	EC		268	*1.03 (0.93–1.12)*	2.6 (0.8–4.4)	19.4 (12.9–25.9)	38.8 (31.7–46.0)	35.1 (27.1–43.1)	*22.0*	4.1 (0.7–7.5)
			I/A	NC		32	*1.45 (1.36–1.53)*	0.0	0.0	15.6 (3.9–27.4)	68.8 (51.9–85.6)	*0.0*	15.6 (0.0–34.7)
				FS		140	*0.98 (0.84–1.12)*	5.7 (0.0–12.0)	18.5 (8.8–28.3)	42.1 (28.2–56.1)	28.6 (14.7–42.5)	*18.5*	5.0 (0.4–9.6)
				KZN		347	*0.63 (0.57–0.70)*	22.8 (16.5–29.0)	41.8 (35.6–47.9)	26.2 (20.0–32.4)	8.1 (4.0–12.1)	*41.8*	1.2 (0.0–2.3)
				NW		154	*1.10 (0.95–1.23)*	1.9 (0.0–5.0)	14.3 (5.7–22.8)	35.1 (23.6–46.5)	42.2 (25.7–58.7)	*14.3*	6.5 (2.3–10.7)
				GP		428	*0.98 (0.94–1.03)*	2.6 (0.8–4.4)	17.8 (12.7–22.8)	43.0 (37.8–48.2)	34.1 (27.8–40.4)	*17.8*	2.6 (0.8–4.4)
				MP		104	*1.16 (1.01–1.31)*	1.9 (0.0–4.9)	9.6 (2.3–16.9)	31.7 (15.5–48.0)	50.0 (30.0–70.0)	*9.6*	6.7 (1.1–12.4)
				LP		161	*0.98 (0.86–1.09)*	3.1 (0.0–6.4)	22.4 (14.7–30.0)	37.3 (27.6–46.9)	34.2 (21.0–47.4)	*22.4*	3.1 (0.0–6.7)
					UF	801	*1.02 (0.98–1.07)*	5.7 (3.8–7.7)	17.0 (13.5–20.5)	35.5 (30.0–41.1)	30.6 (21.7–39.5)	*17.0*	5.0 (0.8–9.1)
					UI	242	*0.98 (0.86–1.09)*	5.8 (0.0–12.4)	23.1 (15.3–31.0)	35.5 (30.0–41.1)	30.6 (21.7–39.5)	*23.1*	5.0 (0.8–9.1)
					RF	133	*1.08 (0.90–1.22)*	3.0 (0.0–7.3)	20.3 (7.8–32.8)	27.1 (15.3–38.8)	42.1 (28.6–55.6)	*20.3*	7.5 (2.9–12.1)
					T	658	*0.91 (0.86–0.96)*	8.2 (5.5–10.9)	24.8 (21.2–28.3)	35.6 (31.0–40.1)	29.3 (24.0–34.7)	*24.8*	2.1 (1.0–3.2)
					U	1043	*1.01 (0.97–1.05)*	5.8 (3.7–7.8)	18.4 (15.3–21.6)	36.6 (33.0–40.2)	33.4 (29.3–37.5)	*18.4*	5.8 (4.1–7.6)
					R	791	*0.94 (0.89–0.98)*	7.3 (5.1–9.6)	24.0 (20.7–27.4)	34.1 (29.7–38.5)	31.5 (26.5–36.4)	*24.0*	3.0 (1.7–4.3)
SANHANES-1 Shisana, *et al.* 2013[7]	2012	All				1 158	1.10 (1.06–1.14)					13.3 (9.9-17.5)	
		16–25				682	1.09 (1.06–1.13)					11.6 (8.8-15.1)	
		26–34				476	1.10 (1.03–1.17)					15.8 (9.6-24.7)	
			B			781	1.07 (1.02–.11)					14.4 (10.5-19.5)	
			C			331	1.27 (1.21–1.34)					7.2 (4.3-11.9)	
				WP		264	1.24 (1.16–1.31)					7.1 (4.6-10.9)	

Table 5.3.2 Continued

FEMALE: Serum vitamin A levels per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SD) / (CI) S-retinol µmol/L	% with serum retinol levels within specific ranges < 0.36 µmol/L (<10 µg/dL)	≥0.36; <0.71 µmol/L (≥ 10; <20 µg/dL)	≥0.71; <1.07 µmol/L (≥20 ;<30 µg/dL)	≥1.07; <1.79 µmol/L (≥30; < 50 µg/dL)	With DEFICIENCY < 0.7 µmol/L (<20 µmol/dL)	≥1.79 µmol/L (≥50 µg/dL)
NATIONAL SURVEYS													
				EC		171	1.11 (1.02–1.21)					9.0(5.1-15.3)	
				NC		94	-					-	
				FS		116	1.12 (1.05–1.18)					8.1 (3.4-18.4)	
				KZN		114	1.04 (0.94–1.14)					16.4 (9.8-26.3)	
				NW		167	1.15 (1.07–1.23)					8.8 (4.6-16.3)	
				GP		106	1.03 (0.92–1.15)					17.8 (8.1-34.7)	
				MP		81	-					-	
				LP		45	-					-	
					UF		1.13 (1.06–1.19)					12.4 (7.1-20.7)	
					UI		1.03 (0.93–1.13)					14.4 (8.3-23.8)	
					RF		1.17 (1.09–1.24)					11.5 (7.7-16.9)	
					RI		1.06 (1.00–1.12)					15.1 (10.5-21.2)	
SANHANES-1 Secondary analysis Parker *et al.*, 2016[69]	2012	All				1205	1.15 (1.10–1.19)					11.7 (8.8–15.2)	
		16–18				229	1.10 (1.04–1.16)					8.4 (4.8–14.3)	
		19–24				435	1.16 (1.10–1.21)					12.6 (7.6–16.8)	
		25–29				278	1.15 (1.06–1.25)					11.4 (6.3–19.6)	
		30–35				263	1.16 (1.06–1.27)					15.5 (9.9–23.5)	
			B			836	1.12 (1.07–1.18)					12.7 (9.4–16.9)	
			C			312	1.27 (1.21–1.33)					7.1 (4.3–11.5)	
			W			10	1.52 (1.19–1.85)					-	
			I			36	1.06 (0.92–1.21)					13.4 (4.4–34.3)	
					UF	562	1.20 (1.13–1.27)					8.8 (5.1–14.8)	
					UI	187	1.10 (0.95–1.25)					15.3 (9.6–23.6)	

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Table 5.3.2 Continued

FEMALE: Serum vitamin A levels per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	**Mean (SD) / (CI)** S-retinol µmol/L	**% with serum retinol levels within specific ranges** < 0.36 µmol/L (<10 µg/dL)	≥0.36; <0.71 µmol/L (≥ 10; <20 µg/dL)	≥0.71; <1.07 µmol/L (≥20 ;<30 µg/dL)	≥1.07; <1.79 µmol/L (≥30; < 50 µg/dL)	With DEFICIENCY < 0.7 µmol/L (<20 µmol/dL)	≥1.79 µmol/L (≥50 µg/dL)
NATIONAL SURVEYS													
					RF	255	1.07 (1.01–1.13)					15.2 (10.8–20.8)	
					RI	201	1.17 (1.10–1.24)					11.8 (8.5–16.1)	
INTERNATIONAL SURVEYS WITH A SA COMPONENT													
THUSA study Kruger *et al.*, 2005[71]	1996 1998	15–80	B	NW	UU	570	1.61 (0.06)					9 (1.6)	
					PU		1.63 (0.04)						
					IS		1.56 (0.04)						
					F	440	1.57 (0.07)					8 (1.8)	
					T		1.60 (0.04)						
REGIONAL SA STUDIES													
Ndunakazi study Faber and Kruger, 2005[46]	1998	25–55	B	KZN	T	126	*1.26 (0.42)*					8 (30)*	
Sharpeville elderly facility study Oldewage-Theron *et al.*, 2010[72]	2004	≥60	B	GP	PU	196	*1.41 (1.30)*			22.4		26.5	

Vitamin A levels expressed in µg/dL were converted to µmol/L; For the FCSB2005, the total percentage with % Vit A <0.7 µmol/L (%Vit A <20 µg/dL), which constitutes deficiency, were calculated by adding the relevant categories

Table 5.3.3: South African adults: Vitamin A status for males and females published as combined data

COMBINED Vitamn A levels	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SD) / (CI) S-retinol µmol/L	% with serum retinol levels within specific ranges < 0.36 µmol/L (<10 µg/dL)	≥0.36; <0.71 µmol/L (≥ 10; <20 µg/dL)	≥0.71; <1.07 µmol/L (≥20 ;<30 µg/dL)	≥1.07; <1.79 µmol/L (≥30; < 50 µg/dL)	With DEFICIENCY < 0.7 µmol/L (<20 µmol/dL)	≥1.79 µmol/L (≥50 µg/dL)
Colon cancer in Africans study O'Keefe *et al.*, 1999[73]		Middle aged	B	EC KZN	U PU	57	1.8 (0.1)						
			W	MP	R	25	2.3 (0.1)						

Table 5.3.4a: South African males: Haemoglobin, iron status and inflammatory markers

FEMALES: Haemoglobin and iron status per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SD/CI) / Median (SE, range) OR % Hb g/dL	% With any anemia Hb <13 g/dL	% with Mild anemia : 11.0-12.9 g/dL	% with Moderate anmeia: 8.0-10.9 g/dL	% with Severe anmeia: <8.0 g/dL	% Iron depleted (Hb ≥ 12g/dL and ferritin ≤ 15ug/L	% Iron deficiency anaemia Hb ≤ 12g/dL and ferritin ≤ 15ug/L	% Iron replete Hb ≥ 12g/dL and ferritin ≥ 15ug/L	Anaemia due to other causes Hb ≤ 12g/dL and ferritin ≥ 15ug/L)	S-ferritin µg/L	% with low ferritin: < 12 µg/L (< 15 µg/L *)/)(<30 µg/L **)	% with high ferritin >150 µg/L	CRP (mg/L)	% with elevted CRP (>10 mg/L) (> 6mg/L*)
SANHANES-1 Shisana, *et al.* 2013[7]	2012	All				1889	14.7 (14.5–14.9)	12.2	10.6	1.5	0.2									
		15–24				566	14.6 (14.4–14.7)	9.3	8.2	1.1	0.0									
		25–34				287	15.4 (14.9–15.9)	9.6	7.6	1.8	0.2									
		35–44				254	14.9 (14.7–15.1)	7.0	6.5	0.5	0.0									
		45–54				282	14.9 (14.6–15.2)	11.3	10.6	0.6	0.0									
		55–64				257	14.5 (14.1–14.9)	16.3	14.0	2.3	0.1									
		≥65				243	13.7 (13.5–14.0)	25.9	21.7	3.3	0.9									
			B			1255	14.7 (14.5–14.9)	12.9	11.2	1.5	0.2									
			C			474	14.9 (14.6–15.2)	6.8	6.2	0.6	0.0									
			W			56	-	-	-	-	-									
			A/I			97	-	-	-	-	-									

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Table 5.3.4A Continued

FEMALES: Haemoglobin and iron status per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SD/CI) / Median (SE, range) OR %													
							Hb g/dL	% With any anemia Hb <13 g/dL	% with Mild anemia : 11.0-12.9 g/dL	% with Moderate anmeia: 8.0-10.9 g/dL	% with Severe anmeia: <8.0 g/dL	% Iron depleted (Hb ≥ 12g/dL and ferritin ≤ 15ug/L	% Iron deficiency anaemia Hb ≤ 12g/dL and ferritin ≤ 15ug/L	% Iron replete Hb ≥ 12g/dL and ferritin ≥ 15ug/L	Anaemia due to other causes Hb ≤ 12g/dL and ferritin ≥ 15ug/L)	S-ferritin µg/L	% with low ferritin: < 12 µg/L (< 15 µg/L *)/)<30 µg/L **)	% with high ferritin >150 µg/L	CRP (mg/L)	% with elevted CRP (>10 mg/L) (> 6mg/L*)
				WC		359	14.8 (14.6–15.0)	5.6	5.3	0.3	0.0									
				EC		318	14.7 (14.4–14.9)	8.9	7.9	0.7	0.4									
				NC		121	15.3 (14.3–16.3)	3.5	2.4	1.2	0.0									
				FS		175	15.0 (14.7–15.3)	10.9	8.9	2.0	0.0									
				KZN		244	14.2 (14.0–14.5)	15.2	12.8	2.2	0.1									
				NW		224	14.8 (14.3–15.2)	13.4	7.4	5.2	0.8									
				GP		185	15.0 (14.5–15.4)	13.4	12.8	0.6	0.0									
				MP		165	14.5 (14.2–14.9)	18.6	17.4	0.6	0.7									
				LP		98														
					UF	921	15.0 (14.7–15.2)	10.5	9.4	1.0	0.1									
					UI	197	14.2 (13.9–14.6)	15.7	13.9	1.8	0.0									
					RF	351	14.7 (14.5–14.9)	14.3	13.6	0.7	0.0									
					RI	420	14.3 (14.1–14.5)	13.8	10.8	2.6	0.4									
SADHS 2016 SADHS Report, 2016[6]	2016	All				2606		16.8												
		15–24				796		13.3												
		15–19				438		17.2												
		20–24				357		8.4												
		24–34				557		10.4												
		35-44				434		14.6												
		45–54				288		25.6												
		55–64				285		22.4												
		65+				246		9.7												
			B			2240		18.0												
			C			151		12.0												

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Table 5.3.4A Continued

FEMALES: Haemoglobin and iron status per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SD/CI) / Median (SE, range) OR % Hb g/dL	% With any anemia Hb <13 g/dL	% with Mild anemia : 11.0-12.9 g/dL	% with Moderate anmeia: 8.0-10.9 g/dL	% with Severe anmeia: <8.0 g/dL	% Iron depleted (Hb ≥ 12g/dL and ferritin ≤ 15ug/L	% Iron deficiency anaemia Hb ≤ 12g/dL and ferritin ≤ 15ug/L	% Iron replete Hb ≥ 12g/dL and ferritin ≥ 15ug/L	Anaemia due to other causes Hb ≤ 12g/dL and ferritin ≥ 15ug/L)	S-ferritin µg/L	% with low ferritin: < 12 µg/L (< 15 µg/L *)/)(<30 µg/L **)	% with high ferritin >150 µg/L	CRP (mg/L)	% with elevted CRP (>10 mg/L) (> 6mg/L*)
			W			184		7.8												
			I/A			31		-												
				WC		238		8.9												
				EC		372		18.2												
				NC		46		19.8												
				FS		168		25.6												
				KZN		395		15.9												
				NW		242		17.5												
				GP		683		17.2												
				MP		233		18.1												
				LP		226		13.9												
					WQ1	550		17.9												
					WQ2	537		19.0												
					WQ3	558		19.1												
					WQ4	495		17.0												
					WQ5	466		9.9												
INTERNATIONAL STUDIES WITH A SA COMPONENT NO DATA RECORDED																				
REGIONAL SA STUDIES																				
Cape Flats Study Charlton *et al.*, 1997[175]	1993	≥ 65	C	WC	U	88	15.1 (1.8)	11.4								198 (337)	1.1	11.4*		
THUSA Study Kruger *et al.*, 2005[71]	1996 1998	15–80	B	NW	UU	447	13.2	1.1								178.0	3.3			
					PU		13.4									212.7				
					IS		13.8									179.4				

Table 5.3.4A Continued

FEMALES: Haemoglobin and iron status per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Hb g/dL	% With any anemia Hb <13 g/dL	% with Mild anemia : 11.0-12.9 g/dL	% with Moderate anmeia: 8.0-10.9 g/dL	% with Severe anmeia: <8.0 g/dL	% Iron depleted (Hb ≥ 12g/dL and ferritin ≤ 15ug/L	% Iron deficiency anaemia Hb ≤ 12g/dL and ferritin ≤ 15ug/L	% Iron replete Hb ≥ 12g/dL and ferritin ≥ 15ug/L	Anaemia due to other causes Hb ≤ 12g/dL and ferritin ≥ 15ug/L)	S-ferritin µg/L	% with low ferritin: < 12 µg/L (< 15 µg/L *)/)(<30 µg/L **)	% with high ferritin >150 µg/L	CRP (mg/L)	% with elevted CRP (>10 mg/L) (> 6mg/L*)
							Mean (SD/CI) / Median (SE, range) OR %													
REGIONAL SA STUDIES																				
					F	314	13.5	0.3								172.0	2.5			
					T		14.4									231.3				
CT Peri Urban Study Charlton *et al.*, 2005[182] Per tertiles of added sugar	n/d	≥60	B	WC	PU	Lowest 17	13.8 (0.9)	16.7								454.1 (546.0)	0**			
						Mid 17	14.3 (1.9)	12.5								409.4 (455.8)	0**			
						Highest 18	13.6 (1.4)	41.7								449.3 (352.4)	6.7**			
Sharpeville elderly facility study: Idewage-Theron *et al.*, 2009[77]	2007	≥60	B	GP	PU	24	13.8 (1.3)	37.5								166.0 (222.1)				
Sharpeville elderly facility study: Oldewage-Theron *et al.*, 2015[78]	2011	≥60	B	GP	PU	16	13.9 (3.5)	35.5								148.0 (161.4)	6.3			
Sharpeville elderly facility study: Jamshidi-Naeini *et al.*, 2019[189]	2004	≥60	B	GP	PU	46	14.0 (3.40)									144 (118)				
	2007					40	14.4 (1.92)									171 (188)				
	2011					16	14.0 (1.59)									149 (106)				
	2014					12	14.5 (2.05)													
Vaal Area (INP) Acham *et al.*, 2012[194]	2004 2019	19–90	B	GP	IS	40	14.16 (1.95)	4.5								26.1 (11.94)	4.9*			
HAALSI Payne *et al.*, 2018	2015	≥60	B	MP	R	2057	13.2 (2.8)	40.1		9.7	1.8								2.3 (1.24.3)	

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Table 5.3.4b: South African males: Haematocrit and markers of iron storage and transport

MALES: Haematocrit and markers of iron storage and transport	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SD/CI) / Median (SE, range) OR %							
							Haematocrit (%)	% low Hematocrit < 40% (M), < 37% (F) (< 36%*)	S-Iron µmol/L	S-Iron < 11.6 / <13* µmol/L	TIBC µg/dL	S- Transferrin (TF) g/L	S-Transferrin Saturation (TFS) %	% With low TFS <16%
Cape Flats Study Charlton *et al*., 1997[175]	1993	≥ 65	C	WC	U	88	45 (5)							
THUSA Study Kruger *et al*., 2005[71]	1996 1998	15–80	B	NW	UU	447	48.2	6.9			73.1		28.4	0
					PU		44.5				63.9		32.5	
					IS		44.1				64.2		31.7	
					F	314	45.6	7.5			66.5		27.6	0
					T		45.0				64.3		28.1	
CT Peri Urban Study Charlton *et al*., 2005[182] Per tertiles of added sugar	n/d	≥60	B	WC	PU	Lowest 17								
						Mid								
						17								
						Highest 18								
Sharpeville elderly facility study: Oldewage-Theron *et al*., 2009[77]	2007	≥60	B	GP	PU	24	42.4 (4.2)		12.7 (5.2)			2.4 (0.7)		
Sharpeville elderly facility study: Oldewage-Theron *et al*., 2015[78]	2011	≥60	B	GP	PU	16	45.5 (11.2)	18.8	13.7 (5.0)	37.5		2.4 (0.6)		

Table 5.3.4b Continued

MALES: Haematocrit and markers of iron storage and transport	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Haematocrit (%)	% low Hematocrit < 40% (M), < 37% (F) (< 36%*)	S-Iron µmol/L	S-Iron < 11.6 / <13* µmol/L	TIBC µg/dL	S- Transferrin (TF) g/L	S-Transferrin Saturation (TFS) %	% With low TFS <16%
							Mean (SD/CI) / Median (SE, range) OR %							
Sharpeville elderly facility study: Jamshidi-Naeini *et al.*, 2019[189]	2004	≥60	B	GP	PU	46								
	2007					40								
	2011					16								
	2014					12	41.95 (5.56)	5.8	21.16 (12.83)	2.7*				
Vaal Area (INP) Acham *et al.*, 2012[194]	2004 2019	19–90	B	GP	IS	40								

Table 5.3.5a: South African females: Haemoglobin, iron status and inflammatory markers

FEMALES: Haemoglobin and iron status per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Hb g/dL	% With any anemia Hb <12 g/dL	% with Mild anemia: 10.0-11.9 g/dL	% with Moderate anmeia: 7.0-9.9 g/dL	% with Severe anmeia: <7.0 g/dL	% Iron depleted (Hb ≥ 12g/dL and ferritin ≤ 15ug/L	% Iron deficiency anaemia Hb ≤ 12g/dL and ferritin ≤ 15ug/L	% Iron replete Hb ≥ 12g/dL and ferritin ≥ 15ug/L	Anaemia due to other causes Hb ≤ 12g/dL and ferritin ≥ 15ug/L)	S-ferritin µg/L	% with low ferritin: < 12 µg/L (< 15 µg/ *)/) (<30 µg/L **)	% with high ferritin >150 µg/L	CRP (mg/L)	% with elveted CRP (>10 mg/L) (>6mg/L*)
							Mean (SD/CI) / Median (SE, range) OR %													
NATIONAL SURVEYS																				
NFCS-FB Department of Health, 2007[3]	2005	≥16	B W C I/A	All WC EC NC		2126	12.5 (12.4–12.6)	29.4								57.6 (51.8–63.4)	14.5 18.6*		5.0 (4.5–5.5)	12.1
						237	12.7 (12.5–12.9)	24.9								69.0 (59.7–78.4)	5.4 6.9*		5.3 (4.1–6.5)	14.7
						299	12.4 (12.2–12.7)	33.1								85.7 (45.9 –125.4)	6.0 10.6*		6.6 (4.8–8.5)	14.7
						44	13.8 (13.5–14.1)	6.8								50.0 (39.3–61.2)	10.9 18.6*		5.8 (0.0–11.7)	9.3

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Table 5.3.5a Continued

FEMALES: Haemoglobin and iron status per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Hb g/dL	% With any anemia Hb <12 g/dL	% with Mild anemia: 10.0-11.9 g/dL	% with Moderate anmeia: 7.0-9.9 g/dL	% with Severe anmeia: <7.0 g/dL	% Iron depleted (Hb ≥ 12g/dL and ferritin ≤ 15ug/L	% Iron deficiency anaemia Hb ≤ 12g/dL and ferritin ≤ 15ug/L	% Iron replete Hb ≥ 12g/dL and ferritin ≥ 15ug/L	Anaemia due to other causes Hb ≤ 12g/dL and ferritin ≥ 15ug/L)	S-ferritin µg/L	% with low ferritin: < 12 µg/L (< 15 µg/ *)/)(<30 µg/L**)	% with high ferritin >150 µg/L	CRP (mg/L)	% with elevted CRP (>10 mg/L) (> 6mg/L*)
							Mean (SD/CI) / Median (SE, range) OR %													
NATIONAL SURVEYS																				
				FS KZN NW GP MP LP		142	12.7 (12.4–13.1)	23.2								59.9 (40.3–79.5)	10.6 15.4*		4.6 (2.6–6.7)	15.4
						394	12.2 (12.0–12.4)	37.6								55.5 (50.4–60.6)	12.6 15.2*		5.5 (4.4–6.5)	14.9
						166	12.9 (12.5–13.3)	17.5								50.0 (39.3–61.2)	10.9 18.6*		4.5 (3.1–5.8)	10.3
						517	12.6 (12.4–12.8)	26.5								47.1 (41.9–52.2)	19.8 24.4*		5.0 (3.8–6.2)	10.6
						133	12.4 (11.9–12.9)	33.1								42.0 (28.6–55.3)	24.8 30.1*		3.3 (2.3–4.3)	7.3
						194	12.1 (11.8–12.3)	37.6								42.6 (38.2–47.0)	27.4 32.3*		3.2 (2.3–4.0)	7.0
						964	12.6 (12.5–12.8)	26.3								55.4 (50.7–60.1)	13.7 17.8*		5.1 (4.4–5.8)	12.5
						264	12.4 (12.2–12.6)	33.7								52.9 (44.5–61.3)	18.8 22.0*		5.7 (3.9–7.5)	10.9
						165	13.0 (12.6–13.3)	18.8								70.1 (58.6–81.6)	10.9 12.5*		4.6 (3.5–5.6)	12.5
						733	12.3 (12.2–12.5)	34.2								59.7 (44.8–74.6)	14.7 19.5		4.8 (4.0–5.8)	11.9
						1228	12.6 (12.5–12.7)	27.9								54.8 (51.0–58.7)	14.9 * 18.8*		5.2 (4.5–5.9)	12.2
						898	12.4 (12.3–12.6)	31.4									15.3*		4.7 (4.1–5.4)	12.0

Table 5.3.5a Continued

FEMALES: Haemoglobin and iron status per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Hb g/dL	% With any anemia Hb <12 g/dL	% with Mild anemia: 10.0-11.9 g/dL	% with Moderate anmeia: 7.0-9.9 g/dL	% with Severe anmeia: <7.0 g/dL	% Iron depleted (Hb ≥ 12g/dL and ferritin ≤ 15ug/L	% Iron deficiency anaemia Hb ≤ 12g/dL and ferritin ≤ 15ug/L	% Iron replete Hb ≥ 12g/dL and ferritin ≥ 15ug/L	Anaemia due to other causes Hb ≤ 12g/dL and ferritin ≥ 15ug/L)	S-ferritin μg/L	% with low ferritin: < 12 μg/L (< 15 μg/ *)/)<30 μg/L **)	% with high ferritin >150 μg/L	CRP (mg/L)	% with elevted CRP (>10 mg/L) (> 6mg/L*)
							Mean (SD/CI) / Median (SE, range) OR %													
NATIONAL SURVEYS																				
SAN-HANES-1 Shisana, *et al.* 2013[7] Ferritin levels and stratification according to severty of anemia and iron depletion was only done in women of reproductive age: 16–25 yrs and 26–35 yrs *Values for this subgroup is indicated in italics*	2012	All				3299 (1359)	12.9 (12.8–13.0) 12.8 (12.7–12.9)	22.0 23.1	11.8	10.1	1.2	5.9	9.7	72.1	12.3	65.3 (56.1–74.4)				
		15–24				846	12.8 (12.7–13.0)	24.2												
		25–34				557	12.7 (12.5–12.8)	24.7												
		35–44				497	12.8 (12.6–13.0)	23.1												
		45–54				553	12.9 (12.7–13.1)	23.7												
		55–64				417	13.2 (13.0–13.4)	15.9												
		≥65				429	13.0 (12.7–13.2)	17.0												
		16–25				730	*12.9 (12.7–13.0)*	22.3	*12.0*	*9.7*	*0.6*	*6.9*	*10.5*	*72.0*	*10.7*	*56.7 (43.4-69.9)*	17.1*			
		26–35				493	*12.6 (12.5–12.8)*	24.2	*11.7*	*10.6*	*1.9*	*4.4*	*8.5*	*72.3*	*14.8*	*78.1 (67.5-88.6)*	12.7*			
			B			2260 *(953)*	12.8(12.7–12.9) *12.7 (12.6–12.8)*	23.5 *24.8*	*12.8*	*10.6*	*1.3*	*6.7*	*10.4*	*69.4*	*13.5*	*58.3 (50.9-65.7)*	16.7*			
			C			829 *(344)*	13.2 (13.1–13.4) *13.3 (13.1–13.5*	12.9 *13.2*	*4.9*	*8.2*	*0.2*	*1.3*	*5.8*	*85.7*	*13.2*	*110.0 (64.7-155.3)*	7.3*			
			W			49 *(12)*	-	-	-	-	-	-	-	-	-	-	-			
			A/I			157 *(47)*	12.8 (12.6–13.0) -	25.4 -	-	-	-	-	-	-	-	-	-			
				WC		620 *274*	13.1 (13.0–13.3) *13.1 (12.9–13.3)*	15.1 *16.1*	*7.4*	*8.8*	*0.0*	*2.6*	*5.7*	*81.5*	*10.2*	*101.9 (57.5-146.3)*	8.2*			
				EC		517 *179*	13.0 (12.8–13.2) *13.0 (12.8–13.2)*	16.9 *19.9*	*13.7*	*6.2*	*0.0*	*0.7*	*3.0*	*79.6*	*16.6*	*88.5 (74.7-102.4)*	3.9*			

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Table 5.3.5a Continued

FEMALES: Haemoglobin and iron status per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SD/CI) / Median (SE, range) OR % Hb g/dL	% With any anemia Hb <12 g/dL	% with Mild anemia: 10.0-11.9 g/dL	% with Moderate anmeia: 7.0-9.9 g/dL	% with Severe anmeia: <7.0 g/dL	% Iron depleted (Hb ≥ 12g/dL and ferritin ≤ 15ug/L	% Iron deficiency anaemia Hb ≤ 12g/dL and ferritin ≤ 15ug/L	% Iron replete Hb ≥ 12g/dL and ferritin ≥ 15ug/L	Anaemia due to other causes Hb ≤ 12g/dL and ferritin ≥ 15ug/L)	S-ferritin µg/L	% with low ferritin: < 12 µg/L (< 15 µg/ *)/) (<30 µg/L **)	% with high ferritin >150 µg/L	CRP (mg/L)	% with elevted CRP (>10 mg/L) (> 6mg/L*)
				NC		211 *83*	13.4 (13.1–13.7) -	11.7 -	-	-	-	-	-	-	-	-	-			
				FS		261 *113*	13.1 (12.9–13.4) *13.1 (12.7–13.4)*	16.8 *17.6*	*10.4*	*7.2*	*0.0*	*2.0*	*8.8*	*79.5*	*9.7*	*55.1 (45.5-64.7)*	10.0*			
				KZN		399 *152*	12.4 (12.2–12.6) *12.4 (12.1–12.7)*	33.1 *35.9*	*21.0*	*14.4*	*0.4*	-	-	-	-	*61.0 (36.0-86.1)*	17.5*			
				NWP		438 *170*	13.3 (12.9–13.6) *13.2 (12.8–13.5)*	16.8 *16.9*	*12.6*	*3.0*	*1.3*	*2.5*	*2.8*	*80.4*	*14.2*	*63.5 N (52.1-74.8)*	5.2*			
				GP		330 *160*	13.0 (12.8–13.2) *12.8 (12.6–13.1)*	20.6 *18.6*	*7.7*	*8.5*	*2.5*	*11.2*	*11.5*	*67.7*	*9.6*	*47.3N (33.8-60.7)*	22.2*			
				MP		311 *145*	12.6 (12.2–13.1) *12.5 (12.1–13.0)*	25.1 *29.5*	*14.3*	*13.8*	*1.4*	-	-	-	-	*47.5 (35.2-59.7)*	29.5*			
				LP		212 *83*	12.5 (12.2–12.7) -	30.3 -	-	-	-	-	-	-	-	-	-			
					UF	1589 *612*	13.0 (12.9–13.1) *12.9 (12.7–13.1*	19.3 *19.0*	*9.4*	*8.1*	*1.5*	*7.0*	*9.5*	*72.7*	*10.8*	*61.9 (47.4-76.4)*	16.1*			
					UI	396 *213*	12.6 (12.3–12.8) *12.5 (12.3–12.8)*	31.2 *31.5*	*17.4*	*13.7*	*0.4*	*2.4*	*14.7*	*67.2*	*15.7*	*63.4 (43.6-83.1)*	17.2*			
					RF	525 *241*	13.1 (13.0–13.3) 12.9 (12.5–13.2)	15.6 *17.9*	*5.8*	*11.0*	*1.1*	*6.1*	*6.2*	*78.4*	*9.3*	*75.5 (60.6-90.5)*	12.2*			
					RI	789 *293*	12.7 (12.5–12.9) 12.7 (12.4–12.9)	24.9 *28.2*	*15.7*	*11.6*	*0.9*	*5.4*	*8.4*	*70.8*	*15.5*	*70.1 (55.2-85.1)*	13.5*			
SADHS 2016 SA DoH, 2016[222]	2016	All				4244		30.6												
		15–24				975		33.0	24.2	8.4	0.5									
		15–19				475		34.0	24.1	9.7	0.2									
		20–24				500		32.1	24.2	7.1	0.8									
		24–34				946		33.0	24.3	8.1	0.7									
		35–44				702		33.8	24.1	8.4	1.4									

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Table 5.3.5a Continued

FEMALES: Haemoglobin and iron status per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SD/CI) / Median (SE, range) OR %: Hb g/dL	% With any anemia Hb <12 g/dL	% with Mild anemia: 10.0-11.9 g/dL	% with Moderate anmeia: 7.0-9.9 g/dL	% with Severe anmeia: <7.0 g/dL	% Iron depleted (Hb ≥ 12g/dL and ferritin ≤ 15ug/L	% Iron deficiency anaemia Hb ≤ 12g/dL and ferritin ≤ 15ug/L	% Iron replete Hb ≥ 12g/dL and ferritin ≥ 15ug/L	Anaemia due to other causes Hb ≤ 12g/dL and ferritin ≥ 15ug/L)	S-ferritin µg/L	% with low ferritin: < 12 µg/L (< 15 µg/ *)/) (<30 µg/L **)	% with high ferritin >150 µg/L	CRP (mg/L)	% with elevted CRP (>10 mg/L) (> 6mg/L*)
		45–54				588		29.0	19.4	8.6	1.0									
		55–64				497		24.9	20.5	4.3	0.2									
		≥65				536		24.9	20.5	4.1	0.3									
			B			3737		32.2	23.6	7.8	0.7									
			C			288		21.6	16.6	5.0	0.0									
			W			157		10.8	10.5	0.3	0.0									
			I/A			44		29.2	(22.3)	(7.0)	(0.0)									
				WC		421		23.9	18.6	5.3	0.0									
				EC		59		29.7	22.1	7.1	0.6									
				NC		78		25.7	21.4	4.3	0.0									
				FS		261		27.7	21.2	5.6	1.0									
				KZN		747		28.9	22.5	5.1	1.2									
				NW		342		38.3	25.8	12.6	0.0									
				GP		968		31.6	24.7	6.2	0.7									
				MP		383		38.5	22.6	14.9	1.0									
				LP		445		29.0	21.7	6.7	0.6									
					U	2584		29.8	23.0	6.2	0.5									
					R	1660		32.0	22.1	9.0	0.9									
					WQ1	935		28.5	19.9	7.6	0.9									
					WQ2	816		35.1	24.8	9.2	1.1									
					WQ3	918		32.8	23.8	8.1	0.9									
					WQ4	834		31.3	24.9	6.2	0.2									
					WQ5	741		24.9	19.7	5.1	0.1									

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Table 5.3.5a Continued

FEMALES: Haemoglobin and iron status per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SD/CI) / Median (SE, range) OR %													
							Hb g/dL	% With any anemia Hb <12 g/dL	% with Mild anemia: 10.0-11.9 g/dL	% with Moderate anmeia: 7.0-9.9 g/dL	% with Severe anmeia: <7.0 g/dL	% Iron depleted (Hb ≥ 12g/dL and ferritin ≤ 15ug/L	% Iron deficiency anaemia Hb ≤ 12g/dL and ferritin ≤ 15ug/L	% Iron replete Hb ≥ 12g/dL and ferritin ≥ 15ug/L	Anaemia due to other causes Hb ≤ 12g/dL and ferritin ≥ 15ug/L)	S-ferritin µg/L	% with low ferritin: < 12 µg/L (< 15 µg/ *)/)(<30 µg/L **)	% with high ferritin >150 µg/L	CRP (mg/L)	% with elevted CRP (>10 mg/L) (> 6mg/L*)
INTERNATIONAL STUDIES WITH A SA COMPONENT NO DATA RECORDED																				
REGIONAL SA STUDIES																				
Cape Flats Study Charlton *et al.*, 1997[175]	1993		C	WC	U	99	13.2 (1.6)	16.2								105.0	5.2*			
THUSA Study Kruger *et al.*, 2005[71]	1996 1998	15–80	B	NWP	UU	570	11.6 (0.22)	0.4								61.7 (19.5)	16.8			
					PU		12.2 (0.14)									75.5 (12.5)				
					IS		12.1 (0.17)									82.1 (14.7)				
					F	440	12.6 (0.27)	0.9								117.7 (23.2)	14.7			
					T		13.0 (0.15)									102.8 (13.1)				
Ndunakazi study Oelofse *et al.*, 1999[45]	1998	25–55	B	KZN	R (T)	127		22									19			
WC fruit factory workers Wolmarans *et al.*, 2003[40]	n/d	18–55	C	WC	R	338	13.6 (1.16)	7.7								48.0 (47.8)	27.4			16*
CT Peri Urban Study Charlton *et al.*, 2005[182] Per tertiles of added sugar	n/d	≥60	B	WC	PU	Lowest 67	12.2 (1.1)	37.7								184.7 (323.6)	7.7**			
						Mid 68	12.6 (1.1)	18.6								128.1 (117.9)	9.3**			
						Highest 70	12.8 (0.9)	16.4								219.3 (468.7)	1.7**			
Sharpeville elderly facility study: Oldewage-Theron, *et al.* 2008[62]	2004	≥60	B	GP	PU	49	13.6 (1.6)	40.8								179.3 (289.8)	4.2			

Table 5.3.5a Continued

FEMALES: Haemoglobin and iron status per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SD/CI) / Median (SE, range) OR %													
							Hb g/dL	% With any anemia Hb <12 g/dL	% with Mild anemia: 10.0-11.9 g/dL	% with Moderate anmeia: 7.0-9.9 g/dL	% with Severe anmeia: <7.0 g/dL	% Iron depleted (Hb ≥ 12g/dL and ferritin ≤ 15ug/L	% Iron deficiency anaemia Hb ≤ 12g/dL and ferritin ≤ 15ug/L	% Iron replete Hb ≥ 12g/dL and ferritin ≥ 15ug/L	Anaemia due to other causes Hb ≤ 12g/dL and ferritin ≥ 15ug/L)	S-ferritin µg/L	% with low ferritin: < 12 µg/L (< 15 µg/ *)/) (<30 µg/L **)	% with high ferritin >150 µg/L	CRP (mg/L)	% with elevted CRP (>10 mg/L) (> 6mg/L*)
INTERNATIONAL STUDIES WITH A SA COMPONENT NO DATA RECORDED																				
REGIONAL SA STUDIES																				
Sharpeville elderly facility study: Oldewage-Theron et al, 2009[77]	2007	≥60	B	GP	PU	114	13.2 (1.2)	13.2								123.4 (136.9)				
AHA-FS: Rural Jordaan et al, 2020[202]	2007	25–49	B C	FS	R	134	13.8 (13.3–14.5)	4.6								94.0 (48.5-180.0)	4.1*	31.1		
Sharpeville elderly facility study: Oldewage-Theron *et al.*, 2015[78]	2011	≥60	B	GP	PU	88	12.0 (2.8)	26.1								83.9 (67.1)	2.3			
Sharpeville elderly facility study: Jamshidi-Naeini *et al.*, 2019[189]	2004	≥60	B	GP	PU	228	13.2 (2.85)									132 (115)				
	2007					211	13.5 (1.40)									1256 (123)				
	2011					98	12.9 (2.75)									94.9 (79.3)				
	2014					69	13.4 (1.23)									-				
Vaal Area INP Acham *et al.*, 2012a[194]	2004 2019	19–90	B	GP	IS	182	13.38 (1.39)	8.0								28.03 (15.9)	29.9			
HAALSI Payne *et al.*, 2018[79]	2015	≥60	B	MP	R	2714	12.0 (1.8)	43.0		19.8	2.8								2.3 (1.2, 4.3)	
STUDIES IN SA STUDENTS																				
University of the North study Steyn *et al.* 2000[222]	1994	18	B	LP	U R	62	13.1 ± 2.4	14.5*								28.4 ±22.2	27.3*			

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Table 5.3.5b: South African females: Haematocrit and markers of iron storage and transport

FEMALES: Haematocrit and markers of iron storage and transport	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SD/CI) / Median (SE, range) OR %							
							Haematocrit (%)	% low Hematocrit < 40% (M), < 37% (F) (< 36%*)	S-Iron µmol/L	S-Iron < 9 µmol/L	TIBC µg/dL	S- Transferrin (TF) g/L	S-Transferrin Saturation (TFS) %	% With low TFS <16%
NATIONAL SURVEYS AND INTERNATIONAL STUDIES WITH A SA COMPONENT NO DATA RECORDED														
REGIONAL SA STUDIES														
Cape Flats Study Charlton *et al.*,1997[175]	1993		C	WC	U	99							40 (5)	
THUSA Study Kruger *et al.*, 2005[71]	1996 1998	15–80	B	NWP	UU	570	42.0 (0.52)	15.7			76.6 (1.37)		22.9	0
					PU		41.1 (0.33)				70.2(0.88)		21.9	
					IS		40.8 (0.39)				68.0(1.03)		24.3	
					F	440	42.2 (0.61)	10.1			67.2 (1.63)		25.5	0
					T		41.1 (0.35)				66.8 (0.92)		23.3	
Ndunakazi study Oelofse *et al.*, 1999[45]	1998	25–55	B	KZN	R (T)	127								28
WC fruit factory workers Wolmarans *et al.*, 2003[40]	n/d	18–55	C	WC	R	338	38.8 (3.1)		16.4 (7.6)		68.9 (9.7)	*24.4 (1.7)*		11.1
CT Peri Urban Study Charlton *et al.*, 2005[182] Per tertiles of added sugar	n/d	≥60	B	WC	PU	Lowest 67								
						Mid								
						68								
						Highest 70								

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Table 5.3.5b Continued

FEMALES: Haematocrit and markers of iron storage and transport	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SD/CI) / Median (SE, range) OR %							
							Haematocrit (%)	% low Hematocrit < 40% (M), < 37% (F) (< 36%*)	S-Iron µmol/L	S-Iron < 9 µmol/L	TIBC µg/dL	S- Transferrin (TF) g/L	S-Transferrin Saturation (TFS) %	% With low TFS <16%
Sharpeville elderly facility study: Oldewage-Theron, *et al.* 2008[62]	2004	≥60	B	GP	PU	49	41.7 (4.0)	30.6	15.7 (7.9)	18.4				
Sharpeville elderly facility study: Oldewage-Theron et al, 2009[77]	2007	≥60	B	GP	PU	114	40.6 (3.4)		11.4 (8.6)	7.9		*2.2 (0.9)*		
AHA-FS: Rural Jordaan et al, 2020[202]	2007	25–49	B C	FS	R	134	42.9 (40.9-44.6)	3.1						
Sharpeville elderly facility study: Oldewage-Theron *et al.*, 2015[78]	2011	≥60	B	GP	PU	88	41.7 (10.0)	11.4		12.4 (4.4)	23.9	*2.6 (0.5)*		
Sharpeville elderly facility study: Jamshidi-Naeini *et al.*, 2019[189]	2004	≥60	B	GP	PU	228								
	2007					211								
	2011					98								
	2014					69								
Vaal Area INP Acham *et al.*, 2012a[194]	2004 2019	19–90	B	GP	IS	182	40.02 (3.76)	8.0	25.4 (18.2)	16.1				
STUDIES IN SA STUDENTS														
University of the North study Steyn *et al.* 2000[222]	1994	18–90	B	LP	U R		44.5 (42.0)		13.3 (6.9)	38.5		*2.9 ± 0.6*		

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Table 5.3.6: South African adults: Haemoglobin status for males and females published as combined data

COMBINED Haemoglobin and iron status per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SD/CI) / Median (SE, range) OR % % WITH ANEMIA Hb <13 g/dL (M), < 12 g/dL (F)
EARISA Study Phatlhane *et al.*, 2016[214]	2014	18–76	B	WC	U	69	31.9
			C			221	17.2
			W			361	6.1

Table 5.3.7: South African males: Iodine status

MALES Iodine analysis per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SD/CI) / Median (SE, range) OR %		
							Urinary Iodine (UI) µg/L	**% with moderate to severe deficiency UI < 50 µg/L**	**% with low levels of UI < 100 µg/L)**
THUSA Study Kruger *et al.*, 2005[71]	1996 1998	15–80	B	NWP	U	131	161.0		
					R	171	93.0		
WHO-SAGE Wave 2 Charlton, *et al.* 2018[80]	2015	≥ 18	BWC IA	All	U R	109	149 (124)	12.8	34.9

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Table 5.3.8: South African females: Iodine status

FEMALES Iodine analysis per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SD/CI) / Median (SE, range) OR %						
							24-h Urinary Iodine (UI) μg/L	**% with Severe deficiency <20 μg/L**	**% with Moderate deficiency 20 ≤ to < 50 μg/L**	**% with Mild deficiency ≥ 50 to <100 μg/L**	**% with Adequate status 100-<200 μg/L**	**% with More than adequate status 200-<300 μg/L**	**% with Excessive intake >300 μg/L**
NATIONAL SURVEYS													
NFCS-FB Department of Health, 2007[3]	2005	16–35	B	WP		230	181.1 (97.1 –261.3)	1.3	4.3	20.0	30.0	24.3	20.0
			W	EC		300	226.5 (102.2-399.1)	3.3	8.3	12.7	21.7	17.0	37.0
			C	NC		24	488.2 (347.3 -728.7)	0.0	0.0	0.0	4.2	12.5	83.3
			I/A	FS		151	220.2 (126.5-382.1)	0.7	3.3	14.6	26.5	20.5	34.4
				KZN		407	210.1 (110.7 -329.0)	1.7	4.9	14.0	27.3	22.6	29.5
				NWP		176	148.3 (81.0 -242.7)	5.7	9.1	18.8	31.3	19.3	15.9
				GP		514	142.4 (81.7 -238.5)	1.4	9.5	22.4	34.0	16.3	16.3
				MP		186	157.8 (90.8 -259.1)	1.6	4.8	21.5	34.4	21.5	16.1
				LP		249	175.3 (84.8 -266.1)	4.0	9.2	16.5	26.5	23.7	20.1
				All		2237	176.8 (94.7 -296.5)	2.3	7.0	17.5	28.9	20.1	24.2
INTERNATIONAL STUDIES WITH A SA COMPONENT													
	2015	≥ 18	BW C I/A	All	U	348	121 (131) (16.1 < 50 μg/L)	41.0					
REGIONAL SA STUDIES NO DATA REPORTED													
STUDIES IN SA STUDENTS NO DATA REPORTED													

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Table 5.3.9: South African males: Iodine Status reported for males and females published as combined data

COMBINED Iodine analysis per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SD/CI) / Median (SE, range) OR %: Urinary Iodine (UI) µg/L	% with moderate to severe deficiency UI < 50 µg/L	% with low levels of UI < 100 µg/L)
THUSA Study Kruger *et al.*, 2005[71]	1996 1998	15–80	B	NWP	All	302		21	
					U	131	161.0		
					R	171	93.0		

Table 5.3.10: South African males: Folate and vitamin B_{12} status

MALE Folate and Vitamin B_{12}, status per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SD/CI) / Median (SE, range) OR %: S-Folic acid ng/mL	% With Low S-folic acid <3 ng/mL	RBC-folic acid ng/mL	% With Low RBC-folic acid <111.6 ng/mL	S-Vit B12 pg/mL	% With Low S-Vit B12 < 200 pg/mL OR * <150 pg/mL
Cape Flats study Charlton *et al.*, 1997[175]	1993	≥65	C	WP	U	88	5.0 (2.5)		261 (110)		449 (204)	
Cape Town peri-urban study Charlton, *et al.*, 2007[41]	n/d	≥65	B	WP	PU	48		12.2				11.9
Sharpeville elderly facility study Oldewage-Theron, *et al.* 2008[62]	2004	≥60	B	GP	PU	18	13.6 (5.4)	0.0			332.3 (120.2)	5.6*

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Table 5.3.11: South African females: Folate and vitamin B12 status

FEMALE Folate and Vitamin B_{12}, status per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SD/CI) / Median (SE, range) OR %					
							S-Folic acid ng/mL	% With Low S-folic acid <3 ng/mL	RBC-folic acid ng/mL	% With Low RBC-folic acid <111.6 ng/mL	S-Vit B12 pg/mL	% With Low S-Vit B12 < 200 pg/mL OR * <150 pg/mL
NFCS-FB Department of Health, 2007[3]	2005	16–35	B	WP		193	*10.25*	0.6	475.64	-		
			W	EC		261	*11.44*	0.8	440.44	-		
			C	NC		46	*19.70*	-	618.2	-		
			I/A	FS		122	*12.10*	-	535.48	-		
				KZN		392	*13.51*	0.3	473.88	0.3		
				NW		99	*11.31*	-	535.92	1.0		
				GP		493	*15.75*	-	777.04	-		
				MP		130	*15.84*	-	666.6	-		
				LP		142	*18.61*	-	633.16	-		
					UF	889	*13.64*	0.1	622.16	0.1		
					UI	232	*14.78*	-	648.12	0.4		
					RF	146	*14.21*	-	572.00	-		
					T	602	*13.99*	0.2	508.20	0.5		
					U	889	*13.90*	0.1	627.44	0.1		
					R	748	*14.01*	0.1	520.96	-		
Cape Flats study Charlton *et al.*, 1997[175]	1993	≥65	C	WP	U	99	*6.0 (4.0)*		313 (160)		458 (233)	
Ndunakazi study Oelofse *et al.*, 1999[45]	1998	25–55	B	KZN	T	127		8*				11
Cape Town peri-urban study Charlton, *et al.*, 2007[41]	n/d	≥65	B	WP	PU	218		19.8*				11.1*

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Table 5.3.11 Continued

FEMALE Folate and Vitamin B_{12}, status per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SD/CI) / Median (SE, range) OR %					
							S-Folic acid ng/mL	**% With Low S-folic acid <3 ng/mL**	**RBC-folic acid ng/mL**	**% With Low RBC-folic acid <111.6 ng/mL**	**S-Vit B12 pg/mL**	**% With Low S-Vit B12 < 200 pg/mL OR * <150 pg/mL**
Sharpeville elderly facility study Oldewage-Theron, *et al.* 2008[62]	2004	≥60	B	GP	PU	49	*15.0 (6.9)*	0.0*			333.3 (141.0)	2.1*

nmol/L was converted to ng/mL for ease of camparison in this review

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Table 5.3.12: South African males: 25(OH) vitamin D_3 status

MALE Vitamin D status per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SD/CI) / Median (SE, range) OR %						
							Serum 25(OH) Vit D3 (ng/mL)	**% with 25(OH) Vit D3 <12 ng/mL (<10 ng/mL)***	**% with 25(OH) Vit D3 12 - 20 ng/mL**	**% with 25(OH) Vit D3 (<20 ng/mL)**	**% with 25(OH) Vit D3 >20 ng/mL**	**Serum PTH (ng/mL)**	**% with Elevated PTH (>65 pg/mL)**
NATIONAL SURVEYS, INTERNATIONAL STUDIES WITH A SA COMPONENT NO DATA RECORDED													
REGIONAL SA STUDIES													
Cape Flats study Charlton *et al.*, 1998[84]	1993	≥65	C	WP	U	96		19.3*					
AHA FS Lategan *et al.*, 2016[83]	2008 2009	25–64	B	FS	PU	76	43.5 ± 11.8						
Bt20 caregivers study George *et al.*, 2013[85]	2011 2012	18–79	B	FS	PU	181	72.7 (51.1, 94.1)					*43.0 (30.0, 56.0)*	
			I/A	GP	U	161	46.8 (33.6, 62.7)					*46.0 (36.0, 64.0)*	
STUDIES ON SA STUDENTS													
University of Stellenbosch study Winter baseline Visser *et al.*, 2019[86]	2016	n/d	All	All	All	121	58.6 (43.7)						

nmol/L was converted to ng/mL for ease of camparison in this review

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Table 5.3.13: South African females: 25(OH) vitamin D3 status

FEMALE Vitamin D status per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SD/CI) / Median (SE, range) OR %						
							Serum 25(OH) Vit D3 (ng/mL)	**% with 25(OH) Vit D3 <12 ng/mL (<10 ng/mL)***	**% with 25(OH) Vit D3 12 - 20 ng/mL**	**% with 25(OH) Vit D3 (<20 ng/mL)**	**% with 25(OH) Vit D3 >20 ng/mL**	**Serum PTH (ng/mL)**	**% with Elevated PTH (>65 pg/mL)**
PURE-NWP Sotunde *et al.*,2015[156]	2005	≥35	B	NWP	U	209			n/d	32 (15.9)	49 (24.4)		37 (17.7)
PURE-NWP Wright *et al.*, 2019[160]	2010	≥35	B	NWP	U	132	35.6 (27.4–46.4)	n/d				41.4 (29.1–55.6)	
	2012	≥65	C	WP	U		30.7 (23.1–36.8)	n/d				45.8 (35.5–63.3)	
Cape Flats study Charlton *et al.*, 1998[84]	1993	≥65	C	WP	U	104		15.6*					
AHA FS Lategan *et al.*, 2016[83]	2008 2009	25–64	B	FS	PU	263	37.0 ± 10.6						
Bt20 caregivers study George *et al.*, 2013[85]	2011 2012	18–79	B	GP	U	192	58.3 (42.9, 85.6)					*53.0 (38.0, 590)*	
			I/A			183	5.7 (23.0, 54.5)					*50.0 (37.0, 72.0)*	
University of Stellenbob-osch study Winter baseline Visser *et al.*, 2019[86]	2016	n/d	All	All	All	121	58.6 (43.7)						

nmol/L was converted to ng/mL for ease of camparison in this review

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Table 5.3.14: South African adults: 25(OH) vitamin D3 status for males and females published as combined data

FEMALE Vitamin D status per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SD/CI) / Median (SE, range) OR %						
							Serum 25(OH) Vit D3 (ng/mL)	**% with 25(OH) Vit D3 <12 ng/mL (<10 ng/mL)***	**% with 25(OH) Vit D3 12 - 20 ng/mL**	**% with 25(OH) Vit D3 (<20 ng/mL)**	**% with 25(OH) Vit D3 >20 ng/mL**	**Serum PTH (ng/mL)**	**% with Elevated PTH (>65 pg/mL)**
METS Study Durazo-Arvizu *et al.*, 2014[34]	2010 2011	25–45	B	WC	U	502	23.2 (8.1)	6.6	28.5	35.1	65.9		

Table 5.3.15: South African males: Vitamin E, vitamin C and zinc status

MALE Vitamin E, vitamin C, and zinc status per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SD/95% CI) / Median (SE, range) "OR" %				
							Vit E mg/dL	**% With deficient Vit E <1.2 mg/dL**	**% With deficient Vit C < 0.6 mg/dL**	**Zn µg/dL**	**% with 25(OH) Vit D3 >20 ng/mL**
REGIONAL SA STUDIES											
Cape Town peri-urban study Charlton, *et al.*, 2007[41]	n/d	≥65	B	WP	PU	48			84		
Sharpeville elderly facility study Oldewage-Theron, *et al.* 2008[62]	2004	≥60	B	GP	PU	18				62.4 (11.7)	83.3
Sharpeville elderly facility study Oldewage-Theron *et al.*, 2010[72]	2004	≥60	B	GP	PU	170	2.01 (1.11)	20.5			

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Table 5.3.16: South African females: Vitamin E, vitamin C and zinc status

FEMALE Vitamin E, vitamin C, and zinc status per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SD/CI) / Median (SE, range) OR %				
							Vit E mg/dL	**% With deficient Vit E <1.2 mg/dL**	**% With deficient Vit C < 0.6 mg/dL**	**Zn µg/dL**	**% with 25(OH) Vit D3 >20 ng/mL**
REGIONAL SA STUDIES											
Cape Town peri-urban study Charlton, *et al.*, 2007[41]	n/d	≥65	B	WP	PU	218			62		
Sharpeville elderly facility study Oldewage-Theron, *et al.* 2008[62]	2004	≥60	B	GP	PU	49				65.8 (7.9)	69.4
Sharpeville elderly facility study Oldewage-Theron *et al.*, 2010[72]	2004	≥60	B	GP	PU	169	2.07 (1.12)	20.9			

Table 5.3.17: South African adults: Vitamin E, vitamin C and zinc status for males and females published as combined data

COMBINED Vitamin E, vitamin C, and zinc status per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SD/CI) / Median (SE, range) OR %		
							Vit E mg/dL	**Vit C mg/dL**	**Zn µg/dL**
REGIONAL SA STUDIES									
Cape Flats study Charlton *et al.*, 1998[175]	1993	≥65	C	WP	U	187			61.8 (8.5)
Colon cancer in Africans study O'Keefe *et al.*, 1999[73]	n/d	Middle-aged	B	EC KZN MP	U PU R	57	0.15 (0.04)	0.15 (0.04)	
			W			25	2.0 (0.28)	2.0 (0.28)	

Table 5.3.18: South African males: Lipid profiles

MALE Lipid Profiles per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Total Serum Cholesterol		Serum LDL		Serum HDL		Serum TAG	
							Total S-Cholesterol mmol/L	% High > 5 (> 5.2*) (>5.18**) mmol/L	S-LDL mmol/L	% High > 3 mmol/L	S-HDL mmol/L	% Low < 1.2 (<1.03 *) (<1.0**) (<0.9***)	S-TAG mmol/L	% High > 1.7 (>2.3)* (>1.5**) mmol/L
NATIONAL SURVEYS														
SANHANES-1 Shisana, *et al.* 2013[7]	2012	All				1950	4.21 (4.13–4.29)	19.2	2.44 (2.35–2.54)	52.8	1.22 (1.18–1.25)	*21.4*	1.44 (1.37–1.52)	28.5
		15–24				579	3.58 (3.50–3.66)	2.9	2.00 (1.90–2.09)	47.6	1.21 (1.17–1.25)	*3.8*	0.97 (0.88–1.06)	7.9
		25–34				291	4.10 (3.98–4.22)	8.9	2.28 (2.16–2.41)	59.6	1.19 (1.08–1.30)	15.7	1.36 (1.19–1.54)	28.5
		35–44				264	4.33 (4.16–4.50)	23.6	2.47 (2.27–2.66)	55.8	1.22 (1.14–1.30)	23.2	1.56 (1.38–1.74)	32.5
		45–54				295	4.84 (4.63–5.05)	36.7	2.76 (2.47–3.06)	55.9	1.24 (1.16–1.31)	28.9	1.88 (1.72–2.03)	51.8
		55–64				272	4.57 (4.37–4.78)	30.3	2.83 (2.52–3.14)	48.0	1.24 (1.17–1.31)	35.1	1.78 (1.56–2.00)	37.3
		≥65				249	4.55 (4.37–4.74)	34.1	2.66 (2.46–2.86)	54.5	1.22 (1.14–1.30)	36.1	1.67 (1.50–1.85)	35.1
			B			1 325	4.09 (4.00–4.19)	15.3	2.28 (2.20–2.36)	15.0	1.21 (1.17–1.25)	53.3	1.37 (1.29–1.46)	25.1
			C			493	4.49 (4.28–4.71)	27.2	2.58 (2.37–2.80)	24.8	1.27 (1.22–1.33)	49.8	1.53 (1.35–1.70	35.2
			W			58	-	-	-	-	-	-	-	-
			A/I			101	5.11 (4.84–5.37)	41.2	3.15 (2.30–4.00)	-	1.08 (1.03–1.14)	-	2.10 (1.65–2.55)	45.5
				WP		363	4.68 (4.41–4.94)	34.8	2.75 (2.51–2.98)	32.1	1.31 (1.25–1.37)	49.1	1.55 (1.37–1.72)	35.5
				EC		326	4.17 (3.99–4.34)	20.8	2.30 (2.18–2.43)	16.3	1.26 (1.19–1.34)	49.4	1.28 (1.17–1.40)	20.5
				NC		133	4.23 (3.89–4.58)	15.4	2.31 (2.03–2.60)	9.1	1.23 (1.11–1.34)	53.0	1.62 (1.20–2.03)	43.7
				FS		185	4.27 (4.04–4.50)	20.3	2.43 (2.22–2.63)	23.9	1.24 (1.18–1.31)	44.5	1.44 (1.24–1.64)	22.5
				KZN		267	4.12 (3.92–4.33)	18.7	-	-	1.11 (1.05–1.17)	62.4	1.40 (1.23–1.58)	27.5
				NW		237	4.08 (3.88–4.29)	17.5	2.20 (2.08–2.33)	14.1	1.31 (1.22–1.39)	46.7	1.20 (1.09–1.32)	17.8
				GP		201	4.24 (4.07–4.41)	14.7	-	-	1.22 (1.13–1.31)	50.9	1.56 (1.40–1.72)	34.6
				MP		164	4.03 (3.72–4.34)	14.6	-	-	1.25 (1.18–1.32)	44.3	1.25 (1.12–1.38)	18.8
				LP		103	3.78 (3.54–4.03)	10.9	-	-*	1.16 (1.07–1.25)	62.6	1.40 (1.12–1.67)	21.7
					UF	967	4.37 (4.24–4.49)	21.2	2.65 (2.49–2.81)	28.3	1.21 (1.16–1.26)	52.8	1.57 (1.46–1.67)	34.8
					UI	203	3.90 (3.67–4.14)	13.1	2.21 (2.05–2.37)	11.6	1.22 (1.12–1.31)	50.1	1.04 (0.95–1.14)	14.2
					RF	371	4.20 (4.05–4.34)	19.5	2.26 (2.14–2.38)	15.4	1.29 (1.22–1.37)	43.2	1.37 (1.22–1.51)	21.4
					RI	434	3.99 (3.86–4.12)	15.7	2.18 (2.06–2.31)	13.2	1.22 (1.16–1.27)	56.1	1.33 (1.20–1.46)	22.1

Table 5.3.18 Continued

MALE Lipid Profiles per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	**Total Serum Cholesterol**		**Serum LDL**		**Serum HDL**		**Serum TAG**	
							Total S-Cholesterol mmol/L	**% High > 5 (> 5.2*) (>5.18**) mmol/L**	**S-LDL mmol/L**	**% High > 3 mmol/L**	**S-HDL mmol/L**	**% Low < 1.2 (<1.03 *) (<1.0**) (<0.9***)**	**S-TAG mmol/L**	**% High > 1.7 (>2.3)* (>1.5**) mmol/L**
INTERNATIONAL STUDIES WITH A SA COMPONENT														
PURE-NW SA Dolman *et al.*, 2013[105]	2005	35–70	B	NWP	U	328	4.89 (1.20,1.40)		3.12 (1.09,1.28)		1.52 (1.13,2.05)		1.00 (0.79,1.46)	
					R	314	4.72 (1.24,1.45)		2.96 (1.10,1.29)		1.41 (1.02,1.95)		0.96 (0.75,1.34)	
PURE-NW SA Voster *et al.*, 2014[154]	2005	35–70	B	NWP	U	205					1.68 (1.59,1.78)			
					R	203					1.55 (1.47,1.64)			
	2010				U	205					1.58 (1.48, 1.69)			
					R	203					1.40 (1.33, 1.48)			
PURE-NW SA Richter *et al.* 2014[33]	2005	35–70	B	NW	U	376	4.68 (3.84–5.71)		2.86 (2.17–3.73)		1.50 (1.12–2.04)		1.00 (0.78–1.46)	
					R	335	4.50 (3.81–5.53)		2.85 (2. 9–3.62)		1.45 (1.02–1.94)		0.97 (0.76–1.35)	
REGIONAL SA STUDIES														
Mamre study Steyn *et al.*, 2004[31]	1996	All 15+	C	WC	PU	430	5.2 (1.2	52.8	3.3 (1.1)		1.3 (0.5)	15.8***	1.2 (0.9)	10.9*
		15–24				128	4.5 (0.9)	25.0	2.7 (0.8)		1.4 (0.4)	7.0***	0.9 (0.5)	2.3*
		25–34				93	5.2 (1.2)	55.9	3.3 (1.2)		1.3 (0.4)	12.9***	1.3 (1.0)	11.8*
		35–44				82	5.7 (1.1)	72.0	3.6 (1.1)		1.5 (0.6)	18.3***	1.4 (1.0)	14.6*
		45–54				69	5.6 (1.1)	71.0	3.6 (1.1)		1.3 (0.6)	26.1***	1.6 (1.0)	24.6*
		55–64				32	5.5 (1.1)	62.5	3.8 (1.1)		1.2 (0.4)	25.0***	1.2 (0.6)	6.3*
		65+				26	5.4 (1.1)	57.7	3.6 (1.0)		1.3 (0.4)	23.1***	1.1 (0.6)	7.7*
West Coast villages elderly study Charlton *et al.*, 2001[39]	2001	≥55	C	WC	R	42	5.4 (.12)							
Dikgale HDSS Alberts *et al.*, 2005[50]	n/d 2000s	All 30+	B	LP	R	498	4.5 (1.0)	25.8	2.7 (1.0)	29.1	1.2 (0.2)	42.5	1.3 (0.8)	25.5**
		30–34				59	4.2 (1.1)	20.6	2.5 (1.0)	25.8	1.2 (0.3)	35.5	1.0 (0.6)	11.8**
		35–44				87	4.4 (0.8)	20.0	2.5 (0.7)	25.0	1.2 (0.2)	41.5	1.3 (0.9)	23.2**
		45–54				101	4.5 (0.9)	26.2	2.7 (0.8)	30.4	1.2 (0.2)	45.8	1.4 (1.0)	27.0**
		55–64				117	4.7 (1.0)	31.7	2.8 (1.0)	31.3	1.2 (0.2)	44.6	1.5 (0.9)	31.0**
		65+				134	4.5 (1.1)	25.5	2.7 (1.1)	30.1	1.2 (0.2)	41.4	1.4 (0.7)	26.1**

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Table 5.3.18 Continued

MALE Lipid Profiles per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	**Total Serum Cholesterol**		**Serum LDL**		**Serum HDL**		**Serum TAG**	
							Total S-Cholesterol mmol/L	**% High > 5 (> 5.2*) (>5.18**) mmol/L**	**S-LDL mmol/L**	**% High > 3 mmol/L**	**S-HDL mmol/L**	**% Low < 1.2 (<1.03 *) (<1.0**) (<0.9***)**	**S-TAG mmol/L**	**% High > 1.7 (>2.3)* (>1.5**) mmol/L**
THUSA Study Kruger *et al.*, 2005[71]	1996 1998	15–80 HIV +	B	NWP	UU	4	4.44 (3.59-5.29)		2.88 (2.08-3.69)		1.10 (0.73-1.48)		-	
					PU	50	3.85 (3.61-4.06)		2.31 (2.08-2.53)		1.17 1.06-1.27)		1.08 (0.95-1.21)	
					IS	14	3.44 (2.98-3.89)		2.11 (1.68-2.54)		0.98 (0.78-1.18)		0.83 (0.61-1.03)	
					F	8	3.65 (3.05-4.24)		2.10 (1.54-2.67)		1.19 (0.93-1.46)		1.15 (0.58-1.71)	
					R	14	3.57 (3.12-4.02)		2.17 (1.74-2.60)		1.11 (0.91-1.31)		0.81 (0.53-1.09)	
		15–80 HIV -			UU	54	4.79 (3.96-4.10		3.10 (2.85-3.35)		1.23 (1.12-1.34)		1.38 (0.88-1.88)	
					PU	171	4.00 (4.54-5.04)		2.37 (2.23-2.51)		1.22 (1.16-1.28)		1.90 (1.04-1.33)	
					IS	115	3.88 (3.86-4.14)		2.22 (2.05-2.39)		1.23 (1.15-1.30)		1.10 (0.90-1.26)	
					F	104	4.07 (3.71-4.05)		2.45 2.27-2.63)		1.18 (1.10-1.25)		1.02 (0.75-1.28)	
					R	176	3.91 (3.89-4.24)		2.33 (2.19-2.47)		1.22 (1.16-1.28)		1.02 (0.85-1.18)	
CT Peri Urban Study Charlton *et al.*, 2005[182] Per tertiles of added sugar	n/d	≥60	B	WC	PU	Low-est	5.2 (1.3)	50.0						
						Mid	4.4 (1.1)	25.0						
						High-est	4.2 (0.93)	13.3						
Ubombo study Motala *et al.*, 2011[47]	2005	≥15	B	KZN	R	189	4.0 (1.0)		2.2 (1.0)		1.24 (0.44)		1.1 (0.7)	
Sharpeville elderly facility study Oldewagen-Theron *et al.*, 2018[188]	2004 2014	≥60	B	GP	PU	16			1.93 (1.57)		0.89 (0.43)		1.70 (0.77)	
									3.17 (0.91)		0.64 (0.35)		1.60 (0.91)	

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Table 5.3.18 Continued

MALE Lipid Profiles per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	**Total Serum Cholesterol**		**Serum LDL**		**Serum HDL**		**Serum TAG**	
							Total S-Cholesterol mmol/L	**% High > 5 (> 5.2*) (>5.18**) mmol/L**	**S-LDL mmol/L**	**% High > 3 mmol/L**	**S-HDL mmol/L**	**% Low < 1.2 (<1.03 *) (<1.0**) (<0.9***)**	**S-TAG mmol/L**	**% High > 1.7 (>2.3)* (>1.5**) mmol/L**
Phoenix Lifestyle Project Prakaschandra *et al.*, 2016[48]	2007 2008	All 15+	I	KZN	U	377	5.4 (1.2)	57.8	3.35 (1.1)	16.4	1.21 (0.33)	30.1*	1.8 (1.1)	45.1
		15–24				54	4.4 (1.2)		2.71 (0.9)		1.25 (0.35)		1.1 (0.6)	
		25–34				60	5.3 (0.9)		3.35 (0.9)		1.22 (0.37)		1.8 (1.0)	
		35–44				68	5.6 (1.0)		3.67 (1.2)		1.24 (0.88)		1.8 (1.0)	
		45–54				81	5.7 (1.2)		3.55 (1.0)		1.17 (0.25)		2.1 (1.1)	
		55–64				114	5.5 (1.2)		3.31 (1.1)		1.25 (0.33)		2.0 (1.3)	
AHA-FS: Rural Van Zyl *et al.*, 201259 Gaziano *et al.*, 2013[199]	2007	25–64	B C	FS	PU	98) 166)	4.2	11.5**		27.4		38.5**		18.8
	2009				R		4.9	36.1**		60.0		39.3**		31.0
Aggregate of PURE NW and AHA-FS Studies Kruger *et al.*, 2017[158]	2005 2010	25–65	B	NW FS	PU U R	721	4.76 (1.23)				1.45 (0.66)	20.0**	1.09 (0.84)	12.1
Stanger Study Naicker *et al.*, 2015[210]	2008	35–55	I	KZN	U	111		63.0*						
Dikgale HDSS Mashinya *et al.*, 2018[54]	2011 2012	15–24	B	LP	R (T) U	525		15.6						11.1
		25–34						44.4						37.9
		35–44						7.1						21.4
		45–54						21.7						21.7
		55–64						14.6						29.3
		≥65						48.2						40.8

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Table 5.3.18 Continued

MALE Lipid Profiles per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	**Total Serum Cholesterol**		**Serum LDL**		**Serum HDL**		**Serum TAG**	
							Total S-Cholesterol mmol/L	**% High > 5 (> 5.2*) (>5.18**) mmol/L**	**S-LDL mmol/L**	**% High > 3 mmol/L**	**S-HDL mmol/L**	**% Low < 1.2 (<1.03 *) (<1.0**) (<0.9***)**	**S-TAG mmol/L**	**% High > 1.7 (>2.3)* (>1.5**) mmol/L**
Discovery Vitality members study: Lambert, *et al.*, 2013[210] (finger prick test)	2012	≥18	All	SA cities	U	635	4.8 (1.1)							
ELS Sekgala *et al.*, 2018[97]	2015	18–30	B	LP	R (T)		4.03 (0.92)		2.62 (0.78)		1.20 (0.37)		1.06 (0.65)	
		18–24				103	4.02 (0.87)		2.61 ((0.71)		1.23 (0.34)		0.96 (0.60)	
		25–30				203	4.04 (0.95)		2.63 (0.81)		1.19 (0.39)		1.11 (0.67)	
STUDIES IN SA STUDENTS														
University of Stellenbosch Smith and Essop, 2009[87]	n/d	n/d	n/d	WC	n/d	88	4.4 (0.6)						1.85 (1.62)	

Lipid values expressed in mg/dL were converted to mmol/L for this review

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Table 5.3.19: South African females: Lipid profiles

FEMALE Lipid Profiles per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	**Total Serum Cholesterol**		**Serum LDL**		**Serum HDL**		**Serum TAG**	
							Total S-Cholesterol mmol/L	**% High > 5 (> 5.2*) (>5.18**) mmol/L**	**S-LDL mmol/L**	**% High > 3 mmol/L**	**S-HDL mmol/L**	**% Low < 1.2 (<1.03 *) (<1.0**) (<0.9***)**	**S-TAG mmol/L**	**% High > 1.7 (>2.3)* (>1.5**) mmol/L**
NATIONAL SURVEYS														
SAN-HANES-1 Shisana, *et al.* 2013[7]	2012	All				3427	3.95 (3.87–4.04)	28.3	2.30 (2.23–2.38)	34.7	1.28 (1.24–1.33)	*43.9*	0.83 (0.79–0.87)	21.3
		15–24				875	4.46 (4.29–4.63)	18.0	2.60 (2.49–2.71)	21.7	1.28 (1.21–1.36)	*49.6*	1.14 (1.06–1.22)	17.0
		25–34				513	4.20 (4.09–4.32)	22.2	2.54 (2.43–2.66)	25.3	1.22 (1.18–1.27)	46.7	1.10 (1.03–1.18)	14.4
		35–44				583	4.88 (4.76–5.00)	38.2	3.05 2.93–3.17)	48.0	1.27 (1.22–1.32)	43.8	1.57 (1.47–1.66)	32.3
		45–54				585	5.07 (4.92–5.22)	50.3	3.08 (2.88–3.27)	53.4	1.30 (1.24–1.36)	38.0	1.64 (1.52–1.76)	36.2
		55–64				433	5.17 (5.02–5.32)	50.3	3.18 (3.02–3.35)	50.7	1.32 (1.26–1.39)	39.0	1.70 (1.58–1.82)	39.2
		≥65				438	4.53 (4.47–4.60)	28.3	2.76 (2.70–2.83)	34.7	1.28 (1.25–1.30)	43.9	1.26 (1.22–1.31)	21.3
			B			2394	4.43 (4.36–4.49)	24.9	2.64 (2.58–2.71)	29.5	1.26 (1.24–1.29)	45.4	1.21 (1.17–1.26)	19.4
			C			866	4.91 (4.78–5.04)	40.6	3.02 (2.89–3.15)	44.3	1.33 (1.29–1.37)	40.1	1.37 (1.29–1.46)	24.5
			W			55	-	-	-	-	-	-	-	-
			A/I			174	5.08 (4.81–5.35)	45.3	2.75 (1.78–3.71)	-	1.20 (1.11–1.29)	47.6	1.96 (1.61–2.31)	45.9
				WP		624	4.84 (4.67–5.01)	39.3	2.96 (2.82–3.10)	43.6	1.33 (1.28–1.38)	38.8	1.31 (1.22–1.40)	20.5
				EC		528	4.55 (4.42–4.69)	30.8	2.65 (2.53–2.76)	28.9	1.23 (1.18–1.28)	51.2	1.35 (1.24–1.46)	24.9
				NC		234	4.66 (4.38–4.94)	32.4	2.71 (2.47–2.94)	35.0	1.32 (1.25–1.38)	44.2	1.48 (1.29–1.66)	31.4
				FS		278	4.52 4.39–4.65)	29.0	2.67 (2.57–2.78)	28.3	1.32 (1.25–1.38)	47.3	1.23 (1.15–1.30)	17.0
				KZN		447	4.47 (4.30–4.63)	22.9	-	-	1.13 (1.08–1.17)	55.9	1.33 (1.21–1.46)	25.4
				NW		472	4.75 (4.54–4.96)	38.2	2.73 (2.59–2.87)	35.1	1.37 (1.30–1.44)	39.3	1.34 (1.20–1.47)	27.0
				GP		359	4.52 (4.40–4.63)	27.1	-	-	1.36 (1.31–1.42)	35.6	1.21 (1.11–1.31)	19.6
				MP		310	4.32 (4.17–4.47)	22.9	-	-	1.28 (1.21–1.35)	34.4	1.16 (1.04–1.27)	14.9
				LP		220	4.16 (3.99–4.33)	15.9	-	-	1.21 (1.16–1.27)	48.0	1.10 (0.94–1.26)	15.1
					UF	1 696	4.69 (4.60–4.78)	33.5	2.90 2.80–3.01)	39.6	1.32 (1.28–1.35)	47.7	1.30 {1.24–1.37)	22.5
					UI	408	4.21 (4.10–4.31)	16.5	2.56 (2.47–2.66)	26.3	1.24 (1.19–1.29)	41.3	1.11 (1.01–1.22)	13.7
					RF	557	4.49 (4.36–4.61)	27.7	2.63 (2.51–2.75)	27.9	1.30 (1.24–1.36)	51.3	1.26 (1.18–1.35)	22.3
					RI	822	4.38 (4.27–4.50)	23.4	2.63 (2.53–2.74)	30.9	1.21 (1.17–1.25)	44.1	1.25(1.18–1.32)	21.6

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Table 5.3.19 Continued

FEMALE Lipid Profiles per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	**Total Serum Cholesterol**		**Serum LDL**		**Serum HDL**		**Serum TAG**	
							Total S-Cholesterol mmol/L	**% High > 5 (> 5.2*) (>5.18**) mmol/L**	**S-LDL mmol/L**	**% High > 3 mmol/L**	**S-HDL mmol/L**	**% Low < 1.2 (<1.03 *) (<1.0**) (<0.9***)**	**S-TAG mmol/L**	**% High > 1.7 (>2.3)* (>1.5**) mmol/L**
INTERNATIONAL STUDIES WITH A SA COMPONENT														
PURE-NW SA Dolman *et al.*, 2013[105]	2005	35–70	B	NWP	U	480	5.22 (1.33, 151)		3.46 (1.13, 1.28)		1.36 (1.01, 1.78)		1.21 (0.89, 1.79)	
					R	588	5.12 (1.30, 1.45)		3.36 (1.17, 1.31)		1.41 (1.09, 1.85)		1.10 (0.82, 1.49)	
PURE-NW SA Voster *et al.*, 2014[154]	2005	35–70	B	NWP	U	366					1.50 (1.43, 1.57)			
					R	459					1.48 (1.43, 1.54)			
	2010				U	366					1.44 (1.38, 1.50)			
					R	495					1.34 (1.29, 1.39)			
REGIONAL SA STUDIES														
Mamre study Steyn *et al.*, 2004[31]	1996	All 15+	C	WC	PU	546	5.3 (1.2)	55.2	3.5 (1.1)		1.3(0.4)	13.8**	1.0 (0.5)	2.8*
		15–24				140	4.5 (0.8)	25.2	2.8 (0.7)		1.3(0.3)	11.5**	0.7 (0.4)	0.0*
		25–34				112	4.7 (0.8)	35.7	3.1 (0.8)		1.2(0.3)	20.5**	0.8 (0.4)	1.8*
		35–44				105	5.3 (1.0)	63.8	3.5 (1.0)		1.3(0.5)	10.5**	1.0 (0.4)	1.9*
		45–54				90	6.0 (1.1)	77.8	4.1 (1.1)		1.4(0.4)	12.2**	1.2 (0.6)	5.6*
		55–64				63	6.5 (1.3)	88.9	4.6 (1.1)		1.3(0.3)	14.3**	1.3 (0.6)	7.9*
		65+				36	6.3 (1.0)	91.7	4.4 (1.0)		1.3(0.4)	13.9**	1.2 (0.4)	2.3*
Dikgale HDSS Alberts *et al.*, 2005[50]	n/d 2000s	All 30+	B	LP	R	1096	4.7 (1.1)	32.4	2.9 (1.0)	44.5	1.2 (0.2)	36.9	1.2 (0.7)	20.1**
		30–34				155	4.1 (1.0)	16.0	2.6 (0.9)	30.8	1.2 (0.2)	37.0	0.9 (0.4)	6.8**
		35–44				342	4.4 (1.0)	20.5	2.8 (1.0)	38.8	1.2 (0.2)	35.0	1.0 (0.6)	8.5**
		45–54				323	4.6 (1.1)	32.2	2.9 (1.0)	42.5	1.2 (0.2)	37.7	1.2 (0.6)	19.1**
		55–64				375	4.9 (1.2)	39.1	3.1 (1.1)	49.1	1.2 (0.2)	45.6	1.3 (0.7)	27.3**
		65+				62.5	5.0 (1.1)	44.0	3.2 (1.0)	52.3	1.2 (0.2)	28.4	1.4 (0.8)	30.0**

Table 5.3.19 Continued

FEMALE Lipid Profiles per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	**Total Serum Cholesterol**		**Serum LDL**		**Serum HDL**		**Serum TAG**	
							Total S-Cholesterol mmol/L	**% High > 5 (> 5.2*) (>5.18**) mmol/L**	**S-LDL mmol/L**	**% High > 3 mmol/L**	**S-HDL mmol/L**	**% Low < 1.2 (<1.03 *) (<1.0**) (<0.9***)**	**S-TAG mmol/L**	**% High > 1.7 (>2.3)* (>1.5**) mmol/L**
THUSA Study Kruger *et al.*, 2005[71]	1996 1998	15–80 HIV +	B	NWP	UU	9	4.39 (3.83-4.95)		2.84 (2.28-3.40)		1.10 (0.89-1.30)		-	
					PU	37	4.21 (3.94-4.48)		2.77 (2.50-3.04)		1.07 (0.97-1.17)		1.03 (0.86-1.20)	
					IS	29	3.73 (3.42-4.03)		2.33 (2.02-2.63)		0.99 0.88-1.10)		1.09 (0.92-1.26)	
					F	13	4.07 3.61-4.53)		2.70 (2.24-3.16)		0.98 (0.81-1.15)		1.02 (0.79-1.24)	
					R	27	3.48 (3.16-3.61)		2.13 (1.81-2.45)		1.01 (0.89-1.13)		0.87 (0.70-1.03)	
		15–80 HIV -			UU	87	4.79 (4.59-5.00)		3.05 (2.62-2.75)		1.24 (1.17-1.30)		0.87 (0.35-1.39)	
					PU	245	4.47 (4.35-4.60)		2.89 (2.85-3.25)		1.15 1.11-1.19)		1.17 (1.07-1.28)	
					IS	142	4.21 (4.05-4.37)		2.61 (2.77-3.01)		1.15 (1.10-1.20)		1.04 (0.89-1.19)	
					F	130	4.12 (3.95-4.29)		2.54 (2.46-2.77)		1.17 (1.12-1.23)		1.09 (0.94-1.24)	
					R	258	4.05 (3.94-4.17)		2.50 (2.38-2.71)		1.18 (1.14-1.21)		0.98 (0.87-1.10)	
Women's health study Hattingh *et al.*, 2008[58]	2000	25–34	B	FS	R	279	4.2						0.9	
		35–44				217	4.5						1.1	
CT Peri Urban Study Charlton *et al.*, 2005[182] Per tertiles of added sugar	n/d	≥60	B	WC	PU	Low-est	5.2 (1.2)	51.9						
						Mid	4.9 (1.1)	49.1						
						High-est	5.7 (1.2)	70.7						
Ubombo study Motala *et al.*, 2011[47]	n/d	≥15	B	KZN	R	758	4.1 (1.1)		2.4 (0.9)		1.24 (0.38)		1.0 (0.7)	
Sharpeville elderly facility study Oldewagen-Theron *et al.*, 2018[188]	2004	≥60	B	GP	PU	89			2.02 (1.61)		1.04 (0.43)		1.42 (0.72)	
	2014					89			3.60 (1.17)		0.84 (0.29)		1.56 (1.12)	

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Table 5.3.19 Continued

FEMALE Lipid Profiles per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Total Serum Cholesterol: Total S-Cholesterol mmol/L	Total Serum Cholesterol: % High > 5 (> 5.2*) (>5.18**) mmol/L	Serum LDL: S-LDL mmol/L	Serum LDL: % High > 3 mmol/L	Serum HDL: S-HDL mmol/L	Serum HDL: % Low < 1.2 (<1.03 *) (<1.0**) (<0.9***)	Serum TAG: S-TAG mmol/L	Serum TAG: % High > 1.7 (>2.3)* (>1.5**) mmol/L
Stanger Study Naicker *et al.*, 2015[24]	2008	35–55	I	KZN	U	139		21.5*						86.3
Phoenix Lifestyle Project Prakaschandra *et al.*, 2016[48]	2007 2008	All 15+	I	KZN	U	1001	5.5 (1.2)	56.7	3.35 (1.0)	26.5*	1.33 (0.33)	48.1*	1.8 (2.6)	41.2
		15–24				77	4.5 (0.9)		2.72 (0.8)		1.51 (0.80)		1.1 (1.0)	
		25–34				101	5.0 (1.0)		3.04 (0.9)		1.26 (0.32)		1.4 (0.6)	
		35–44				227	5.3 (1.2)		3.27 (1.0)		1.32 (0.53)		1.6 (0.7)	
		45–54				342	5.6 (1.1)		3.55 (1.0)		1.36 (0.47)		1.8 (1.1)	
		55–64				254	5.8 (1.2)		3.47 (0.9)		1.34 (0.31)		2.0 (1.2)	
AHA-FS: Rural Van Zyl *et al.*, 201259 Gaziano *et al.*, 2013[199]	2007	25–64	B C	FS	PU	216	4.9	20.1*		46.3*	1.2	67.7*		19.8
	2009				R	261	4.2	39.6*		65.1*	1.2	69.8*		41.7
Aggregate of PURE NW and AHA-FS Studies Kruger *et al.*, 2017[158]	2005 2010	25–65	B	NW FS	UP U R	1388	4.90 (1.34)				1.33 (0.59)	52.3*	1.10 (0.83)	19.2
Discovery Vitality members study: Lambert, *et al.*, 2013[210] (finger prick test)	2012	≥18	B C W A/I	All (SA cities)	U	729	4.8 (1.0)							

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Table 5.3.19 Continued

FEMALE Lipid Profiles per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Total Serum Cholesterol: Total S-Cholesterol mmol/L	Total Serum Cholesterol: % High > 5 (> 5.2*) (>5.18**) mmol/L	Serum LDL: S-LDL mmol/L	Serum LDL: % High > 3 mmol/L	Serum HDL: S-HDL mmol/L	Serum HDL: % Low < 1.2 (<1.03 *) (<1.0**) (<0.9***)	Serum TAG: S-TAG mmol/L	Serum TAG: % High > 1.7 (>2.3)* (>1.5**) mmol/L
Dikgale HDSS Mashinya *et al.*, 2018[54]	2011 2012	15–24	B	LP	R (T) U	878		20.0						7.0
		25–34						17.3						13.7
		35–44						22.7						18.6
		45–54						32.6						27.1
		55–64						47.1						25.7
		≥65						48.4						39.6
ELS Sekgala *et al.*, 2018[97]	2015	18–30	B	LP	R (T)	218	4.62 (1.11)		2.97 (0.95)		1.10 (0.30)		0.96 (0.51)	
		18–24				101	4.07 (1.03)		2.80 (0.89)		1.09 (0.28)		0.87 (0.48)	
		25–30				217	4.35 (1.13)		3.05 (0.96)		1.10 (0.31)		1.00 (0.52)	
STUDIES IN SA STUDENTS														
University of the North Steyn *et al.* 2000 95 Steyn *et al.* 2000[222]	1994	All	B	LP	U R	62	3.5 (0.8)	3.8					0.6 (0.2)	0.0
		≤18				27	3.3 (8.8)						0.6 (0.2)	
		19–23				26	3.5 (0.7)						0.6 (0.1)	
		≥ 24				9	4.0 (0.8)						0.9 (0.3)	
University of Stellenbosch Smith and Essop, 2009[87]	n/d	n/d	n/d	WC	n/d	178	4.3 (0.9)						2.15 (1.79)	

Lipid values expressed in mg/dL were converted to mmol/L for this review

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Table 5.4.1: Macronutrient intake of South African males: Energy, protein, carbohydrate and fat

MALES Energy, protein, carbohydrate, and fat intakes per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SE/SD) OR Median (range/interquartile range/95%CI)								
							Energy kJ	**Total Protein g**	**Animal Protein g**	**Plant Protein g**	**CHO g**	**Fat g**	**Saturated fat g**	**Poly unsaturated fat g**	**Mono unsaturated fat g**
NATIONAL SURVEYS NO MACRONUTRIENT ANALYSIS RECORDED IN NATIONAL SURVEYS															
INTERNATIONAL STUDIES WITH A SA COMPONENT															
PURE-NWP-SA Dolman *et al.*, 2013[105]	2005	35–70	B	NWP	U	328	8603 (6516-11288)								
					R	314	6029 (4765-7757)								
PURE-NWP-SA Richter *et al.*, 2014[33]	2005	35–70	B	NWP	U R	393	9440 (7174-12384)					60.76 (44.31-81.63)	14.70 (10.33-20.80)	17.23 (12.05-24.44)	16.35 (11.69-24.21)
						333	6548 (4931-8341)					29.66 (21.41-41.19)	6.32 (3.77-9.17)	9.34 (6.26-13.63)	6.55 (4.09-9.76)
PURE-NWP-SA Vorster *et al.*, 2014[154]	2005	35–70	B	NWP	U	205	10200 (9600-10800)								
					R	203	7300 (6900-7800)								
	2010				U	205	13900 (13200-14700)								
					R	203	10300 (9500-10900)								
PURE-NWP-SA Wentzel-Viljoen et al, 2018[93]	2005	35–70	B	NWP	U	202	9900 (7.2–12.6)	72.8 (52.5–95.8)	30.0 (20.8-43.5)	36.9 (27.6-47.3)	330.8 (238.6-431.6)	61.6 (44.4-86.2)	15.1m (10.6-21.5)	18.0 (12.5-25.7)	16.7 (11.99-24.8)
					R	186	6900 (5.6-8.8)	44.4 (35.3-61.2)	12.6 (8.0-19.5)	30.4 (22.2-39.7)	257.5 (199.0-334.96)	31.2 (24.8-43.1)	6.9 (4.8-9.7)	10.3 (7.3-14.3)	7.3 (4.7-10.7)
	201o				U	202	13 700 (10.5-17.89)	100.0 (75.0-138.4)	51.0 (37.1-75.3)	43.5 (32.9-63.5)	419.4 (306.7-584.2)	94.4 (65.9-131.9)	24.9 (17.3-35.4)	25.6 (16.8-39.2)	28.1 (20.6-40.7)
					R	186	9700 (6.95-13.8)	66.2 (46.79-91.5)	25.8 (16.4-45.2)	33.8 (24.4-51.5)	333.4 (231.6-458.6)	54.6 (36.4-79.4)	15.6 (10.2-23.5)	16.3 (9.99-26.3)	15.5 (9.6-22.9)

Table 5.4.1 Continued

MALES Energy, protein, carbohydrate, and fat intakes per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SE/SD) OR Median (range/interquartile range/95%CI)								
							Energy kJ	**Total Protein g**	**Animal Protein g**	**Plant Protein g**	**CHO g**	**Fat g**	**Saturated fat g**	**Poly unsaturated fat g**	**Mono unsaturated fat g**
REGIONAL SA STUDIES															
I-CHD study Wolmarans *et al.* 1999[98]	1984 1986	15–24	I	KZN	U	107	8300 (6400-10100)								
		25–34				91	7700 (6500-10000)								
		35–44				94	8100 (6400-10700)								
		45–54				69	7600 (5500-10200)								
		55-69				45	5700 (3800-6700)								
CT black elderly study Charlton *et al.*, 2001[30]	1990	≥60	B	WC	PU IS	74	7245 (2906)	67 (47)	42 (29)	25 (15)	229 (104)	50 (33)	18 (13)		
Cape Flats study Charlton *et al.*, 2001[30]	1993	≥65	C	WC	U	104	8022 (3259)	69 (30)	45 (24)	23 (9)	246 (87)	69 (36)	22 (12)		
West Coast villages study Charlton *et al.*, 2001b[39]	1997	≥55	C	WC	R	38	9911 (3812)	85.2 (34.0)	52.0 (29.4)	33.3 (16.8)	312 (139)	86.4 (40.6)	27.3 (13.2)	20.3 (10.2)	31.2 (16.8)
DHDSS - Limpopo Steyn *et al.*, 2001[100]	1997 1998	≥20	B	LP	R	74	6090 (2391)	55.7 (32.1)	23.7 (30.6)	32.0 (14.0)	230.5 (87.8)	27.4 (25.3)	7.3 (9.9)	6.0 (5.9)	9.3 (10.5)
THUSA study MacIntyre *et al.*, 2002[96]	1996 1998	15–80	B	NWP	UU	83	9818 (425)	76.9 (2.7)	44.1 (1.7)	32.6 (1.9)	315.0 (16.8)	77.3 (2.8)	24.9 (0.95)	17.2 (0.87)	27.9 (1.02)
					MU	229	9897 (256)	66.3 (1.7)	29.2 (1.0)	36.9 (1.1)	343.4 (10.2)	63.0 (1.7)	19.0 (0.57)	16.5 (0.52)	21.9 (0.62)
					IS	128	9333 (342)	63.8 (2.2)	27.2 (1.4)	36.3 (1.5)	335.0 (13.5)	55.3 (2.3)	16.8 (0.76)	14.6 (0.70)	19.1 (0.83)
					F	109	8913 (371)	63.6 (2.4)	28.2 (1.5)	35.3 (1.6)	340.0 (14.7)	51.1 (2.5)	16.9 (0.83)	12.2 (0.76)	17.4 (0.90)
					T	194	9597 (278)	65.9 (1.8)	25.9 (1.1)	39.8 (1.2)	360.5 (11.0)	54.4 (1.9)	16.1 (0.62)	14.8 (0.57)	18.0 (0.67)

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Table 5.4.1 Continued

MALES Energy, protein, carbohydrate, and fat intakes per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SE/SD) OR Median (range/interquartile range/95%CI) Energy kJ	Total Protein g	Animal Protein g	Plant Protein g	CHO g	Fat g	Saturated fat g	Poly unsaturated fat g	Mono unsaturated fat g
REGIONAL SA STUDIES															
CT peri-urban study Charlton, *et al.*, 2007[41]	n/d	≥ 60	B	WC	PU	53	6417 (1990)	57.1 (24.0)							
Sharpeville elderly facility study: Oldewage-Theron, *et al.* 2008[62] *% not meeting the EAR*	2004	≥ 60	B	GP	PU	20	8640±3799 *42%*	86±48 *27%*	54±41	32±14	300.9±138.5 *4%*	47 (29)	49±32		
Somerset-West elderly study Marais *et al.* 2007[195]	n/d	≥ 60	n/d	WC	U	53	6963	66			219	58			
Ga-Rankuwa Study Li *et al.*, 2007[196]	2005	18–40	B	GP	PU	334	6107	61.0			223.5	28.6			
Umlazi Study Mkhize *et al.* 2013[49] *% not meeting the EAR*	2009 2010	≥ 60	B	KZN	PU	45	4793 (1092) *100%*	20.2 (11.8) *91.1%*			174.9 (47.3) *0%*				
CRIBSA Study Steyn *et al.*, 2016[205]	2009	19–44	B	WC	U	285	8500 (3700)	77 (44.0)	42 (40.0)	34 (21.0)	282 (128)	60 (43.0)	20 (17.0)	13 (10.0)	21 (17.0)
		45–64				98	9196 (3800)	78 (51.0)	46 (49.0)	31 (18.0)	266 (112)	57 (43.0)	21 (18.0)	10 (9.0)	20 (18.0)
	2010	19–44				138	8557 (2971)	64.5 (29.0)	35.5 (26.5)	26.9 (11.0)	247.8 (97.9)	70.3 (41.2)	18.6 (12.5)	23.5 (19.8)	22.6 (14.6)
		45–64				76	7666 (2219)	57.0 (27.4)	29.1 (25.8)	25.6 (10.6)	237.5 (67.4)	52.9 (35.0)	14.5 (10.3)	17.3 (16.4)	16.9 (12.8)

Table 5.4.1 Continued

MALES Energy, protein, carbohydrate, and fat intakes per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SE/SD) OR Median (range/interquartile range/95%CI)								
							Energy kJ	**Total Protein g**	**Animal Protein g**	**Plant Protein g**	**CHO g**	**Fat g**	**Saturated fat g**	**Poly unsaturated fat g**	**Mono unsaturated fat g**
REGIONAL SA STUDIES															
Empangeni Study Kolahdooz *et al.*, 2013[94]	2011	19–50	B	KZN	R	33	*11159 (3692)¥*	75 (34)			474 (174)	32 (22)	6.3 (6)	10.1 (7.6)	12.8 (11.6)
		>50				18	*10874 (5116)¥*	60 (63)			422 (184)	25 (37)	6.9 (16.8)	8.2 (7.6)	10.6 (12.1)
ELS Sekgala *et al.*, 2018[97]	2015	18–24	B	LP	R	103	3520 (3647)								
		25–30				203	2886 (3968)								
		All				306	3029 (3874)								
STUDIES AMONG SA STUDENTS															
University of Fort Hare Van den Berg *et al.*, 2012[132]	2008	18–42	B	EC	R	51	6 333								
University of the Free State Van den Berg *et al.*, 2013[126]	2013		All	FS		39	8 943								

¥ Energy expressed as kcal was converted to kJ for this review

Table 5.4.2: Macronutrient intake of South African females: Energy, protein, carbohydrate and fat

FEMALES Energy, protein, carbohydrate, and fat intakes per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SE/SD) OR Median (range/interquartile range/95%CI)								
							Energy kJ	**Total Protein g**	**Animal Protein g**	**Plant Protein g**	**CHO g**	**Fat g**	**Saturated fat g**	**Poly unsaturated fat g**	**Mono unsaturated fat g**
NATIONAL SURVEYS NO MACRONUTRIENT ANALYSIS RECORDED IN NATIONAL SURVEYS															
INTERNATIONAL STUDIES WITH A SA COMPONENT															
PURE-NWP-SA Dolman *et al.*, 2013[105]	2005	35–70	B	NWP	U	480	7664 (5366-10401)								
					R	588	5677 (4446-7169								
PURE-NWP-SA Richter *et al.*, 2014[33]	2005	35–70	B	NWP	U R	591	8539 (6009-11457)					61.47 (42.49-85.84)	15.53 (10.61-22.14)	17.54 (11.88-25.61)	17.51 (11.56-25.30)
						633	5889 (4519-7422)					30.21 (20.95-40.64)	6.31 (3.87-9.49)	9.75 (6.35-14.21)	6.60 (4.08-9.91)
PURE-NWP-SA Vorster *et al.*, 2014[154]	2005	35–70	B	NWP	U	366	9200 (8800-9600)								
					R	459	6200 (5900-6400)								
	2010				U	366	12000 (11500-12500)								
					R	459	9700 (9300-10200)								
PURE-NWP-SA Wentzel et al, 2018[93]	2005	35–70	B	NWP	U	355	9000 (6.5-11.6)	63.2 (47.4-87.4)	29.2 (21.4-40.9)	31.1 (22.8-40.4)	294.6 (209.8-376.2)	64.7 (45.9-88.4)	16.6 (11.3-23.0)	18.3 (12.6-25.8)	18.1 (12.2-26.2)
					R	411	6200 (5.0-7.6)	40.4 (31.9-51.0)	12.5 (7.3-18.5)	27.1 (20.9-33.2)	243.5 (191.3-295.6)	32.1 (23.2-42.4)	7.0 (4.6-9.8)	10.3 (7.0-14.7)	7.1 (4.9-10.7)
	201o				U	355	11 700 (8.9-14.9)	86.5 (64.2-113.9)	46.7 (30.9-65.9)	36.5 (26.7-49.3)	368.3 (274.9-477.7)	83.5 (58.3-112.4)	22.9 (15.3-31.4)	22.6 (16.0-33.7	25.7 (16.7-36.5)
					R	411	9100 (6.9-12.8)	60.4 (44.6-82.5)	24.1 (14.1-37.1)	33.6 (24.3-48.9)	322.0 (240.9-468.8)	56.6 (36.6-86.7)	15.4 (9.6-24.5)	17.7 (10.9-27.7)	15.9 (9.8-24.6)

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Table 5.4.2 Continued

FEMALES Energy, protein, carbohydrate, and fat intakes per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SE/SD) OR Median (range/interquartile range/95%CI)								
							Energy kJ	**Total Protein g**	**Animal Protein g**	**Plant Protein g**	**CHO g**	**Fat g**	**Saturated fat g**	**Poly unsaturated fat g**	**Mono unsaturated fat g**
REGIONAL SA STUDIES															
I-CHD study Wolmarans *et al.* 1999[98]	1984 1986	15–24	I	KZN	U	69	6100 (4900-7600)								
		25–34				79	5300 (4400-6600)								
		35-44				103	5700 (4300-6800								
		45–54				75	5400 (4200-6600)								
		55–69				44	4700 (3700-6000)								
CT black elderly study Charlton *et al.*, 2001[30]	1990	≥60	B	WC	PU IS	74	5140 (2092)	47 (23)	27 (19)	18 (9)	180 (73)	35 (24)	12 (9)		
Cape Flats study Charlton *et al.*, 2001[30]	1993	≥65	C	WC	U	96	7014 (2230)	60 (22)	39 (18)	21 (7)	215 (70)	62 (27)	20 (9)		
West Coast villages study Charlton *et al.*, 2001b[39]	1997	≥55	C	WC	R	91	7932 (3999)	66.7 (32.0)	40.7 (26.8)	25.5 (11.5)	248 (115)	70.9 (36.7)	23.4 (14.4)	15.5 (8.3)	24.9 (12.8)
DHDSS - Limpopo Steyn *et al.*, 2001[100]	1997 1998	≥20	B	LP	R	136	6278 (2577)	53.8 (24.7)	16.9 (20.0)	36.9 (18.0)	253.9 (109.0)	26.0 (18.7)	6.0 (6.5)	6.6 (6.6)	8.1 (6.8)
THUSA study MacIntyre *et al.*, 2002[96]	1996 1998	15–80	B	NWP	UU	106	8523 (297)	69.7 (2.1)	42.6 (1.43)	29.0 (1.33)	276.0 (12.7)	72.7 (2.4)	24.2 (0.84)	15.0 (0.67)	26.1 (0.87)
					MU	292	8010 (179)	59.5 (1.3)	29.1 (0.86)	30.2 (0.80)	283.6 (7.6)	58.8 (1.5)	18.3 (0.51)	14.8 (0.40)	20.3 (0.52)
					IS	172	7893 (233)	56.9 (1.6)	25.9 (1.12)	30.9 (1.04)	292.2 (9.9)	52.8 (1.9)	16.4 (0.66)	13.2 (0.53)	18.2 (0.68)
					F	148	7973 (251)	54.4 (1.8)	22.1 (1.21)	32.2 (1.13)	313 (10.7)	47.0 (2.0)	15.0 (0.71)	12.3 (0.57)	15.5 (0.73)
					T	290	7906 (180)	54.8 (1.3)	22.2 (0.86)	32.4 (0.80)	308.0 (7.7)	48.7 (1.5)	15.1 (0.51)	13.0 (0.41)	15.9 (9.52)

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Table 5.4.2 Continued

FEMALES Energy, protein, carbohydrate, and fat intakes per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	**Mean (SE/SD) OR Median (range/interquartile range/95%CI)**								
							Energy kJ	**Total Protein g**	**Animal Protein g**	**Plant Protein g**	**CHO g**	**Fat g**	**Saturated fat g**	**Poly unsaturated fat g**	**Mono unsaturated fat g**
Ndunakazi Study Faber and Kruger, 2005[46]	1998	25–55	B	KZN	R	187	9801 (1839)								
Women's Health Study Hattingh *et al.*, 2008[92]	2000	25–34	B	FS	PU	279	11 475 (1671; 35312)	80.5	40.5	34.4	339.4	99.4	28	26.7	32.1
		35–44				217	10 780 (2647; 26782	77.9	40.6	32.2	317.3	88.5	26	23.2	29.6
CT peri-urban study Charlton, *et al.*, 2007[41]	n/d	≥ 60	B	WC	PU	205	5621 (1928)	49.4 (22.7)							
Sharpeville elderly facility study: Oldewage-Theron, *et al.* 2008[62] *% not meeting the EAR*	2004	≥ 60	B	GP	PU	81	5394±2946 *61%*	47±31 *54%*	26±27	21±13	196.4±122.8 *19%*	28±21			
Vaal Area INP Oldewage-Theron *et al.*, 2014[116] Oldewage-Theron *et al.*, 2014[103]	2004 2019	19–90	B	GP	PU IS	All	4872 (80.4)	21 (0.9)			169 (2.8)				
						Low DDS 17	3733 (1869)	34 (25)	19 (24)	15 (9)	125 (61)	24 (25)	7.5 (9.1)	5.4 (5.6)	8.4 (10.3)
						Med DSS 156	4663 (2272)	46 (29)	29 (27)	17 (9)	138 (64)	37 (33)	12.2 (13.0)	7.3 (5.9)	14.0 (14.1)
						High DDS 449	5169 (2095)	40 (24)	18 (21)	21 (9)	192 (73)	28 (26)	8.2 (8.7)	7.7 (9.7)	9.0 (9.6)

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Table 5.4.2 Continued

FEMALES Energy, protein, carbohydrate, and fat intakes per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SE/SD) OR Median (range/interquartile range/95%CI) Energy kJ	Total Protein g	Animal Protein g	Plant Protein g	CHO g	Fat g	Saturated fat g	Poly unsaturated fat g	Mono unsaturated fat g
Somerset-West elderly study Marais *et al.* 2007[195]	n/d	≥ 60	n/d	WC	U	157	6963	66			219	58			
Ga-Rankuwa Study Li *et al.*, 2007[196]	2005	18–40	B	GP	PU	270	6321	55.2			257.9	25.3			
Umlazi Study Mkhize *et al.* 2013[49] *% not meeting the EAR*	2009 2010	≥ 60	B	KZN	PU	124	4745 (1233) *89.2%*	42.7 (14.4) *63.1%*			168.3 (43.7) *4.1%*				
CRIBSA Study Steyn *et al.*, 2016[205]	1990	19–44	B	WC	U	364	6400 (2800)	56 (33.0)	23 (14.0)	33 (30.0)		49 (33.0)	16 (12.0)	11 (9.0)	17 (14.0)
	1990	45–64	B	WC	U	117	6400 (2000)	49 (21.0)	22 (10.0)	28 (19.0)		42 (25.0)	15 (10.0)	8 (5.0)	15 (11.0)
	2009	19–44	B	WC	U	216	7619 (2271)	52.8 (23.4)	23.6 (8.9)	23.6 (8.9)		66.4 (38.4)	17.3 (11.5)	22.6 (17.1)	21.7 (14.1)
	2009	45–64	B	WC	U	114	7104 (1838)	48.7 (18.0)	22.9 (8.2)	22.9 (8.2)		59.9 (38.9)	17.3 (16.2)	20.6 (21.7)	17.7 (11.7)
Empangeni Study Kolahdooz *et al.*, 2013[94]	2011	19–50	B	KZN	R	84	*11651 (3175)¥*	70 (27)			463 (159)	32 (20.7)	7.4 (4.1)	11.7 (6.0)	14.5 (8.5)
	2011	>50	B	KZN	R	84	*11978 (2841)¥*	71 (28)			479 (146)	31 (26.0)	8.8 (5.7)	11.4 (8.7)	16.3 (11.7)
ELS Sekgala *et al.*, 2018[97]	2015	18–24	B	LP	R	101	3314 (2919)								
	2015	25–30	B	LP	R	217	3674 (3992)								
	2015	All	B	LP	R	318	3474 (3482)								
STUDIES AMONG SA STUDENTS															
University of the North Steyn *et al.*, 2000[95]	1994	17–34	B	LP	U	45	10400 (3600)	78.8 (30.9)	44.8 (25.9)	34.0 (13.1)	365 (139)	79.8(35.0)	26.2 (13.8)	14.4 (6.8)	27.2 (13.3)
	1994	17–34	B	LP	R	70	9700 (3000)	75.0 (25.5)	39.9 (19.3)	35.1 (12.4)	328 (110)	77.8 (31.8)	23.7 (10.9)	16.0 (7.8)	26.3 (13.0)

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Table 5.4.2 Continued

FEMALES Energy, protein, carbohydrate, and fat intakes per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SE/SD) OR Median (range/interquartile range/95%CI)								
							Energy kJ	**Total Protein g**	**Animal Protein g**	**Plant Protein g**	**CHO g**	**Fat g**	**Saturated fat g**	**Poly unsaturated fat g**	**Mono unsaturated fat g**
University of Fort Hare Van den Berg *et al.*, 2012[132]	2008	18–42	B	EC	R	110	5 543								
University of the Free State Van den Berg *et al.*, 2013[126]	2011	n/d	All	FS	n/d	122	5 195								

¥ Energy expressed as kcal was converted to kJ for this review

Table 5.4.3: Macronutrient intakes of South African adults (published 1997–2019) for males and females published as combined data

MALES AND FEMALES Combined data Energy, protein, carbohydrate, and fat intakes per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Mean (SE/SD) OR Median (range/interquartile range/95%CI)								
							Energy kJ	**Total Protein g**	**Animal Protein g**	**Plant Protein g**	**CHO g**	**Fat g**	**Saturated fat g**	**Poly unsaturated fat g**	**Mono unsaturated fat g**
Qwa-Qwa INP (Rural): Oldewage-Theron *et al.*, 2012[12]	2008 2009	21–60	B	FS	R	30	4548 (2866)	41 (28)	23 (22)	19 (17)	146 (106)	*31 (26)*			

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Table 5.4.4: Macronutrients intakes of South African males: Cholesterol, fibre, added sugar and alcohol

MALES: Cholesterol, fibre, added sugar, and alcohol intakes per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Median (SE/SD) OR Median (range/interquartile range/95%CI)					
							Cholesterol mg	**Fibre g**	**Soluble fibre g**	**Soluble fibre g**	**Added sugar g**	**Alcohol g**
NATIONAL SURVEYS NO DATA REPORTED												
INTERNATIONAL SURVEYS WITH A SA COMPONENT												
PURE-NWP-SA Dolman *et al.*, 2013[105]	2005	35–70	B	NWP	U	328	234 (149-331)	24.1 (16.5-33.2)				11.6 (0.00–26.70)
					R	314	106 (56-153)	18.1 (12.6–24.2)				2.04 (0.00–28.60)
PURE-NWP-SA Richter *et al.*, 2014[33]	2005	35–70	B	NWP	U	393			1.94 (1.28–3.21)			11.57 (0.00–26.65)
					R	333			0.93 (0.54–1.43)			2.21 (0.00–25.71)
					U	205					44.7 (39.8, 49.5)	
					R	203					27.5 (23.2, 31.9)	
PURE-NWP-SA Vorster *et al.*, 2014[154]	2005	35–70	B	NWP	U	205					74.3 (66.9, 81.8)	
	2010				R	203					63.2 (54.6, 71.9	
PURE-NWP-SA Wentzel-Viljoen et al, 2018[93]	2005	35-70	B	NWP	U	202	249 (163-355)	27.3 (17.5-35.4)	34.7 (20.9-56.1)			11.4 (0-27.7)
					R	186	111 (72-171)	31.4 (23.1-43.1)	59.3 (36.5-99.7)			7.1 (0-26.5)
	2010				U	202	408 (279-657)	18.5 (14.2–25.2)	23.9 (14.27–33.06)			4.3 (0–32)
					R	186	210 (87-377)	20.6 (14.2-31.1)	45.3 (23.9-82.5)			0.7 (0-18.8)
REGIONAL SA STUDIES												
CT black elderly study Charlton *et al.*, 2001[30]	1990	≥60	B	WC	PU IS	74	300 (344)				48 (37)	
Cape Flats study Charlton *et al.*, 2001[30]	1993	≥65	C	WC	U	104	285 (168)	17 (8)				
West Coast villages elderly study Charlton *et al.*, 2001[39]	1997	≥55	C	WC	R	38	293 (165)	22.1 (9.6)			99.1 (70.9)	53.6 (56.4)

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Table 5.4.4 Continued

MALES: Cholesterol, fibre, added sugar, and alcohol intakes per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Median (SE/SD) OR Median (range/interquartile range/95%CI)					
							Cholesterol g	**Fibre g**	**Soluble fibre g**	**Soluble fibre g**	**Added sugar g**	**Alcohol g**
REGIONAL SA STUDIES												
DHDSS study, Limpopo Steyn *et al.*, 2001[100]	1997 – 1998	≥20	B	LP	R	74	144.9 (240.9)	18.7			19.4	
THUSA study MacIntyre *et al.*, 2002[96]	1996 – 1998	15–80	B	NWP	UU	83	420 (24.7)	19.7 (1.02)				12.7 (4.4)
					MU	229	377 (14.9)	18.8 (0.61)				24.7 (2.6)
					IS	128	332 (19.9)	17.4 (0.82)				21.2 (3.5)
					F	109	283 (21.6)	15.6 (0.90)				10.9 (3.8)
					R	194	315.6 (16.2)	19.2 (0.67)				16.2 (2.9)
CT peri-urban study Charlton *et al.*, 2005[182]	n/d	≥ 60	B	WC	PU	52		18.9 (11.1)			9.5 (5.8)	
Sharpeville elderly facility study Oldewage-Theron *et al.*, 2008[62] *15±6*	2004	≥ 60	B	GP	PU	20	260.7±217.2	15±6 *85%*				
Somerset-West elderly study Marais *et al.* 2007[195]	n/d	≥ 60	n/d	WC	U	53	234	21				
Ga-Rankuwa Study Li *et al.*, 2007[196]	2005	18–40	B	GP	PU	334		12.2				
Stanger Study Naicker *et al.*, 2015[24]	2008	35–55	I	KZN	U	111	204.7	18.8				

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Table 5.4.4 Continued

MALES: Cholesterol, fibre, added sugar, and alcohol intakes per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Median (SE/SD) OR Median (range/interquartile range/95%CI) **Cholesterol mg**	**Fibre g**	**Soluble fibre g**	**Soluble fibre g**	**Added sugar g**	**Alcohol g**
REGIONAL SA STUDIES												
Umlazi Study Mkhize *et al.*, 2013[49] *% not meeting the EAR*	2009 – 2010	≥ 60	B	KZN	PU	45		15.41 ± 5.12 *33.3%*				
CRIBSA Study Steyn *et al.*, 2016[205]	1990	19–44	B	WC	U	285	265 (288)	21.0 (15.0)			50.0 (44.0)	
		45–64				98	260 (270)	19.0 (13.0)			51.0 (39.0)	
	2009	19–44				138	359.8 (346)	18.9 (10.4)			45.0 (42.8)	
						76	258.5 (322)	18.1 (10.4)			49.4 (37.7)	
Empangeni Study Kolahdooz *et al.*, 2013[94]	2011	19–50				33	95 (87)	36 (18)			35 (25)	
ELS Sekgala *et al.*, 2018b[219]	2015	>50	B	LP	R	18	91 (196)	28 (25)			39 (53)	
		18–24				103		5.83 (8.18)			24.40 (39.83)	
		25–30				203		5.70 (7.85)			24.00 (49.70)	
		All				306		4.05 (8.43)			24.0 (45.50)	
STUDIES ON SA STUDENTS NO DATA REPORTED												

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Table 5.4.5: Macronutrients intakes of South African females: Cholesterol, fibre, added sugar and alcohol

FEMALES Cholesterol, fibre, added sugar, and alcohol intakes per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Median (SE/SD) OR Median (range/interquartile range/95%CI)					
							Cholesterol mg	**Fibre g**	**Soluble fibre g**	**Soluble fibre g**	**Added sugar g**	**Alcohol g**
NATIONAL SURVEYS NO DATA REPORTED												
INTERNATIONAL SURVEYS WITH A SA COMPONENT												
PURE-NWP-SA Dolman *et al.*, 2013[105]	2005	35–70	B	NWP	U	588	205 (131-310)	20.4-(13.3–28.5)				0.00 (0.00-0.00)
					R	480	95 (49-151)	16.5 (12.5–21.3)				0.00 (0.00-0.00)
PURE-NWP-SA Richter *et al.*, 2014[33]	2005	35–70	B	NWP	U	591			2.27 (1.34–3.43)			0.00 (0.00–11.43)
					R	633			1.11 (0.66–1.62)			0.00 (0.00–0.00)
PURE-NWP-SA Vorster *et al.*, 2014[154]	2005	35–70	B	NWP	U	366					47.1 (43.8,50.4)	
					R	459					26.7 (24.6,28.8)	
	2010				U	366					78.5 (71.8,85.1)	
					R	459					65.7 (58.6,72.7)	
PURE-NWP-SA Wentzel-Viljoen et al, 2018[93]	2005	35–70	B	NWP	U	355	234.9 (152.9-334.9)	22.8 (15.1-30.6)			40.6 (24.1-62.1)	0.0 (0.0-14.3)
					R	355	102 (60-157)	17.3 (13.8-22.1)			23.9 (12.8-36.5)	0.0 (0.0-0.0)
	2010				U	411	342.4 (215.1-509.8)	27.5 (19.6-37.8)			67.6 (32.6-98.5)	0.0 (0.0-6.1)
					R	411	167 (83-313)	20.7 (14.9-31.3)			46.6 (24.2-83.6)	0.0 (0.0-0.0)
REGIONAL SA STUDIES												
CT black elderly study Charlton *et al.*, 2001[30]	1990	≥60	B	WC	PU IS	74	175 (162)				44 (28)	
Cape Flats study Charlton *et al.*, 2001[30]	1993	≥65	C	WC	U	96	225 (114)	16 (8)				
West Coast villages elderly study Charlton *et al.*, 2001[39]	1997	≥55	C	WC	R	91	222 (159)	17.6 (9.7)			64.7 (62.4)	40.5 (44.8)

Table 5.4.5 Continued

FEMALES Cholesterol, fibre, added sugar, and alcohol intakes per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Median (SE/SD) OR Median (range/interquartile range/95%CI)					
							Cholesterol mg	**Fibre g**	**Soluble fibre g**	**Soluble fibre g**	**Added sugar g**	**Alcohol g**
NATIONAL SURVEYS NO DATA REPORTED												
DHDSS study, Limpopo Steyn *et al.*, 2001[100]	1997 – 1998	≥20	B	LP	R	136	116.6 (224.1)	22.4			22.3	
THUSA study MacIntyre *et al.*, 2002[96]	1996 – 1998	15–80	B	NWP	UU	106	332 (19.4)	17.7 (0.73)				0.6 (1.03
					MU	292	316 (11.7)	17.1 (0.44)				3.0 (0.62)
					IS	172	280 (15.2)	16.3 (0.58)				3.8 (0.81)
					F	148	241 (16.4)	15.4 (0.62)				4.4 (0.87)
					R	290	258 (11.7)	15.8 (0.44)				2.3 (0.62)
Women's Health Study Hattingh *et al.*, 2008[92]	2000	25–34	B	FS	PU	279	279	317.9				
		35–44				217	217	296.0				
CT peri-urban study Charlton *et al.*, 2005[182]	n/d	≥ 60	B	WC	PU	205		15.9 (8.4)			31.8 (25.2)	
Sharpeville elderly facility study Oldewage-Theron, *et al.* 2008[62] *% not meeting the EAR*	2004	≥ 60	B	GP	PU	81	124.6±151.5	12±7 *86%*				

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Table 5.4.5 Continued

FEMALES Cholesterol, fibre, added sugar, and alcohol intakes per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Median (SE/SD) OR Median (range/interquartile range/95%CI)					
							Cholesterol mg	Fibre g	Soluble fibre g	Soluble fibre g	Added sugar g	Alcohol g
NATIONAL SURVEYS NO DATA REPORTED												
Vaal Area INP Oldewage-Theron *et al.*, 2014 116 Oldewage-Theron *et al.*, 2014[103]	2004 – 2019	19–90	B	GP	PU IS	All		11.0 (0.2)				
						Low DDS 117	133 (220.2)	9 (7)				
						Med SSD 156	165.0 (232.3)	9 (6)				
						High DDS 449	109.1 (189.5)	11 (6)				
Somerset-West Elderly study Marais *et al.* 2007[195]	n/d	≥ 60	n/d	WC	U	157	234	21				
Ga-Rankuwa Study Li *et al.*, 2007[196]	2005	18–40	B	GP	PU	270		18.3				
Stanger Study Naicker *et al.*, 2015[24]	2008	35–55	I	KZN	U	139	184.3	18.1				
Umlazi Study Mkhize *et al.* 2013[49] *% not meeting the EAR*	2009 – 2010	≥ 60	B	KZN	PU	222		14.15 ± 5.82 *86.5%*				
CRIBSA Study Steyn *et al.*, 2016[205]	1990	19–44	B	WC	U	364	213 (226)	16 (11.0)			47 (34.0)	
		45–64				117	174 (136)	13 (6.0)			38 (24.0)	
	2009	19–44				216	285.9 (326)	16.2 (8.5)			54.4 (40.8)	
		45–64				114	216.3 (227)	16.8 (8.2)			47.0 (36.3)	

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Table 5.4.5 Continued

FEMALES Cholesterol, fibre, added sugar, and alcohol intakes per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Median (SE/SD) OR Median (range/interquartile range/95%CI)					
							Cholesterol mg	**Fibre g**	**Soluble fibre g**	**Soluble fibre g**	**Added sugar g**	**Alcohol g**
NATIONAL SURVEYS NO DATA REPORTED												
Empangeni Study Kolahdooz *et al.*, 2013[94]	n/d	19–50	B	KZN	R	40	53.0 (109)	39 (14)			47 (24)	
		>50				44	74 (103)	47 (14)			47 (21)	
ELS Sekgala *et al.*, 2018[219]	2015	18–24	B	LP	R	101		5.90 (7.80)			34.70 (49.30)	
		25–30				217		4.80 (9.85)			25.80 (38.45)	
		ALL				318		4.3 (7.00)			26.0 (36.00)	
STUDIES ON SA STUDENTS												
University of the North Steyn *et al.*, 2000[95]	1994	17–34	B	LP	U	45	469 (453)	28.8 (12.5)			65.8 (4.9)	
					R	70	383 (200)	28.4 (12.7)			52.2 (32.9)	

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Table 5.4.6: Macronutrients intakes of South African males: Nutrient distribution and contribution of added sugar and alcohol to energy intakes

MALES: Nutrient, added sugar and alcohol distribution per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	**Percentage of total energy**									
							Protein (% of TE)	**Animal protein (% of TE)**	**Plant Protein (% of TE)**	**CHO (% of TE)**	**Fat (% of TE)**	**Saturated fat (% of TE**	**Poly-unsaturated fat (% of TE)**	**Mono-unsaturated fat (% of TE)**	**Added sugar (% of TE)**	**Alcohol (% of TE)**
NATIONAL SURVEYS NO MACRONUTRIENT ANALYSIS DATA IS AVAILABLE FOR NATIONAL SURVEYS																
INTERNATIONAL SURVEYS WITH A SA COMPONENT																
PURE-NWP-SA Richter *et al.*, 2014[33]	2005	35–70	B	NWP	U	393					24.68 (24.07–25.29)	6.14 (5.94–6.35)	7.09 (6.85–7.33)	11.24 (10.99–1.50)		
					R	333					17.83 (17.09–18.56)	3.96 (3.71–4.22)	5.66 (5.37–5.95)	8.13 (7.13–8.43)		
PURE-NWP-SA Vorster *et al.*, 2014[154]	2005	35–70	B	NWP	U	205									7.4 (6.7-8.1)	
					R	203									6.9 (5.9-7.9)	
	2010				U	205									9.5 (8.6-10.4)	
					R	203									10.5 (9.4- 11.7)	
PURE-NWP-SA Wentzel-Viljoen *et al.*, 2018[93]	2005	35–70	B	NWP	U	202	12.5 (11.6–13.5)	5.4 (4.3–6.9)	6.5 (5.7–7.2)	56.1 (52.0–60.6)	24.9 (21.6–29.4)	6.4 (5.1–7.6)	7.2 (5.7–8.8)	7.1 (5.8–8.4)	6.5 (4.5–9.2)	3.5 (0–7.9)
					R	186	10.6 (9.8–11.6))	3.1 (2.0–4.2)	7.5 (6.7–8.1)	63.8 (58.1–69.7)	17.8 (13.6–23.1)	3.9 (2.5–5.1)	5.9 (4.1–7.9)	3.9 (2.7–5.5)	5.8 (2.9–8.3)	2.0 (0–12.5)
	2010				U	202	12.7 (11.3–14.3)	6.8 (5.1–8.5)	5.7 (4.8–6.3)	54.3 (48.4–59.7)	26.3 (22.1–31.3)	6.9 (5.7–8.8)	7.2 (5.7–9.1)	8.0 (6.5–9.8)	7.9 (4.5–12.0)	1.4 (0–4.9)
					R	186	11.3 (9.5–13.5)	4.6 (2.9–7.5)	6.2 (5.2–7.2)	59.5 (51.6–66.5)	21.5 (15.7–28.9)	6.2 (4.1–8.5)	6.1 (4.2–8.9)	6.3 (4.3–8.6)	8.1 (4.5–14.2)	0.3 (0–6.0)

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Table 5.4.6 Continued

MALES: Nutrient, added sugar and alcohol distribution per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	**Percentage of total energy**									
							Protein (% of TE)	**Animal protein (% of TE)**	**Plant Protein (% of TE)**	**CHO (% of TE)**	**Fat (% of TE)**	**Saturated fat (% of TE**	**Poly-unsaturated fat (% of TE)**	**Mono-unsaturated fat (% of TE)**	**Added sugar (% of TE)**	**Alcohol (% of TE)**
REGIONAL SA STUDIES																
I-CHD study Wolmarans *et al.*,1999[98]	1984 1986	15–69	I	KZN	U	107	12.7 (10.1–15.9)	7.2 (3.5–11.3)	5.0 (4.0–6.3)	50.0 (42.8–57.8)	34.6 (28.4–41.5)	9.1 (5.9–11.8)	11.7 (9.0–14.6)	9.6 (7.6–11.9)	15.8 (9.0–21.4)	
		25–34				91	13.8 (11.6–17.9)	9.3 (5.2–13.3)	4.8 (3.9–6.1)	49.7 (43.1–57.5)	33.3 (27.4–38.4)	9.4 (6.7–11.8)	9.5 (6.9–12.9)	9.6 (7.3–12.5)	15.8 (10.1–22.6)	
		35–44				94	12.3 (9.1–15.7)	6.7 (2.8–10.7)	5.0 (3.9–6.6)	49.3 (39.6–56.4)	33.2 (26.3–40.7)	8.4 (5.9–11.5	10.2 (8.4–14.5)	9.6 (6.7–11.8)	13.5 (9.1–19.2)	
		45–54				69	13.1 (9.8–16.9)	8.1 (4.2–12.4)	5.0 (3.8–6.3)	45.5 (37.1–53.8)	35.9 27.5–40.9)	8.7 (6.3–11.1)	11.0 (8.1–15.5)	9.4 (7.5–11.7)	11.2 (7.4–21.4)	
		55–69				45	12.2 (9.9–15.4)	6.7 (3.0–10.0)	5.8 (4.7–7.6)	45.6 (41.9–55.4)	36.6 (26.6–42.1)	7.8 (5.0–11.5)	12.5 (9.0–16.9)	8.9 (5.9–11.4)	10.8 (5.4–13.4)	
CT black elderly study Charlton *et al.*, 2001[30]	1990	≥60	B	WC	PU IS	74	15.7 (5.2)			57.9 (15.8)	25.9 (10.4)					
Cape Flats study Charlton *et al.*, 2001[30]	1993	≥65	C	WC	U	104	14.3 (2.5)			56.3 (7.2)	31.8 (5.1)				18.9 (8.0)	
West Coast villages elderly study Charlton *et al.*, 2001[39]	1997	≥55	C	WC	R	38	13.7 (3.5)			47.3 (11.1)	29.4 (8.1)				12.1 (9.4)	8.0 (12.1)
THUSA study MacIntyre *et al.*, 2002	1996 – 1998	15 – 80	B	NWP	UU	106	13.2 (0.23)			57.3 (1.02)	30.6 (0.78)					
					MU	292	11.8 (0.14)			64.0 (0.62)	26.0 (0.47)					
					IS	172	12.0 (0.18)			65.5 (0.82)	24.3 (0.63)					
					F	148	12.1 (0.20)			67.2 (0.89)	22.8 (0.68)					
					R	290	11.6 (0.15)			67.4 (0.67)	22.9 (0.51)					

Table 5.4.6 Continued

MALES: Nutrient, added sugar and alcohol distribution per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	**Percentage of total energy**									
							Protein (% of TE)	**Animal protein (% of TE)**	**Plant Protein (% of TE)**	**CHO (% of TE)**	**Fat (% of TE)**	**Saturated fat (% of TE**	**Poly-unsaturated fat (% of TE)**	**Mono-unsaturated fat (% of TE)**	**Added sugar (% of TE)**	**Alcohol (% of TE)**
REGIONAL SA STUDIES																
CT peri-urban study Charlton, *et al.*, 2007[41]	n/d	≥ 60	B	WC	PU	52	14.8 (4.0)			65.4 (9.5)	18.6 (7.1)				9.3 (6.0)	
Umlazi study Mkhize *et al.*, 2013[49]	2009 2010	≥ 60	B	KZN	PU	45	15			65	20					
CRIBSA study Steyn *et al.*, 2016[205]	1990	19–44	B	WC	U	285	15.1 (4.8)			61.3 (16.3)	25.9 (11.8)	8.6 (4.4)	5.7 (3.7)	9.0 (5.2)	11.0 (9.6)	
		45–64				98	15.3 (5.4)			59.2 (16.6)	23.8 (11.7)	8.8 (4.8)	4.5 (3.4)	8.3 (5.0)	11.4 (10.1)	
	2009	19–44				138	13.7 (4.8)			53.2 (13.7)	32.0 (12.1)	8.5 (4.3)	10.7 (6.8)	10.2 (4.8)	9.5 (8.3)	
		45–64				76	13.4 (5.1)			57.4 (14.1)	27.2 (14.0)	7.5 (4.5)	8.8 (6.9)	8.6 (5.5)	12.1 (9.3)	
Empangeni study (b) Kolahdooz *et al.*, 2013[94]	n/d	19-50	B	KZN	R	33	13 (3)			69 (13)	19 (11)					
		>50				18	13 (3)			68 (9)	18 (10)					
ELS Sekgala *et al.*, 2018b[97]	2015	18-24	B	LP	R	103	14.5 (11.67)			61.8 (24.49)	23.18 (17.73)	5.83 (6.42)	5.07 (7.37)	8.20 (9.55)		
		25-30				203	12.1 (13.75)			63.8 (35.57)	22.22 (25.80)	4.14 (10.06)	2.97 (7.74)	5.19 (13.77)		
		All				306	12.9 (12.34)			62.8 (30.82)	22.6 (21.51)	4.8 (8.54)	3.7 (7.57)	6.6 (11.75)		
STUDIES IN SA STUDENTS NO STUDIES RECORDED NUTRITENIT DISTRIBUTION PER GENDER																

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Table 5.4.7: Macronutrients intakes of South African females: Nutrient distribution and contribution of added sugar and alcohol to energy intakes

FEMALES: Nutrient, added sugar and alcohol distribution per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Percentage of total energy									
							Protein (% of TE)	**Animal protein (% of TE)**	**Plant Protein (% of TE)**	**CHO (% of TE)**	**Fat (% of TE)**	**Saturated fat (% of TE**	**Poly-unsaturated fat (% of TE)**	**Mono-unsaturated fat (% of TE)**	**Added sugar (% of TE)**	**Alcohol (% of TE)**
NATIONAL SURVEYS NO MACRONUTRIENT ANALYSIS DATA IS AVAILABLE FOR NATIONAL SURVEYS																
INTERNATIONAL SURVEYS WITH A SA COMPONENT																
PURE-NWP-SA Dolman *et al.*, 2013[105]	2005	35–70	B	NWP	U	588	12.9 (11.8–14.1)			68.9 (63.5–73.2)	29.1 (24.4–33.0)	7.19 (5.92–8.77)	8.17 (6.56–9.71)		8.38 (6.08–11.10)	
					R	480	11.1 (10.0-12.3)			58.0 (53.6–62.9)	19.9 (15.9–24.6)	4.14 (2.90–5.77)	6.61 (4.86–8.52)		6.76 (3.79–10.40)	
PURE-NWP-SA Richter *et al.*, 2014[33]	2005	35–70	B	NWP	U	591					27.51 (27.0–28.0)	7.11 (6.9–7.3)	7.94 (7.7–8.1)	12.16 (11.9–12.4)		
					R	633					19.84 (19.30–20.38)	4.42 (4.21–4.63)	6.55 (6.31–6.80)	8.78 (8.59–9.96)		
PURE-NWP-SA Vorster *et al.*, 2014[154]	2005	35–70	B	NWP	U	366										8.8 (8.3,9.2)
					R	459										7.6 (7.1, 8.2)
	2010				U	366										11.2 (10.5,11.9)
					R	459										11.3 (10.5,12.2)
PURE-NWP-SA Wentzel-Viljoen *et al.*, 2018[93]	2005	35–70	B	NWP	U	355	12.5 (11.3-13.5)	5.8 (4.7-7.2)	6.1 (5.3-6.8)	55.7 (51.1-60.2	28.4 (23.7-31.9	7.0 (5.8-8.6)	8.0 (6.4-9.7)	8.0 (6.4-9.7)	8.2 (5.7-10.8)	0.0 (0.0-4.4)
					R	411	10.9 (9.9-12.0)	3.3 (2.2-4.8)	7.5 (6.6-8.0)	66.7 (61.3-71.9)	20.3 (15.6-24.5)	4.3 (2.9-5.7)	6.5 (4.8-8.6)	4.5 (3.2-5.9)	6.4 (3.7-10.2)	0.0 (0.0-0.0)
	2010				U	355	12.5 (11.1-14.3)	6.8 (51.-9.2)	5.5 (4.6-6.2)	54.1 (49.5-59.8)	27.7 (22.8-32.3)	7.5 (5.9-9.0)	7.6 (6.1-9.3)	7.6 (6.1-9.3)	9.0 (5.9-14.5)	0.0 (0.0-1.5)
					R	411	11.1 (9.6-12.9)	4.5 (2.8-6.7)	6.3 (5.4-7.4)	61.7 (53.8-67.7)	22.9 (17.7-30.0)	6.5 (4.6-8.5)	7.3 (4.9-9.9)	6.2 (4.6-9.9)	8.9 (4.3-14.9)	0.0 (0.0-0.0)

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Table 5.4.7 Continued

FEMALES: Nutrient, added sugar and alcohol distribution per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Percentage of total energy									
							Protein (% of TE)	**Animal protein (% of TE)**	**Plant Protein (% of TE)**	**CHO (% of TE)**	**Fat (% of TE)**	**Saturated fat (% of TE**	**Poly-unsaturated fat (% of TE)**	**Mono-unsaturated fat (% of TE)**	**Added sugar (% of TE)**	**Alcohol (% of TE)**
REGIONAL SA STUDIES																
I-CHD study Wolmarans *et al.* 1999[98]	1984 – 1986	15–69	I	KZN	U	69	13.5 (10.8–16.6)	8.7 (4.7–12.0)	5.1 (3.7–6.1)	48.6 (40.7–55.0)	36.9 (31.1–40.5)	9.8 (6.7–12.5)	11.3 (8.1–14.9)	10.9 (8.4–13.0)	14.2 (9.7–20.9)	
		25–34				79	13.3 (10.3–17.7)	8.6 (3.2–13.1)	5.3 (3.8–6.9)	48.8 (41.6–54.7)	34.8 (29.7–40.3)	9.0 (6.7–10.4)	11.7 (9.7–15.0)	9.9 (7.6–11.7)	13.4 (9.4–21.0)	
		35–44				103	13.6 (9.7–16.7)	7.7 (2.8–12.0)	5.5 (4.0–6.8)	48.8 (41.6–54.7)	36.0 (29.4–42.0)	8.5 (6.1–11.5)	12.4 (9.7–15.7)	9.6 (7.2–11.8)	13.8 (9.1–17.8)	
		45–54				75	13.0 (9.8–15.7)	6.9 (2.5–10.9)	5.5 (4.1–7.1)	53.0 (43.1–58.2)	32.8 (26.9–39.1)	7.0 (5.1–9.8)	12.5 (9.4–15.5)	8.3 (6.1–11.6)	11.6 (7.7–19.0)	
		55–69				44	11.9 (9.2–15.3)	6.0 (3.4–9.7)	5.5 (4.5–6.8)	50.4 (46.4–60.4)	34.0 (26.5–38.9)	8.2 (5.5–10.5)	11.6 (8.8–15.5)	9.1 (6.0–10.5)	11.4 (7.2–17.4)	
CT black elderly study Charlton *et al.*, 2001[30]	1990	≥60	B	WC	PU IS	74	14.2 (4.5)	52 (23)		64.8 (14.4)	24.1 (10.8)				15.9 (10.5)	
Cape Flats study Charlton *et al.*, 2001[30]	1993	≥65	C	WC	U	96	14.7 (3.3)			55.9 (7.3)	33.1 (5.6)				16.2 (9.2)	
West Coast villages study Charlton *et al.*, 2001b[39]	1997	≥55	C	WC	R	91	14.4 (3.7)			49.7 (8.1)	32.3 (6.4)					0.98 (5.5)
THUSA study MacIntyre *et al.*, 2002[96]	1996 – 1998	15–80	B	NWP	UU	106	13.4 (0.21)			55.6 (0.89)	31.8 (0.67)					
					MU	292	12.1 (0.12)			61.5 (0.54)	27.7 (0.40)					
					IS	172	11.8 (0.16)			64.1 (0.70)	25.6 (0.53)					
					F	148	11.3 (0.18)			68.3 (0.75)	22.6 (0.57)					
					R	290	11.4 (0.13)			67.0 (0.54)	23.6 (0.41)					

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Table 5.4.7 Continued

FEMALES: Nutrient, added sugar and alcohol distribution per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Percentage of total energy									
							Protein (% of TE)	**Animal protein (% of TE)**	**Plant Protein (% of TE)**	**CHO (% of TE)**	**Fat (% of TE)**	**Saturated fat (% of TE**	**Poly-unsaturated fat (% of TE)**	**Mono-unsaturated fat (% of TE)**	**Added sugar (% of TE)**	**Alcohol (% of TE)**
REGIONAL SA STUDIES																
Women's Health Study Hattingh *et al.*, 2008[92]	2000	25–34	B	FS	PU	279	12 (7-22)	6 (0.4-19)	5 (2-10)	51 (33-77)	32 (10-54)	9 (2-18)	9 (3-26)	10 (3-21)	12 (1-39)	
		35–44				217	12 (4-24)	6 (0.5-20)	5 (2-11)	53 (31-83)	31 (8-53)	9 (2-17)	8 (2-23)	10 (3-19)	13 (2-37)	
CT peri-urban study Charlton *et al.*, 2005[182]	n/d	≥ 60	B	WC	PU	205	14.7 (4.8)			63.8 (11.1)	20.5 (9.5)				9.9 (7.9)	
Stanger Study Naicker *et al.*, 2015[24]	2008	35–55	I	KZN	U	139	12.0			47.0	37.1	9.4	11.2	8.9	12.5	
Umlazi Study Mkhize *et al.*, 2013[49]	2009 – 2010	≥ 60	B	KZN	PU	222	15			65	20					
CRIBSA Study Steyn *et al.*, 2016[205]	1990	19–44	B	WC	U	364	14.5 (4.8)			62 (15.3)	27 (11.2)	8.8 (4.3)	6.3 (3.0)	9.4 (5.0)	13.6 (11.1)	
		45–64				117	14.3 (3.3)			62.7 (12.2)	26.1 (9.6)	9.2 (3.9)	5.4 (3.0)	9.3 (4.0)	11.4 (6.6)	
	2009	19–44				216	12.4 (4.5)			55.5 (12.5)	33.4 (11.8)	8.6 (3.8)	11.5 (6.7)	10.8 (4.7)	13.3 (9.6)	
		45–64				114	12.7 (4.9)			57.3 (15.0)	32.6 (14.1)	9.6 (7.9)	10.8 (7.8)	9.8 (5.2)	12.2 (8.9)	
Empangeni Study Kolahdooz *et al.*, 2013[94]	2011	19–50	B	KZN	R	40	11 (2)			67 (12)	17 (9)					
		>50				44	12 (3)			64 (11	17 (7)					

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Table 5.4.7 Continued

FEMALES: Nutrient, added sugar and alcohol distribution per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	Percentage of total energy									
							Protein (% of TE)	**Animal protein (% of TE)**	**Plant Protein (% of TE)**	**CHO (% of TE)**	**Fat (% of TE)**	**Saturated fat (% of TE**	**Poly-unsaturated fat (% of TE)**	**Mono-unsaturated fat (% of TE)**	**Added sugar (% of TE)**	**Alcohol (% of TE)**
REGIONAL SA STUDIES																
ELS Sekgala *et al.*, 2018b[97]	2015	18–24	B	LP	R	101	11.6 (9.24)			65.98 (28.8)	20.71 (22.37)	4.56 (8.42)	2.97 (7.67)	5.39 (10.50)		
		25–30				217	11.7 (12.78)			62.29 (33.4)	22.75 (25.80)	5.28 (10.62)	4.16 (8.61)	6.97 (14.95)		
		All				318	11.7 (11.19)			63.7 (30.91	22.1 (24.26)	5.0 (9.91)	3.4 (8.18)	6.4 (14.01)		
STUDIES IN SA STUDENTS																
University of the North Steyn *et al.* 2000[95]	1994	17–34	B	LP	U	45	12.8 (2.8)			63.4 (9.8)	28.9 (7.3)				10.4 (5.4)	
					R	70	13.2 (2.9)			62.0 (8.6)	30.1 (6.8)				8.9 (4.9)	

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MICRONUTRIENT INTAKES

Table 5.5.1: Micronutrient intake of South African males: Vitamins

MALES: Vitamin intakes per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	**VITAMINS** **Vit A µg (RE*/ RAE**)**	**Vit D µg (*IU)**	**Vit E µg**	**Vit C mg**	**Thiamin mg**	**Ribofla-vin mg**	**Niacin mg**	**Vit B6 mg**	**Biotin µg**	**Pantho thenic acid mg**	**Folate µg DFE**	**Vit B12 µg**
NATIONAL SURVEYS NO MACRONUTRIENT ANALYSIS RECORDED IN NATIONAL SURVEYS																		
INTERNATIONAL STUDIES WITH A SA COMPONENT																		
PURE-NWP-SA Dolman *et al.*, 2013[105] (using SA FCT) *% not meeting the EAR/AI*	2005	35–70	B	NWP	U	328	809 (523-1439) *23.5%*			30.7 (17.8-55.4) *89%*	1.8 (1.3-2.7) *14.0%*	1.5 (1.1-2.0) *26.8%*	17.2 (13.0-23.2) *19.5%*	1.7 (1.1-2.6) *31.1%*		4.7 (3.2-6.2) *56.7%*	438 (304-625) *27.1%*	4.5 (2.5-7.5) *18.9%*
					R	314	409 (257-648) *62%*			11.2 (6.1-15.5) *99.7%*	1.5 (1.1-2.0) *20.1%*	0.8 (0.6-1.4) *68.5%*	11.3 (8.6-16.3) *55.1%*	1.2 (0.8-1.6) *50.3%*		2.7 (1.9-3.6) *89.5%*	359 (228-460) *42.4%*	1.5 (0.8-2.9) *61.2%*
PURE-NWP-SA Wentzel-Viljoen *et al.*, 2018[93] *(using SA FCT)* *% not meeting the EAR/AI*	2005	35–70	B	NWP	U	202	890 (536-1447) *33.2%*	3.2 (1.98-4.8) *97.5%*	12.4 (8.3-17.4) *48.5%*	33 (20-57) *84.2%*	1.9 (1.3-2.7) *12.9%*	1.5 (1.1-2.1) *26.2%*	18.5 (14.0-25.1) *19.3%*	1.8 (1.2-2.7) *28.2%*	45.8 (29.5-61.7) *25.3%*	4.9 (3.6-6.6) *51.0%*	443.0 (307.3-626.5) *26.2%*	4.8 (2.4-7.7) *25.2%*
	2010						1742 (1042-2572) *5.5%*	5.0 (2.8-8.2) *82.2%*	16.0 (10.9-24.2) *30.2%*	62 (36-97) *58.4%*	2.3 (1.5-3.1) *3.5%*	2.3 (1.5-3.1) *7.9%*	34.4 (25.2-49.7) *0.0*	4.4 (3.0-6.4) *1.0%*	62.5 (41.9-88.7) *9.9%*	8.61 (6.2-11.4) *15.8%*	675.9 (485.3-1022.8) *8.4%*	6.4 (3.8-11.9) *8.4%*
	2005				R	186	426 (274-712) *70.4%*	1.7 (0.9-2.7) *98.8%*	8.4 (5.2-11.9) *75.8%*	12 (7-16) *99.5%*	1.6 (1.2-2.1) *14.5%*	0.9 (0.7-1.4) *63.4%*	12.2 (9.4-17.6) *48.9%*	1.2 (0.94-1.6) *46.8%*	25.0 (18.2-31.9) *67.7%*	2.9 (2.2-4.1) *85.0%*	356.9 (268.9-467.5) *39.8%*	1.8 (0.9-2.95) *39.8%*
	2010						941 (535-1727) *30.7%*	2.4 (0.96-5.1) *90.3%*	11.9 (6.1-19.6) *51.6%*	29 (14-56) *85.0%*	1.9 (1.3-2.8) *10.8%*	1.4 (0.97-1.97) *32.8%*	24.1 (17.0-34.8) *7.0%*	2.9 (1.9-4.3) *8.6%*	30.8 (19.2-48.4) *48.4%*	4.6 (3.1-6.5) *55.4%*	467.7 (300.8-744.9) *29.0%*	2.73 (1.3-5.5) *29.0%*
Cape Flats study Charlton *et al.*, 1998[84] *(using SA FCT)*	1993	≥65	C	WC	U		1185 (971)	3.6 (2.7)	14.7 (7.3)	61 (62)	0.95 (0.47)	1.4 (0.9)	16.3 (8.5)	1.3 (0.7)			236 (129)	8.9 (8.3)

Table 5.5.1 Continued

MALES: Vitamin intakes per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	VITAMINS											
							Vit A µg (RE*/ RAE)**	**Vit D µg (*IU)**	**Vit E µg**	**Vit C mg**	**Thiamin mg**	**Ribofla-vin mg**	**Niacin mg**	**Vit B6 mg**	**Biotin µg**	**Pantho thenic acid mg**	**Folate µg DFE**	**Vit B12 µg**
REGIONAL SA STUDIES																		
West Coast villages study Charlton *et al.*, 2001 *(using SA FCT)*	1997	≥55	C	WC	R	38		3.8 (3.6)										
HDSS study, Limpopo Steyn *et al.*, 2001[100] *(using Foodfinder)*	1997 1998	≥20	B	LP	R	74					1.3	1.0	11.8	0.5			110	
THUSA study MacIntyre *et al.*, 2002[96] *(using Foodfinder)*	1996 1998	15–80	B	NWP	UU	83	900 (67.7)			67.4 (3.6)	1.3 (0.1)	1.8 (0.08)	18.6 (0.9)				244 (11.3)	1.56 (0.06)
					MU	229	762 (40.7)			36.8 (2.2)	1.2 (0.03)	1.5 (0.05)	16.2 (0.53)				237 (6.8)	1.2 (0.04)
					IS	128	729 (54.5)			29.4 (2.9)	1.15 (0.05)	1.5 (0.07)	14.9 (0.71)				209 (9.1)	1.1 (0.05)
					F	109	588 (59.0)			21.9(3.2)	1.12 (0.05)	1.4 (0.07)	11.7 (0.77)				187 (9.8)	0.83 (0.06)
					R	194	609 (44)			29.5 (2.4)	1.22 (0.04)	1.4 (0.05)	14.7 (0.57)				227 (7.4)	0.98(0.04)
Sharpeville elderly facility study: Oldewage-Theron, *et al.* 2008[62] (using Foodfinder) *% not meeting the EAR/AI*	2004	≥ 60	B	GP	PU	20	447.7 ±746.3* 447.7 ±746.3* *77%*	3.3±3.9 *100%*	6.3±5.9 *88%*	65.6 ±166.2 65.6 ±166.2 *85%*	1.3±0.6 *35%*	0.9±0.6 *58%*	16.8±9.0 *23%*	1.2±0.9 *73%*	25.9±12.0 *62%*	5.9±4.0 *65%*	165.5±99.5 *92%*	3.3±3.2 *50%*
CT peri-urban study Charlton, *et al.*, 2007[41] *(using SA FCT)*	n/d	≥ 60	B	WC	PU	52	804 (1069)	2.08 (3.11)	5.79 (5.16)	27.3 (24.5)	0.85 (0.31)	0.68 (0.40)	11.9 (5.0)	0.81 (0.39)	21.5 (11.4)	3.9 (2.4)	190 (173)	2.7 (3.1)

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Table 5.5.1 Continued

MALES: Vitamin intakes per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	**VITAMINS** Vit A µg (RE*/ RAE**)	Vit D µg (*IU)	Vit E µg	Vit C mg	Thiamin mg	Ribofla-vin mg	Niacin mg	Vit B6 mg	Biotin µg	Pantho thenic acid mg	Folate µg DFE	Vit B12 µg
REGIONAL SA STUDIES																		
Somerset-West Elderly study, Marais *et al.* 2007[195] *(using Foodfinder)*	n/d	≥ 60	n/d	WC	U	53	957	3	9	49	1	1	12	1	18	3	192	4
Umlazi Study Mkhize *et al.* 2013[49] *(using Foodfinder % not meeting the) EAR*	2009 2010	≥ 60	B	KZN	PU	45	445.9 (776.3) *100%*	2.4 (2.7) *91%*	5.0 (3.2) *95.6%*	32.7 (31.3) *93%*	0.76 (0.29) *73%*	0.63 (0.45) *89%*	9.08 (4.6) *61%*	2.6 (7.8) *86%*	18.38 (13.73) *84%*	4.04 (2.45) *64%*	165.2 (83.9) *77%*	2.0 (2.1) *70%*
Empangeni Study Kolahdooz *et al.*, 2013[94] *(using US FCT)*	2011	19–50	B	KZN	R	33	125 (246)**	*0.18 (2.55)* 7.5 (102)*	8.2 (7.0)	20 (93)	3.1 (1.3)	2.0 (0.9)	30 (13)	1.7 (0.9)		4.2 (1.9)	1633 (732)	1.3 (4.8)
		>50				18	134 (426)**	*0.18 (0.8)* 7.7 (32.1)*	8.1 (6.0)	20 (37)	2.8 (1.5)	2.1 (1.9)	29 (20)	2.2 (1.2)		3.8 (4.5)	1532 (923)	1.1 (4.1)
STUDIES IN SA STUDENTS NO DATA RECORDED																		

Vitamin D expressed in IU was converted to µg for this review

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Table 5.5.2: Micronutrient intake of South African females: Vitamins

FEMALES: Vitamin intakes per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	**VITAMINS**											
							Vit A µg (RE*/ RAE)**	**Vit D µg (*IU)**	**Vit E µg**	**Vit C mg**	**Thiamin mg**	**Riboflavin mg**	**Niacin mg**	**Vit B6 mg**	**Biotin µg**	**Pantothenic acid mg**	**Folate µg DFE**	**Vit B12 µg**
NATIONAL SURVEYS NO MACRONUTRIENT ANALYSIS RECORDED IN NATIONAL SURVEYS																		
INTERNATIONAL STUDIES WITH A SA COMPONENT																		
PURE-NWP-SA Dolman *et al.*, 2013[105] (using SA FCT) *% not meeting the EAR/AI*	2005	35–70	B	NWP	U	588	828 (408-1398) *36.5%*			32.1 (17.0-53.9) *81.0%*	1.41 (0.98-2.10) *20%*	1.3 (0.9-1.9) *39.9%*	14.3 (9.9-20.4) *32.5%*	1.40 (0.9-2.1) *40.6%*		4.20 (2.8-5.7) *64.2%*	339 (235-490) *44.4%*	4.0 (2.1-6.7) *23.5%*
					R	480	452 (289-693) *68.2%*			11.9 (7.3-17.6) *98.1%*	1.4 (1.0-1.7) *16%*	0.7 (0.5-1.0) *71.1%*	9.9 (7.6-12.6) 61.6%	1.1 (0.8-1.4) 54.9%		2.5 (1.9-3.3) 93.7%	317 (224-417) 51.5%	1.54 (0.7-2.9) 61.2%
PURE-NWP-SA Wentzel-Viljoen *et al.*, 2018[93] *(using SA FCT) % not meeting the recommendations*	2005	35–70	B	NWP	U	355	995 (560-1563) *21.4%*	2.8 (1.6-4.7) *96.3%*	12.4 (8.4-16.9) *46.2%*	40 (21-59) *75.2%*	1.5 (1.1-2.2) *12.7%*	1.4 (0.9-2.0) *21.7%*	16.1 (11.3-22.3) *22.6%*	1.6 (1.1-2.3) *30.7%*	42.8 (29.8-58.3) *25.1%*	4.7 (3.4-6.2) *56.1%*	374 (272-531) *36.6%*	4.6 (2.7-7.5) *17.6%*
	2010						1724 (985-2588) *3.1%*	4.2 (2.5-6.6) *91.6%*	14.7 (9.6-21.7) *37.2%*	64 (40-107) *46.6%*	2.0 (1.6-2.9) *4.2%*	1.9 (1.4-2.7) *7.6%*	28.2 (21.0-38.9) *2.0%*	3.4 (2.5-4.7) *2.0%*	58.7 (38.6-78.7) *14.9%*	6.8 (5.4-9.5) *20.0%*	533 (375-781) *17.6%*	5.6 (3.1-10.6) *12.4%*
	2005				R	411	476 (336-704) *53.3%*	1.6 (0.8-2.6) *98.6%*	7.9 (5.6-12.1) *74.5%*	13 (8-19) *96.1%*	1.4 (1.1-1.8) *8.0%*	0.7 (0.6-1.0) *68.1%*	10.4 (8.4-13.6) *55.2%*	1.2 (0.9-1.5) *50.6%*	22.2 (16.9-31.7) *72.0%*	2.6 (2.0-3.5) *92.0%*	335 (253-429) *45.7%*	1.7 (0.8-3.0) *56.9%*
	2010						959 (609-1575) *18.0%*	1.9 (0.9-0.9) *94.4%*	11.2 (6.9-16.7) *53.3%*	32 (18-55) *78.4%*	1.8 (1.3-2.6) *9.3%*	1.2 (0.9-1.7) *25.3%*	22.2 (15.7-30.6) *6.6%*	2.2 (1.5-3.8) *11.4%*	29.2 (20.1-44.5) *51.6%*	4.3 (3.1-6.6) *59.6%*	424 (260-663) *34.6%*	2.4 (1.2-5.2) *41.6%*
REGIONAL SA STUDIES																		
Cape Flats study Charlton *et al.*, 1998[84] *(using SA FCT)*	1993	≥65	C	WC	U	104	987 (759)	2.8 (1.7)	13.2 (6.6)	65 (84)	0.9 (0.4)	1.3 (0.7)	14.4 (6.2)	1.3 (0.6)			210 (92)	*6.8 (6.2)*
West Coast villages study Charlton *et al.*, 2001[39] *(using SA FCT)*	1997	≥55	C	WC	R	91		2.1 (1.95)										

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Table 5.5.2 Continued

FEMALES: Vitamin intakes per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	**VITAMINS** Vit A µg (RE*/ RAE**)	Vit D µg (*IU)	Vit E µg	Vit C mg	Thiamin mg	Riboflavin mg	Niacin mg	Vit B6 mg	Biotin µg	Pantothenic acid mg	Folate µg DFE	Vit B12 µg
REGIONAL SA STUDIES																		
HDSS study, Limpopo Steyn *et al.*, 2001[100] *(using Foodfinder)*	1997 1998	≥20	B	LP	R	136	423			32.3	1.3	0.9	11.0	0.5			107.4	3.3
THUSA study MacIntyre *et al.*, 2002[96] *(using Foodfinder)*	1996 1998	15–80	B	NWP	UU	106	1246 (66.3)			82.9 (3.8)	1.15 (0.05)	1.6 (0.07)	15.7 (0.6)				225 (7.8)	1.45 (0.05)
					MU	292	892 (40.0)			43.2 (2.3)	1.06 (0.03)	1.4 (0.04)	13.0 (0.34)				209 (4.7)	1.11 (0.03)
					IS	172	773 (52.1)			31.9 (3.0)	1.05 (0.04)	1.2 (0.05)	12.6 (0.45)				182 (6.1)	1.05 (0.04)
					F	148	533 (56.1)			24.6 (3.2)	1.04 (0.04)	1.4 (0.06)	11.0 (0.48)				177 (6.6)	0.80 (0.04)
					R	290	573 (40.1)			29.9 (2.3)	1.07 (0.02)	1.2 (0.04)	11.3 (0.34)				181 (4.7)	0.84 (0.03)
Women's Health Study Hattingh *et al.*, 2008[92] *(using SA FCT)*	2000	25–34	B	FS	PU	279	687 (49-5934)	4.9 (0-36.3)	15.3 (0.8-74.4	54.8 (3.2-1424	1.7 (0.3-10.3)	2.1 (0.3-3776)	20.5 (4-94)	1.5 (0.3-9.4)	35.7 (1.9-325.1)	5.5 (0.4-21.6)	241 (31-1525)	5.1 (0.2-50.2)
		35–44				217	698 (85-5198)	4.4 (0.3-31.8)	13.6 (1.3-92.6)	45.4 (3.5-1691)	1.5 (0.3-8.6)	1.8 (0.2-9.8)	18.6 (2.2-106.1)	1.1 (0.2-12)	33.4 (4-154)	5.3 (0.6-16.8)	234 (40.8-1467)	4.6 (0.1-30.7)
Sharpeville elderly facility study: Oldewage-Theron, *et al.* 2008[62] (using Foodfinder) *% not meeting the EAR/AI*	2004	≥ 60	B	GP	PU	113	361.1 ±765.7 * *80%*	1.2±2.1 *100%*	3.9±6.7 *99%*	32.4±69.7 *83%*	0.8±0.5 *61%*	0.7±0.8 *79%*	9.8±6.8 *59%*	0.7±0.5 *87%*	19.4±27.6 *84%*	3.6±3.1 *69%*	136.3 ±124.9 *89%*	1.9±3.1 *69%*
CT peri-urban study Charlton, *et al.*, 2007[41] *(using SA FCT)*	n/d	≥ 60	B	WC	PU	205	691 (1302)	1.86 (3.00)	5.3 (5.1)	41.6 (61.0)	0.79 (0.36)	0.68 (0.74)	11.7 (5.8)	0.77 (0.42)	20.8 (13.7)	3.8 (2.4)	176 (136)	3.8 (11.7)

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Table 5.5.2 Continued

FEMALES: Vitamin intakes per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	VITAMINS											
							Vit A µg (RE*/ RAE)**	**Vit D µg (*IU)**	**Vit E µg**	**Vit C mg**	**Thiamin mg**	**Ribofla-vin mg**	**Niacin mg**	**Vit B6 mg**	**Biotin µg**	**Pantho thenic acid mg**	**Folate µg DFE**	**Vit B12 µg**
REGIONAL SA STUDIES																		
Vaal Area INP Oldewage-Theron *et al.*, 2005[102] *(using Foodfinder)*	2004 2019	19–90	B	GP	PU IS	QFFQ 357	210.64 (452.49)	1.45 (2.09)	7.42 (10.38)	13.4 (25.7)	0.6 (0.51)	0.32 (0.51)	4.58 (6.66)	0.30 (0.50	10.52 (10.35)	1.67 (2.19)	64.19 (87.64)	1.33 (2.76)
						24h recall 357	175.91 (617.28)	0.73 (1.84)	4.56 (7.33)	14.32 (14.87)	0.72 (0.32)	0.35 (0.36)	4.93 (4.08)	0.34 (0.23)	14.62 (25.30)	1.78 (1.65)	85.13 (125.11)	1.19 (3.17)
Vaal Area INP Oldewage-Theron *et al.*, 2014[103] *(using Foodfinder)*	2004 2019	19–90	B	GP	PU IS	Low DDS 117				17.5 (28.8)								
						Med DSS 156				21.2 (36.0)								
						High DDS 449				20.5 (34.1)								
Vaal Area INP Acham *et al.*, 2012[124] *(using Foodfinder) % not meeting the EAR/AI*	2004 2007	All	B	GP	PU IS	260	945.33* (1981.97) *58.1%*			58.02 (90.38) *73.5%*	1.15 (0.75) *45.0%*	1.51 (1.53) *50.0%*	18.93 (30.10) *34.2%*	1.74 (1.23) *37.3%*			540.89 (484.06) *40.8%*	7.66 (18.53) *42.3%*
		19–25				46	1254.61* (2487.02) *58.7%*			78.87 (93.00) *56.5%*	1.47 (0.96) *30.4%*	2.07 (1.84) *37.0%*	19.91 (14.32) *30.4%*	2.03 (1.17) *23.9%*			553.74 (469.15) *39.1%*	11.02 (23.77) *26.1%*
		26–35				67	1198.75* (1860.55) *40.3%*			91.40 (19.22) *58.2%*	1.34 (0.88) *37.3%*	1.95 (1.78) *41.8%*	18.94 (12.75) *32.8%*	1.77 (1.15) *32.8%*			482.40 (431.61) *43.3%*	7,54 (13.20) *37.3%*
		36–45				56	1125.21* (2869.70) *62.5%*			35.13 (48.47) *85.7%*	1.05 (0.68) *50.0%*	1.35 (1.58) *60.7%*	24.32 (61.04) *32.1%*	1.97 (1.69) *35.7%*			713.98 (587.12) *32.1%*	10.90 (28.99) *39.3%*
		46–55				41	508.69* (66.99) *63.4%*			34.81 (51.43) *87.8%*	0.99 (0.44) *51.2%*	1.12 (0.97) *53.7%*	17.67 (8.72) *26.8%*	1.72 (0.92) *34.1%*			594.79 (503.29) *41.5%*	3.91 (3.86) *48.8%*
		≥56				50	477.77* (633.81) *72.0%*			38.77 (89.07) *84.0%*	0.86 (0.41) *58.0%*	0.92 (0.55) *58.0%*	13.02 (8.23) *48.0%*	1.18 (0.79) *60.0%*			369.41 (346.80) *48.0%*	4.16 (7.68) *62.0%*

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Table 5.5.2 Continued

FEMALES: Vitamin intakes per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	**VITAMINS** Vit A µg (RE*/ RAE**)	Vit D µg (*IU)	Vit E µg	Vit C mg	Thiamin mg	Riboflavin mg	Niacin mg	Vit B6 mg	Biotin µg	Panthothenic acid mg	Folate µg DFE	Vit B12 µg
REGIONAL SA STUDIES																		
Somerset-West Elderly study, Marais *et al.* 2007[195] *(using Foodfinder)*	n/d	≥ 60	n/d	WC	U	157	957	3	9	49	1	1	12	1	18	3	192	4
Umlazi Study Mkhize *et al.* 2013[49] *(using Foodfinder % not meeting the) EAR*	2009 2010	≥ 60	B	KZN	PU	124	359.2 (640.4) *89.0%*	2.37 (2.63) *98.2%*	4.47 (2.58) *98.6%*	33.8 (44.7) *86.5%*	0.7 (0.26) *82.9%*	0.61 (0.48) *82.9%*	9.47 (4.66) *71.6%*	0.70 (0.33) *95.5%*	18.5 (14.6) *93.7%*	3.73 (2.06) *85.6%*	150 (89) *96.8%*	3.45 (7.25) *58.1%*
Empangeni Study Kolahdooz *et al.*, 2013[94] *(using US FCT)*	2011	19–50	B	KZN	R	40	216 (336)**	*0.23 (3.2)* 9.0 (128)*	10.4 (5.3)	38.1 (40.5)	2.6 (1.2)	1.9 (0.9)	28 (12)	1.8 (0.6)		3.7 (1.4)	1429 (793)	1.1 (6.2)
		>50				44	196 (204)**	*0.23 (3.7)* 8.8 (149)*	10.9 (8.4)	44 (45)	3.1 (1.1)	2.3 (0.8)	31.8 (11.0)	1.8 (0.6)		3.8 (1.5)	1763 (716)	1.5 (6.7)
STUDIES IN SA STUDENTS																		
University of the North Steyn *et al.*, 2000[95] *(using Foodfinder)*	1994	17–34	B	LP	U	45	2105 (1769)			217 (204)	1.4 (0.5)	2.2 (1.3)	18.1 (7.4)	2.0 (1.0)			269 (128)	7.0 (9.3)
					R	70	1655 (1498)			200 (215)	1.4 (0.6)	2.0 (1.0)	17.6 (6.6)	1.8 (0.8)			296 (161)	8.4 (12.8)

Vitamin D expressed in IU was converted to µg for this review

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Table 5.5.3: Micronutrient intakes of South African adults: Vitamins for males and females published as combined data

MALES AND FEMALES Combined data -Vitamin intakes per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	**VITAMINS** Vit A µg (RE*/ RAE**)	Vit D µg (*IU)	Vit E µg	Vit C mg	Thiamin mg	Riboflavin mg	Niacin mg	Vit B6 mg	Biotin µg	Pantothenic acid mg	Folate µg DFE	Vit B12 µg
CT black elderly study Charlton *et al.*, 2001[30] *(using SA FCT)*	1990	≥60	B	WC	PU IS	148	1214 (4456)	2.0 (3.2)	6.2 (6.6)	49 (108)	0.9 (0.6)	1.29 (2.5)	14.8 (10.6)	1.1 (0.7)			210 (250)	9.2 (47.6)
Qwa-Qwa INP (Rural) Oldewage-Theron *et al.*, 2012[125] *(using Foodfinder)*	2008 2009	21–60	B	FS	R	383	444 (1239)	1.4 (2.3)	4.2 (4.5)	28.1 (44.0)	0.7 (0.5)	0.6 (0.7)	10.9 (9.5)	0.8 (0.6)	14.3 (12.2)	3.6 (4.0)	213.5 (190.3)	1.2 (5.6)

Table 5.5.4: Micronutrients intakes of South African males: Minerals and electrolytes

MALES: Mineral and electrolyte intakes per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	**MINERALS** Ca mg	Mg mg	Phosphate (P) mg	Fe mg	Zn mg	Cu mg	Cr mg	Se mg	Mn µg	Iodine µg	Potassium (K) mg
NATIONAL SURVEYS (NO DATA RECORDED)																	
INTERNATIONAL SURVEYS WITH A SA COMPONENT																	
PURE-NWP-SA Dolman *et al.*, 2013[105] (using SA FCT) *using SA FCT) % not meeting the EAR/AI*	2005	35–70	B	NWP	U	328	369 (277-535) *75.0%*	379 (277-519) *96.3%*		15.1 (10.8-20.9) *40.6%*	11.8 (8.6-16.8) *7.0%*	139 (103-186) *11%*			2488 (1765-3482) *46.0%*		1988 (1449-2741) *97.3%*
					R	314	213 (139-309) *95.2%*	277 (194-421) *99.0%*		11.9 (8.7-15.2) *66.6%*	8.3 (6.2-10.8) *13.7%*	102 (76-139) *19.4%*			1554 (834-3051) *67.2%*		1309 (956-1714) *99.7%*

Table 5.5.4 Continued

MALES: Mineral and electrolyte intakes per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	**MINERALS** Ca mg	Mg mg	Phosphate (P) mg	Fe mg	Zn mg	Cu mg	Cr mg	Se mg	Mn µg	Iodine µg	Potassium (K) mg
NATIONAL SURVEYS (NO DATA RECORDED)																	
PURE-NWP-SA Wentzel-Viljoen et al., 2018[93] *(using SA FCT) % not meeting the EAR/AI*	2005	35–70	B	NWP	U	202	397 (292-573) *89.6%*	389 (288-539) *38.1%*	1107 (856-1477) *9.4%*	16.0 (11.2-21.9) *6.4%*	12.5 (9.0-17) *27.2%*	1.5 (1.1-1.9) *10.9%*			2647 (1899-3866) *42.6%*		2078 (1526-2809) *97.5%*
	2010						296 (432-800) *75.3%*	493 (369-745) *20.3%*	1642 (1166-2229) *1.5%*	22.2 (16.2-30.1) *0.0%*	18.4 (14.1-26.5) *5.9%*	1.9 (1.4-2.6) 0.5%			3132 (2219-4188) *27.2%*		3326 (2420-4378) *80.7%*
	2005				R	186	229 (156-345) *98.9%*	297 (214-452) *61.3%*	847 (656-1113) *18.3%*	12.2 (9.1-15.9) *6.5%*	8.6 (6.7-11.3) *55.4%*	1.1 (0.8-1.5) *14.0%*			1749 (1110-3259) *63.4%*		1394 (1089-1759) *100%*
	2010						339 (192-552) *94.1%*	402 (285-810) *38.7%*	1206 (839-1638) *9.1%*	16.0 (11.4-23.1) *4.3%*	13.3 (9.5-20.2) *24.7%*	1.4 (0.9-1.9) *9.1%*			2061 (1329-3124) *53.2%*		2441 (1711-3243) *94.1%*
REGIONAL SA STUDIES																	
Cape Flats study Charlton et al., 1998[84] *(using SA FCT)*	1993	≥65	C	WC	U		499 (263)	260 (109)	1030 (458)	9.5 (4.8)	9.3 (4.4)	1.5 (0.9)					
West Coast villages study Charlton et al., 2001 *(using SA FCT)*	1997	≥55	C	WC	R	38	493 (384)	306 (132)									2901 (1322)
HDSS study, Limpopo Steyn et al., 2001[100] *(using Foodfinder)*	1997 1998	≥20	B	LP	R	74	293			14.0	8.6						
THUSA study MacIntyre et al., 2002[96] *(using Foodfinder)*	1996 1998	15–80	B	NWP	UU	83	500 (29.0)			10.8 (0.48)	11.2 (4.2)						
					MU	229	422 (17.4)			9.1 (0.29)	8.8 (0.25)						
					IS	128	435 (23.3)			9.1 (0.38)	8.6 (0.34)						
					F	109	569 (25.3)			7.8 (0.42)	8.3 (0.36)						
					R	194	452 (18.9)			9.4 (0,31)	8.8 (0,27)						

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Table 5.5.4 Continued

MALES: Mineral and electrolyte intakes per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	**Ca mg**	**Mg mg**	**Phosphate (P) mg**	**Fe mg**	**Zn mg**	**Cu mg**	**Cr mg**	**Se mg**	**Mn µg**	**Iodine µg**	**Potassium (K) mg**
							MINERALS										
REGIONAL SA STUDIES																	
CT peri-urban study Charlton, *et al.*, 2007[41] *(using SA FCT)*	n/d	≥ 60	B	WC	PU	52	390 (378)	272 (95)	873 (329)	7.6 (3.9)	8.1 (3.8)	0.90 (0.45		12.0 (19.8)			
Sharpeville elderly facility study: Oldewage-Theron, *et al.* 2008[62] (using Foodfinder) *% not meeting the EAR/AI*	2004	≥ 60	B	GP	PU	20	238.7 ±240.6 *100%*	318.2 ±127.1 *35%*		8.5±4.3 *23%*	11.5±8.2 *35%*	0.9±0.4	60.4±51.2 *35%*				
Somerset-West Elderly study, Marais *et al.* 2007[195] *(using Foodfinder)*	n/d	≥ 60	n/d	WC	U	53	620	260	979	8	9						
Umlazi Study Mkhize *et al.* 2013[49] *(using Foodfinder % not meeting the) EAR*	2009 2010	≥ 60	B	KZN	PU	45	253.2 (165.2)	189.3 (48.3)		6.68 (3.83)	5.61 (2.12)		21.5 (14.1)	13.1 (8.6)		12.2 (7.2)	645.1 (180.1)
Empangeni Study Kolahdooz *et al.*, 2013[94] *(using US FCT)*	2011	19–50	B	KZN	R	33	329 (188)	369 (179)		27 (12)	8.6 (5.6)			99 (50)			2511 (1442)
		>50				18	299 (1009)	331 (287)		23 (15)	8.2 (7.6)			89 (60)			2174 (2306)
STUDIES IN SA STUDENTS NO DATA RECORDED																	

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Table 5.5.5: Micronutrients intakes of South African females: Minerals and electrolytes

FEMALES: Mineral and electrolyte intakes per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	MINERALS										
							Ca mg	**Mg mg**	**Phosphate (P) mg**	**Fe mg**	**Zn mg**	**Cu mg**	**Cr mg**	**Se mg**	**Mn µg**	**Iodine µg**	**Potassium (K) mg**
NATIONAL SURVEYS (NO DATA RECORDED)																	
INTERNATIONAL SURVEYS WITH A SA COMPONENT																	
PURE-NWP-SA Dolman *et al.*, 2013[105] (using SA FCT) *using SA FCT)* *% not meeting the EAR/AI*	2005	35–70	B	NWP	U	588	368 (263-586) *99.4%*	296 (203-402) *54.0%*		12.3 (8.3-17.5) *16.5%*	9.6 (6.7-14.0) *26.7%*	126 (85-173) *16.3%*			1998 (1359-2913) *42.3%*		1828 (1193-2488) *99.0%*
					R	480	186 (114-267) *100%*	225 (172-299) *80.1%*		10.6 (8.1-13.4) *18.0%*	7.3 (5.6-9.3) *42.9%*	95 (70-121) *25.2%*			1158 (667-1829) *74.3%*		1160 (905-1499) *99.7%*
PURE-NWP-SA Wentzel-Viljoen *et al.*, 2018[93] *(using SA FCT)* *% not meeting the recommen-dations*	2005	35–70	B	NWP	U	355	02 (282-622) *93.0%*	331 (237-424) *31.0%*	1018 (744-1361) *10.7%*	13.8 (9.5-18.7) *9.6%*	10.8 (7.5-14.8) *18.0%*	1.4 (1.0-1.9) *34.4%*			2252 (1532-3152) *9.6%*		2088 (1394-2581) *98.9%*
	2010						526 (372-740) *85.1%*	402 (300-548) *15.5%*	1292 (976-1751) *3.1%*	18.7 (13.8-25.2) *1.1%*	15.7 (11.8-20.9) *5.4%*	1.7 (1.3-2.4) *3.9%*			2650 (1804-3618) *24.8%*		2948 (2208-3898) *85.6%*
	2005				R	411	198 (129-277) *98.5%*	240 (188-310) *59.9%*	694 (544-876) *29.7%*	11.2 (8.9-13.9) *10.5%*	7.9 (6.2-9.6) *33.6%*	1.0 (0.8-1.3) *73.7%*			1221 (783-1876) *16.6%*		1223 (991-1546) *99.8%*
	2010						344 (200-514) *94.4%*	365 (270-522) *23.1%*	1054 (788-1413) *6.1%*	15.5 (11.2-21.6) *3.4%*	12.4 (9.0-17.3) *7.3%*	1.4 (1.0-1.9) *7.5%*			1820 (1296-2524) *49.2%*		2322 (1742-3213) *93.4%*
REGIONAL SA STUDIES																	
Cape Flats study Charlton *et al.*, 1998[84] *(using SA FCT)*	1993	≥65	C	WC	U	104	482 (216)	235 (85)	915 (327)	8.6 (3.8)	8.0 (3.1)	1.5 (0.9)					
West Coast villages study Charlton *et al.*, 2001[39] *(using SA FCT)*	1997	≥55	C	WC	R	91	455 (360)	262 (112)									2096 (1535)

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Table 5.5.5 Continued

FEMALES: Mineral and electrolyte intakes per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	**MINERALS** Ca mg	Mg mg	Phosphate (P) mg	Fe mg	Zn mg	Cu mg	Cr mg	Se mg	Mn µg	Iodine µg	Potassium (K) mg
NATIONAL SURVEYS (NO DATA RECORDED)																	
HDSS study, Limpopo Steyn *et al.*, 2001[100] *(using Foodfinder)*	1997 1998	≥20	B	LP	R	136	339			15.0	8.1						
THUSA study MacIntyre *et al.*, 2002[96] *(using Foodfinder)*	1996 1998	15–80	B	NWP	UU	106	512 (23.3)			10.4 (0.39)	10.6 (0.32)						
					MU	292	405 (14.0)			8.8 (0.24)	8.2 (0.19)						
					IS	172	387 (18.3)			8.3 (0.31)	7.6 (0.25)						
					F	148	418 (19.7)			7.5 (0.33)	7.1 (0,27)						
					R	290	384 (14.1)			8.4 (0.24)	7.6 (0.20)						
Women's Health Study Hattingh *et al.*, 2008[92] *(using SA FCT)*	2000	25–34	B	FS	PU	279	627 (113-2855	365.5 (40.2-1365)	1331 (191-4904	12.2 (2.2-65.8)	10.3 (0.5-38.0)	1.5 (0.2-8.1)	41.4 (0.9-294.3)	37.3 (1.1-232.6)	3053 (146-14023)	40.5 (1.1-187.7)	2902 (389-10054)
		35–44				217	636 (73-2890)	366 (75-954)	1295 (290-3430	11.4 (2.1-73.1)	9.6 (1.2-36.5)	1.4 (0.3-5)	41 (0.8-228)	35.9 (2-176.9)	2795 (449-9973)	36.7 (0.9-241)	2731 (651-6982)
Sharpeville elderly facility study: Oldewage-Theron, *et al.* 2008[62] (using Foodfinder) *% not meeting the EAR/AI*	2004	≥ 60	B	GP	PU	113	214.6±209.8 *100%*	222.8±124.8 *61%*		5.5±3.3 *47%*	5.8±3.7 *60%*	0.6±0.3	21.4±29.6 *57%*				
Vaal Area INP Oldewage-Theron *et al.*, 2005[102] *(using Foodfinder)*	2004 2019	19–90	B	GP	PU IS	QFFQ 357	116.2 (165.0)	(103.2)		3.54 (4,73)	2.9 (2.65)	0.39 (0.42)	14.3 (23.3)	10.27 (16.57)		11.28 (16.31)	
						24-hr recall 357	150.1 (176.7)	194.7 (93.5)		3.79 (2.04)	3.8 (2.4)	0.41 (0.29)	14.7 (19.8)	8.27 (13.15)		8.97 (18.12)	

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Table 5.5.5 Continued

FEMALES: Mineral and electrolyte intakes per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	**MINERALS** Ca mg	Mg mg	Phosphate (P) mg	Fe mg	Zn mg	Cu mg	Cr mg	Se mg	Mn µg	Iodine µg	Potassium (K) mg
NATIONAL SURVEYS (NO DATA RECORDED)																	
Vaal Area INP Oldewage-Theron *et al.*, 2014[103] *(using Foodfinder)*	2004 2019	19–90	B	GP	PU IS	Low DDS 117	172.4 (191.1)			4.3 (3.8)							
						Med DSS 156	205.8 (201.8)			5.1 (3.3)							
						High DDS 449	205.1 (219.5)			5.9 (4.5)							
Vaal Area INP Acham *et al.*, 2012[124] (using *Foodfinder) % not meeting the EAR/AI*	2004 2007	Overall	B	GP	PU IS	260	395.3 (339.7) *92.3%*			11.75 (7.57) *31.9%*	17.75 (18.68) *30.8%*						
		19–25				46	477.4 (368.8) *91.3%*			13.47 (8.46) *26.1%*	18.93 (16.87) *21.7%*						
		26–35				67	469.4 (398.5) *86.6%*			12.58 (8.43) *29.9%*	16.16 (15.73) *31.3%*						
		36–45				56	354.4 (292.2) *94.6%*			10.62 (6.89) *29.9%*	23.85 (24.71) *25.0%*						
		46–55				41	296.1 (228.0) *97.6%*			12.01 (7.94) *34.1%*	18.92 (19.51) *26.8%*						
		≥56				50	347.7 (326.4) *94.0%*			10.12 (5.40) *34.0%*	10.99 (12.61) *48.0%*						
CT peri-urban study Charlton, *et al.*, 2007[41] *(using SA FCT)*	n/d	≥ 60	B	WC	PU	205	299 (271)	224 (91)	736 (310)	6.6 (3.3)	6.5 (3.4)	0.98 (1.35)		25.8 (24.0)			

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Table 5.5.5 Continued

FEMALES: Mineral and electrolyte intakes per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	*n*	**Ca mg**	**Mg mg**	**Phosphate (P) mg**	**Fe mg**	**Zn mg**	**Cu mg**	**Cr mg**	**Se mg**	**Mn µg**	**Iodine µg**	**Potassium (K) mg**
							MINERALS										
NATIONAL SURVEYS (NO DATA RECORDED)																	
Somerset-West Elderly study, Marais *et al.* 2007[195] *(using Foodfinder)*	n/d	≥ 60	n/d	WC	U	157	620	260	979	8	9						
Umlazi Study Mkhize *et al.* 2013[49] *(using Foodfinder % not meeting the) EAR*	2009 2010	≥ 60	B	KZN	PU	124	240 (176)	641 (301)		6.1 (3.2)	6.06 (2.33)		23.23 (14.56)	12.95 (10.08)		13.57 (9.98)	641 (213)
Empangeni Study Kolahdooz *et al.*, 2013[94] *(using US FCT)*	2011	19–50	B	KZN	R	40	245 (206)	393 (133)		24 (10)	8.3 (3.6)			102 (44)			2442 (841)
		>50				44	265 (208)	409 (154)		29 (15)	9.3 (3.9)			95 (144)			2663 (1021)
STUDIES IN SA STUDENTS																	
University of the North Steyn *et al.*, 2000[95] *(using Foodfinder)*	1994	17–34	B	LP	U	45	690 (380)			13.6 (5.7)	11.0 (4.6)						
					R	70	639 (652)			13.0 (5.9)	10.1 (3.4)						

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DIETARY DIVERSITY

Table 5.6: Dietary diversity of South African adults

Dietary diversity per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	Gender	n	Assessment tool	Dietary diversity scores and classification	
								NATIONAL SURVEYS		
									Mean DDS (95% CI)	% with Low DD (DDS<4)
South African Social Attitudes Survey (SASAS) Labadarios *et al.*, 2011[111]	2009		B: 76.6% W: 10.9% C I/A: 12%			All	3287	**Dietary diversity score (DDS):** Calculated by summing the number of food groups (out of 9*) from which food had been consumed the previous day (based on 1 x 24-hour recall) *1) cereals/roots/tubers; 2) meat/poultry/fish; 3) dairy; 4) eggs; 5) vitamin A rich fruit and vegetables; 6) legumes; 7) other fruit; 8) other vegetables; 9) fats and oils. (Recommended by the United Nations Food and Agricultural Organization (FAO))	4.02 (3.96 - 4.07}	38.3
						M	1336		4.01 (3.92 - 4.09)	-
						F	1951		4.02 (3.95 - 4.10)	-
		16–24					648		3.93 (3.82 - 4.05)	-
		25–34					779		3.92 (3.82 - 4.02)	-
		35–49					1001		4.09 (3.98 - 4.19)	-
		≥ 50					859		4.08 (3.98 - 4.19)	-
				WC			441		4.78 (4.66 - 4.90}	15.7
				EC			446		3.38 (3.22 - 3.54)	59.6
				NC			228		4.05 (3.85 - 4.26)	35.1
				FS			241		4.40 (4.23 - 4.58)	26.6
				KZN			630		3.97 (3.81 - 4.12)	40.8
				NW			136		3.72 (3.43 - 4.01)	44.1
				GP			613		4.22 (4.08 - 4.36)	32.5
				MP			246		4.14 (3.95 - 4.33)	30.5
				LP			306		3.24 (3.03 - 3.45)	61.8
					UF		2024		4.42 (4.34 - 4.50)	26.0
					UI		309		3.46 (3.30 - 3.61)	55.7
					RF		355		3.17 (3.05 - 3.29)	50.1
					T		599		3.64 (3.46 - 3.81(	63.9
Low living standard							585		2.93 (2.81 - 3.05)	-
Medium living standard							1320		3.84 (3.76 - 3.93)	-
High living standard							1219		4.72 (4.64 -4.80)	-

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Table 5.6 Continued

Dietary diversity per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	Gender	n	Assessment tool	Dietary diversity scores and classification	
								NATIONAL SURVEYS		
									Mean DDS (95% CI)	**% with Low DD (DDS<4)**
SANHANES-1 Shisana *et al.*, 2013[7]	2012	All				M	13 357	**Dietary diversity score (DDS):** Calculated by summing the number of food groups (out of 9*) from which food had been consumed the previous day (based on 1 x 24-hour recall)	4.2 (4.1–4.3)	39.7
		15–24				F	3 702		4.1 (3.9–4.3)	41.7
		25–34					2 644		4.2 (4.0–4.4)	38.3
		35–44					2 215		4.1 (3.9–4.3)	40.7
		45–54					2 038		4.3 (4.1–4.5)	37.1
		55–64					1 514		4.3 (4.1–4.5)	39.8
		≥ 65					1 237		4.2 (4.0–4.5)	38.8
			B				7467		4.0 (3.8–4.1)	44.9
			W				1662		5.6 (5.2–6.0)	14.9
			C				1764		4.5 (4.2–4.7)	30.0
			I/A				2464		4.1(3.7–4.6)	31.6
				WC			2 038		4.6 (4.3–4.8)	28.2
				EC			1 532		4.0 (3.7–4.2)	42.1
				NC			955		3.8 (3.5–4.1)	43.6
				FS			711		4.0 (3.7–4.3)	45.1
				KZN			2 358		3.7 (3.5–4.0)	49.3
				NW			1 709		3.3 (3.1–3.5)	61.3
				GP			2 289		4.9 (4.6–5.2)	26.3
				MP			1 249		4.0 (3.5–4.4)	46.2
				LP			516		3.2 (2.8–3.6)	65.6
					UF		7 467		4.7 (4.5–4.9)	29.3
					UI		1 764		3.8 (3.5–4.1)	46.6
					RF		1 662		3.6 (3.4–3.9)	50.7
					RI		2 464		3.3 (3.2–3.5)	59.7

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Table 5.6 Continued

Dietary diversity per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	Gender	n	Assessment tool	Dietary diversity scores and classification
								REGIONAL SA STUDIES	
Embo study Msaki and Hendricks, 2013[118]	2004 2005	n/d	B	KZN	RF	F	200	**Food group diversity:** Based on a food group variety score. The mean number of foods types per 5 food groups that a household consumed during the previous month, was reported.	**Food group** / **November** / **March** Starch: 8.8 / 8.7 Vegetables/ Fruits: 4.95 / 5.8 Animal foods & fish: 5.0 / 5.3 Fats: 1.6 / 2.2 Legumes: 0.9 / 1.1
Sharpeville elderly facility based study Oldewage-Theron and Kruger, 2008[114] Oldewage-Theron and Kruger, 2009[186]	2004	≥60	B	GP	PU	M F	149	**Dietary diversity assessed based on a 7-day FFQ, as Dietary diversity score (DDS):** DDS was calculated by summing the number of food groups (out of 9*) from which food had been consumed (variety score among all nine food groups) **Food variety score (FVS):** Simple count of single food items within 9 food groups <30 food items consumed = low food variety 30 - 60 foods = medium food variety, > 60 foods = high variety (FVS)	**Mean DDS** / **% with Low DD (DDS:0-3)** / **% with Med DD (DDS:4-5)** / **% with High DD (DDS:6-9)** 3.41 (±1.34) / 55.1 / 37.6 / 7.4 **Mean FVS** (nr of single food items consumed in 7 days) 4.77 (±2.20) ; Range: 1-13 <30 food items consumed = low mean food variety
Vaal Area INP Oldewage-Theron *et al.*, 2014[116]	2004 2019	19– 90	B	GP	IS	F	722 384 H	**Dietary diversity assessed based on a 7-day FFQ, as Dietary diversity score (DDS):** DDS was calculated by summing the number of food groups (out of 9*) from which food had been consumed (variety score among all nine food groups) **Food variety score (FVS)**: Simple count of single food items within 9 food groups <30 food items consumed = low food variety 30 - 60 foods = medium food variety, > 60 foods = high variety (FVS) **Food group diversity score (FGDS):** Variety score within every food group	**Mean DDS** / **% with Low DD (DDS:0-3)** / **% with Med DD (DDS:4-5)** / **% with High DD (DDS:6-9)** 3.41 (±1.34) / 55.1 / 37.6 / 7.4 **Mean FVS** (nr of single food items consumed in 7 days) 4.77 (±2.20) ; Range: 1-13 <30 food items consumed = low mean food variety 6.4 (±2.4) Range: 0-9 / 16.2 / 21.6 / 62.2

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Table 5.6 Continued

Dietary diversity per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	Gender	n	Assessment tool	Dietary diversity scores and classification	
								REGIONAL SA STUDIES		
									Mean DDS (95% CI)	**% with Low DD (DDS<4)**
RENEWAL Study Drimie, *et al.*, 2013[112]	2008	n/d	B	GP		All	487	**Dietary diversity score:** Calculated by summing the number of food groups (out of 9*) from which food had been consumed the previous day (based on 1 x 24-hour recall)	4.1 (4.0; 4.3)	36.8
						M	210		4.0 (3.8; 4.3)	37.8
						F	274		4.2 (4.0; 4.4)	35.7
					UF		292		4.8 (4.6; 5.0)	15.4
					UI		195		3.2 (3.0; 3.4)	68.1
									Mean MDD-W (±SD)	**% with Low MDD-W (MDD-W<5)**
Richards Bay, Dundee, and Harrismith Study Chakona *et al.*, 2017[117]	2014 2015	15–49	B	All		F	554	**Dietary diversity score (MDD-W):** Calculated by summing the number of food groups (out of 10*) from which food had been consumed the previous 48 hours (based on 1 x 48-hour recall) **Food group: (1) Grains, white roots and tubers, and plantains (also known as starchy staples); (2) Pulses (beans, peas, lentils); (3) Nuts and seeds; (4) Dairy; (5) Meat, poultry and fish; (6) Eggs; (7) Dark green leafy vegetables; (8) Other Vitamin A-rich fruits and vegetables; (9) Other fruits and (10) Other vegetables.	4.79 ± 0.15	68
				KZN Richards Bay	U		183		3.19 ± 0.11	80
					PU				3.40 ± 0.13	78
					R				3.74 ± 0.16	74
				KZN Dundee	U		173		3.09 ± 0.11	91
					PU				3.03 ± 0.12	93
					R				4.05 ± 0.12	67
				FS Harrismith	U		198		3.78 ± 0.10	73
					PU				3.53 ± 0.12	78
Letaba study Mbhenyane *et al.*, 2017[119]	n/d	19–45	B	LP	R	F	160	Food availability and variety was determined through inventory and direct observations. Data were interpreted and contrasted for appropriateness and compliance against the eleven messages of the SAFBDGs	The list of available foods contained 46 items, some items being consumed by very few women, with the highest variety being 15 Dietary patterns only complied with three of the eleven SAFDBGs messages, namely for starch, protein and vegetable meal groupings	
									Mean DDS (+SD)	
Khayelitsha and Mitchells Plain Survey 2016 Dinbabo *et al.*, 2019[29]	2016	≥18	n/d	WC	U	M F	1500	**Dietary Diversity Score (DDS):** 12 food groups were identified based on the 36 food choices reported by participants based on 1 x 24-hour recall	3.70 (+1.73)	

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Table 5.6 Continued

Dietary diversity per study	Date of collection	Age (yrs)	Ethnicity	Province	Area	Gender	n	Assessment tool	Dietary diversity scores and classification		
								REGIONAL SA STUDIES			
									% with Low DD (DDS: 1-4)	**% with Med DD (DDS: 5-8)**	**% with High DD (DDS: 9-12)**
Nelson Mandela Bay study de Bruin and Gresse, 2018[113]	2017	n/d	B	EC	U	M	238	**Dietary diversity score** Counting number of food groups out of 12*** consumed in previous day) based on 1 x 24-hour recall ***cereals; white roots and tubers; other non-starchy vegetables; other fruits; organ meat and/or flesh meat; eggs; fish and seafood; legumes, nuts and seeds; milk and milk products; oils and fats; sweetening agents and sweets; and spices, condiments and beverages.	6.1	0.9	1.5
			C			F	73		40.1	22.3	10.6
			W				150		5.0	9.3	3.7

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DIETARY PATTERNS

Table 5.7.1: Foods groups most consumed by South African adults

Most consumed food groups per study	Data collection	Methodology	Food groups	% of sample that consumed ≥1/food group/day													
NATIONAL SURVEYS																	
			Food group	n	Gender		Age				Ethnicity				Living standards		
				3287	M	F	16-24	25-34	35-49	>50	B	C	W	A/I	Low	Med	High
South African Social Attitudes Survey (SASAS) Labadarios *et al.*, 2011[111]	2009	Percentages of participants who consumed at least one item of food from 9 food groups (used in the DDS) based on 1 x 24-hour recall	Cereals/ roots/ tubers	99.7	100	100	100	100	100	100	100	100	99	100	99	100	100
			Vit A-rich fruit and vegetables	17.0	15	18	13	16	20	17	17	15	22	12	14	15	20
			Other fruit–not vit A-rich	25.0	26	25	27	25	26	22	20	22	48	37	5	18	42
			Other vegetables–not vit A-rich	52.0	51	53	46	48	55	58	47	58	71	49	49	46	60
			Legumes and nuts	18.0	16	19	15	17	19	19	19	17	9	20	24	18	15
			Fats and oils	38.0	36	39	40	37	38	38	32	54	43	42	22	42	43
			Meat/ poultry/ fish	78.0	81	76	79	81	77	76	69	89	94	90	45	78	93
			Dairy	56.0	57	56	54	50	58	62	43	69	86	80	25	48	80
			Eggs	18.0	19	17	20	19	17	15	17	20	23	14	9	20	19

Food groups	Provinces									Geographic area			
	WC	EC	NC	FS	KZN	NW	GP	MP	LP	UF	UI	RF	T
Cereals/ roots/ tubers///	99	100	99	100	100	100	100	100	100	100	100	100	100
Vit A-rich fruit and vegetables	14	16	14	26	12	21	20	22	17	18	17	14	14
Other fruit–not vit A-rich	23	15	23	31	28	18	38	15	25	33	16	15	9
Other vegetables–not vit A-rich	69	48	57	49	41	40	51	70	52	54	45	50	51
Legumes and nuts	20	24	11	14	25	10	15	15	18	16	18	17	23
Fats and oils	66	21	40	43	39	30	28	56	38	42	29	42	26
Meat/ poultry/ fish	87	54	89	83	77	80	88	76	78	89	66	65	55
Dairy	77	44	58	72	59	55	64	42	56	70	39	45	27
Eggs	24	17	14	22	16	18	18	19	18	20	17	17	11

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Table 5.7.1 Continued

Most consumed foods	Data Collection	Age	Ethnicity	Province	Area	Gender n	Methodology	Food groups	Most consumed foods								
Vaal Area INP Oldewage-Theron *et al.*, 2014[116]	2004 2019	19–90	B	GP	IS	F	Mean overall food variety score (FVS) (mean number of food items eaten daily from 9 food groups (used in the DDS) based on 1 x 24-hour recall	Cereals/ roots/ tubers	5.5 (3.5)								
						722		Vit A-rich fruit and vegetables	1.9 (1.9)								
						384 H		Other fruit–not vit A-rich	1.5 (2.6)								
								Other vegetables–not vit A-rich	3.1 (2.7)								
								Legumes and nuts	0.9 (1.0)								
								Fats and oils	1.5 (1.2)								
								Meat/ poultry/ fish	3.3 (2.6)								
								Dairy	1.3 (1.5)								
								Eggs	1.0 (0.0)								
RENEWAL Study Drimie, *et al.*, 2013[112]	2008	n/d	B	GP	UF	M	Percentages of participants who consumed at least one item of food from 9 food groups (used in the DDS) based on 1 x 24-hour recall		**% of sample that consumed ≥1 item/group/day**								
					UI	F			**All**	**M**	**F**	**UF**	**UI**				
								Cereals/ roots/ tubers	99.6	99.0	100	99.7	99.5				
								Vit A-rich fruit and vegetables	28.2	26.0	29.7	31.2	23.6				
								Other fruit–not vit A-rich	19.4	17.9	20.4	24.0	12.6				
								Other vegetables–not vit A-rich	59.3	58.5	60.6	69.8	43.2				
								Legumes and nuts	9.7	7.4	11.5	8.8	11.0				
								Fats and oils	65.8	65.2	66.7	82.0	41.1				
								Meat/ poultry/ fish	72.1	72.9	72.2	86.2	50.8				
								Dairy	33.0	28.2	36.7	42.0	19.4				
								Eggs	26.7	28.5	25.7	33.7	16.2				
Richards Bay, Dundee, and Harrismith Study Chakona *et al.*, 2017[117]	2014 2015	15–49	B	FS	U	F	Percentages of participants who consumed at least one item of food from 10 food groups (used in the DDS) based on 1 x 48 hour recall		**% of sample that consumed ≥1 item/group/day**								
				KZN	PU	544			FS Harrismith			KZN Dundee			KZN Rich. Bay		
					R				**U**	**PU**	**R**	**U**	**PU**	**R**	**U**	**PU**	**R**
								Grains, white roots,tubers, plantain	100	100	100	100	100	100	100	100	100
								Pulses (beans, peas, lentils)	9	8	8	13	17	25	29	33	29
								Nuts and seeds	9	0	0	10	0	0	7	2	8
								Dairy	84	64	50	55	41	30	45	32	42
								Meat, poultry and fish;	83	61	64	62	50	59	80	80	79
								Eggs;	31	22	12	22	16	11	30	18	10
								Dark green leafy vegetables	11	13	16	10	10	16	10	13	15
								Other Vitamin A-rich F&V	29	12	16	9	3	4	28	9	15
								Other vegetables	71	69	70	80	90	94	80	98	96
								Other fruits	52	45	49	60	30	28	47	56	44

Table 5.7.1 Continued

Most consumed foods	Data Collection	Age	Ethnicity	Province	Area	Gender n	Methodology	Food groups	Most consumed foods
Khayelitsha and Mitchells Plain Survey 2016 Dinbabo *et al*., 2019[29]	2016	≥18	n/d	WC	U	1500	Percentages of participants who consumed at least one item of food from 12 food groups (used in the DDS) based on 1 x 24-hour recall		**% of sample that consumed ≥1 item/group/day**
						M		Cereals (mealies, maize)	28.1
						F		White roots (potatoes)	6.3
								Vegetables (spinach, cabbage)	8.7
								Fruits (mango, orange)	2.6
								Fish (including canned fish)	1.7
								Meat (beef, pork chicken)	16.0
								Legumes (peas, beans, nuts)	2.2
								Milk (yoghurt, cheese)	5.3
								Oils and fats	2.8
								Sweets (sugar)	5.7
								Condiments (spices, pepper)	5.7
								Beverages	14.9
Nelson Mandela Bay study de Bruin and Gresse, 2018[113]	2017	n/d	B	EC	U	480	Percentages of participants who consumed at least one item of food from 12 food groups (used in the DDS) based on 1 x 24-hour recall		**% of sample that consumed ≥1 item/group/day**
						M		Cereals	95.2
						F		Sweetening agents and sweets	89.2
								Spices, condiments and beverages	86.5
								Organ meat and/or flesh meat	81.5
								Milk and milk products	72.9
								Other non-starchy vegetable	64.8
								Eggs	64.8
								Oils and fats	61.5
								Fruit	45.2
								White roots and tubers	36.7
								Legumes, nuts and seeds	14.2
								Fish and seafood	13.5

Table 5.7.2: Foods most consumed by South African adults

Most consumed foods	Data Collection	Age	Ethnicity	Province	Area	Gender n	Methodology	Most consumed foods		
Colon cancer in Africans study O'Keefe *et al.*, 1999[73]	n/d	Middle Age	B	EC	U		Frequency of food intakes per week (based on FFQ)	**Frequency of intake per week (times eaten /week)**		
								Food	**Whites**	**Black Africans**
								Fish	1.5 (0.1)	1.3 (0.2)
								Meat	3.8 (0.3)	2.8 (0.3)
			W	KZN	PU	B:67		Cheese	4.4 (0.4)	Rarely
				MP	R	W: 29		Eggs	2.3 (0.4)	3.5 (0.6)
								Cereal	2.8 (0.5)	Rarely
								Rice	2.0 (0.3)	1.5 (0.2)
								Potato	4.0 (0.4)	3.5 (0.3)
								Pasta	1.8 (0.3)	Rarely
								Green vegetables	5.9 (0.6)	9.9 (0.7)
								Fruit	5.6 (0.6)	3.8 (0.5)
								Milk	4.2 (0.5)	3.3 (0.4)
								Bread (per day)	4.0 (0.5)	2.0 (0.2)
								Maize-meal (per day)	Rarely	2.0 (0.1)
								Desserts/sweets	3.0 (0.5)	Rarely
DHDSS study, Limpopo Steyn *et al.*, 2001[100]	1997 1998	≥20	B	LP	R	M:74 F: 136	Food items appearing most frequently in the diet of adults (based on 4 x 24-hour recalls)	Maize porridge Tea White sugar Brown bread Morogo (green leafy vegetable) Chicken Non-dairy creamer Tomato and onion Dry beans White bread	Hard margarine Fried egg Sorghum beer Cooked cabbage Cooldrink Peanut butter White rice Banana Whole milk Jam	

Table 5.7.2 Continued

Most consumed foods	Data Collection	Age	Ethnicity	Province	Area	Gender n	Methodology	Most consumed foods: Males	Most consumed foods: Females
THUSA study MacIntyre *et al.*, 2002[96]	1996 1998	15–80	B	NW	UU	M:83 F: 106	Foods consumed by 85% and more of sample (based on 145 item QFFQ)	Maize meal porridge Rice, white Sugar, white Onion, cooked Boerewors Milk, fresh, whole Apple Bread, white Sunflower oil Tomato, cooked	Onion, cooked Sugar, white Rice, white Sunflower oil Milk, fresh, whole Maize meal porridge Apple Pumpkin, cooked Tomato, cooked Margarine, hard
					MU	M:229 F: 292		Maize meal porridge Sugar, white Rice, white Onion, cooked Sunflower oil Tomato, cooked Margarine, hard Apple Bread, white Savoury sausage	Sugar, white Maize meal porridge Sunflower oil Rice, white Onion, cooked Bread, white Margarine, hard Cabbage, cooked Tomato, cooked Milk, fresh whole
					IS	M: 128 F: 172		Sugar, white Maize meal porridge Onion, cooked Rice, white Sunflower oil Tomato, cooked Apple Margarine, hard Bread, white Cabbage, cooked	Sugar, white Maize meal porridge Onion, cooked Rice, white Sunflower oil Tomato, cooked Cabbage, cooked Apple Bread, white Banana
					F	M:109 F: 148		Maize meal porridge Sugar, white Rice, white Sunflower oil Milk, fresh, whole Bread, white Onion, cooked	Maize meal porridge Sugar, white Rice, white Cabbage, cooked Onion, cooked Sunflower oil Bread, white Tomato, cooked Margarine, hard Banana

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<table>
<tr><td colspan="10">Table 5.7.2 Continued</td></tr>
<tr><th rowspan="2">Most consumed foods</th><th rowspan="2">Data Collection</th><th rowspan="2">Age</th><th rowspan="2">Ethnicity</th><th rowspan="2">Province</th><th rowspan="2">Area</th><th rowspan="2">Gender n</th><th rowspan="2">Methodology</th><th colspan="2">Most consumed foods</th></tr>
<tr><th>Males</th><th>Females</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>F</td><td>M:109
F: 148</td><td></td><td>Sugar, white
Maize meal porridge
Sunflower oil
Onion, cooked
Tomato, cooked
Rice, white
Bread, white
Margarine, hard
Apple
Milk, fresh whole</td><td>Sugar, white
Onion, cooked
Rice, white
Cabbage, cooked
Sunflower oil
Tomato, cooked
Bread, white
Margarine, hard
Samp</td></tr>
<tr><td>Ndunakazi study
Faber and Kruger, 2005[46]</td><td>n/d
(1998)</td><td>25–55</td><td>B</td><td>KZN</td><td>R
(deep)
(T)</td><td>F:
187

(127
moth-
ers)</td><td>Food items reported by more than 10% of participants during the 24-hour recall</td><td colspan="2">Sugar
Water
Tea
Phutu
Bread–brown
Rice
Non-dairy creamer
Bread–white
Beans
Egg (fried or boiled)
Soft porridge
Cabbage
Tomato and onion stew
Banana
Samp-and-beans
Imifino
Curry sauce
Carbonated drinks
Mahewu
Orange
Apple
Potato
Chicken
Peanut butter
Beef
Milk</td></tr>
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Table 5.7.2 Continued

Most consumed foods	Data Collection	Age	Ethnicity	Province	Area	Gender n	Methodology	Most consumed foods
Sharpeville Elderly facility study Oldewage-Theron, *et al.* 2008[62]	2004 2016	> 60	B	GP	PU	101	Twenty food items most consumed based on 2 x Structured 24-hour recalls, 1 month apart	Tea, brewed Maize meal, cooked, stiff porridge Brown bread/rolls Milk, full cream, fresh Chicken Beef Fermented maize drink (mageu) Egg, cooked Apple Orange Maltabella, cooked (sorghum) Coffee, brewed, instant Potato, boiled Sugar, white Cold drink, carbonated Soup, bean and meat Orange Juice Rice, white, cooked Cabbage, cooked Spinach, cooked
Vaal Area INP: Acham *et al.*, 2012[124]	2004 2017		B	GP	IS	224	Twenty most frequently consumed foods based on 24-hour recall based on mean daily intake g/ person	Water Maize meal Cold drink (carbonated) Maize meal(soft porridge) Tea (Rooibos) Orange Egg Rice Milk Beef Sorghum porridge Mango (raw, peeled) Bread Coffee brewed Tomato/Onion gravy Orange (raw, peeled) Cold drink (Squash) Tea, brewed Macaroni/Spaghetti Sausage

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Table 5.7.2 Continued

Most consumed foods	Data Collection	Age	Ethnicity	Province	Area	Gender n	Methodology	Most consumed foods	
WC School Educators study Senekal *et al.*, 2015[43] Seme *et al.*, 2017[28]	2007	Educators	B W C	WC	U R	517 R: 329 U: 188	Twenty most frequently consumed indicator foods (times per day) (based on self-administered non-quantified 36 category FFQ)	Sugar Margarine/butter Milk/sour milk, yogurt Rice, maize porridge, pasta, samp, potatoes Bread, white Juice, fruit Breakfast cereals Bread, brown Apple, banana, pears Tomato (raw, cooked) Orange or yellow vegetables Green vegetables, e.g. spinach Yellow cheese Mixed vegetables Red meat Cabbage, cauliflower Eggs Chicken with skin Sweets	
Mariannhill Study Faber *et al.*, 2013[121]	2007	Caregivers	B	KZN	PU	394	Ten most frequently reported food items over the 2-day recall period (based on repeated 24-hour dietary recalls)	Sugar Maize meal porridge Bread Tea Rice Hard margarine Legumes Cordial squash Non-dairy creamer Milk	
AHA-FS Study: Rural Tydeman-Edwards *et al.*, 2018[60]	2007	25–64	B C	FS	R	553 M: 163 F: 390	Twenty most frequently consumed foods (based on short FFQ)	**Males** Sugar Porridge, cooked Salt/ stock Tea Full cream milk Coffee Margarine/ oil/ fat Bread Fruit Vegetables Cool drinks Chicken	**Females** Sugar Porridge, cooked Tea Salt/ stock Margarine/ oil/ fat Full cream milk Bread Fruit Vegetables Coffee Cool drinks Cake/biscuits

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Table 5.7.2 Continued

Most consumed foods	Data Collection	Age	Ethnicity	Province	Area	Gender n	**Methodology**	**Most consumed foods**	
								Males	**Females**
AHA-FS Study: Urban Tydeman-Edwards *et al.*, 2018[60]	2008 2009	25–64	B C	FS	PU	419 M: 100 F: 319	Twenty most frequently consumed foods (based on short FFQ)	Sugar Porridge, cooked Tea Salt/ stock Coffee Margarine/ oil/ fat Full cream milk Bread Vegetables Fruit Cool drinks Eggs Chicken Cake/biscuits Alcohol Soy mince/ legumes Peanut butter Chips/crisps Samp/ mealie rice Fruit juice	Sugar Tea Porridge, cooked Salt/ stock Margarine/ oil/ fat Bread Full cream milk Vegetables Fruit Cool drinks Chicken Eggs Sweets/ chocolates Chips/crisps Cake/biscuits Peanut butter Soy mince/ legumes Samp/ mealie rice Red meat Fish
Qwa-Qwa (INP Oldewage-Theron *et al.*, 2012[125] Oldewage-Theron *et al.*, 2014[61]	2008 2009	21–60	B	FS	R	383	Ten consumed foods by weight g/ day (based on 3 x 24-hour recalls)	Maize meal, stiff Tea, brewed Bread, brown and white Maize meal, soft Chicken, cooked Milk, fresh full cream Spinach, cooked Rice, cooked Tinned beans Fruit juice Maas/sour milk Sugar, brown and white Cabbage, cooked Tomato and onion gravy Potato, cooked	

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Table 5.7.2 Continued

Most consumed foods	Data Collection	Age	Ethnicity	Province	Area	Gender n	Methodology	Most consumed foods
Umlazi Study Mkhize *et al.* 2013[49]	2009 – 2010	≥ 60 yrs	B	KZN	PU	270 M:46 F:124	Most frequently consumed foods (based on 3 x 24-hour recalls)	Maize meal, cooked crumbly porridge Tea, brewed Chicken stew (with skin) Bread/rolls, white/brown Rice, white, cooked Stew, beef, with vegetables Beans, sugar, dried, cooked Fresh milk, full cream Samp and beans, 1:1 Cabbage, cooked with potato, onion and sunflower oil Spinach (swiss chard), cooked with potato, onion, sunflower oil Steamed bread Sugar, white, granulated Fruit punch (alcohol-free) Orange, raw (peeled) Mahewu/mageu, liquid Coffee, brewed/instant Breakfast cereal Pilchards in tomato sauce Tomato and onion, stewed (no sugar)
Empangeni study Sheehy *et al.*, 2014[122]	2011	19–79	B	KZN	R	79 M:34 F: 45	Food and drink items commonly consumed by more than 10% of participants (based on 1x 24-h dietary recall)	Phutu Brown sugar Tea Sugar/ kidney beans White rice Whole wheat bread White bread Coffee creamer Chicken Margarine Cabbage Spinach Beef Samp and beans Cordial Potato

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Table 5.7.2 Continued

Most consumed foods	Data Collection	Age	Ethnicity	Province	Area	Gender n	Methodology	Most consumed foods
Letaba study Mbhenyane *et al.*, 2017[119]	n/d	19–45	B	LP	R	F 160	The ten most available food items in the households on the day of data collection	Maize meal Vegetable varieties Tomatoes Cooking oil Chicken Sugar Onion Salt Cooked porridge Bread
ELS Mashiane *et al.*, 2018[67]	2015	22–30	B	LP	R (deep) (T)	742 M: 377 F: 365	Most frequently consumed foods (based on 2 x 24-hour recalls) Listed according to the most common food liked to the least liked	Fried chicken with skin Pap Cold drink White sugar Vetkoek Fried beef Peanut butter Samp Yoghurt Spinach Pilchards
HealthKick study De Villiers *et al.*, 2018[44]	n/d	Caregivers	B C	WC	U R	487	Most frequently consumed indicator foods (based on FFQ)	Vegetables Fruits Sugar Margarine Starches (eg, rice) Milk, yogurt Bread, white Bread, brown Breakfast cereals Processed meat Sweets Sweet drinks Fruit juice Eggs Peanuts/peanut butter Crisps Porridge (e.g oats) Chicken Jam Red meat

Table 5.7.2 Continued

Most consumed foods	Data Collection	Age	Ethnicity	Province	Area	Gender n	Methodology	Most consumed foods
Nelson Mandela Bay study de Bruin and Gresse, 2018[113]	2017	n/d	B	EC	U	480	Percentages of participants who consumed food from 12 food groups (used in the DDS) based on 1 x 24-hour recall	Cereals (95.2 %) Sweetening agents and sweets (89.2%) Spices, condiments and beverages (86.5%) Organ meat and/or flesh meat (81.5%) Milk and milk products (72.9%) Other non-starchy vegetable (64.8%) Eggs (64.8%) Oils and fats (61.5%) Fruit (45.2%) White roots and tubers (36.7%) Legumes, nuts and seeds (14.2%) Fish and seafood (13.5%)

Table 5.7.3: Eating patterns and dietary scores of South African adults

Fruit, vegetables, sugar, meat and fat intakes and intake scores	Data collection	Methodology	Categories	Per category												
NATIONAL SURVEYS																
SADHS 2003 SADHS Report, 2007[5]	2003	Micronutrient intakes were assessed using a 30-item FFQ developed as part of the Nutrition Index (N-Index) to rapidly assess micronutrients associated with the development and prevention of chronic diseases of lifestyle, and relevant in terms of micronutrient deficiencies		Age (%)								Ethnicity (%)				
				15–24	25–34	35–44	45–54	55–64	≥ 65			B	C	W	A/I	
			Gender													
			Males	21.5 (0.56)	19.6 (0.67)	20.4 (0.72)	20.4 (0.75	20.0 (0.96)	24.0 (0.93)			20.8 (0.40)	21.4 (1.55)	19.1 (0.72)	23.0 (2.29)	
			Females	21.3 (0.56)	20.1 (0.59)	19.5 (0.56)	20.9 (0.56)	19.7 (0.75)	21.3 (0.81)			20.4 (0.38)	21.5 (0.95)	18.7 (0.93)	23.4 (1.14)	
				Provinces (%)									Area (%)			
				WC	EC	NC	FS	KZN	NW	GP	MP	LP	U		R (NU)	
			Gender													
			Males	24.9 (0.83)	25.9 (1.35)	29.0 (0.88)	25.2 (1.03	13.4 (0.70)	26.2 (0.84)	15.9 (0.77)	30.3 (0.88)	28.9 (0.67)	19.6 (0.52)		23.3 (0.48)	
			Females	21.7 (0.76)	27.0 (0.85)	25.1 (0.80)	28.7 (0.83)	11.2 (0.62)	26.8 (0.52)	13.5 (0.71)	29.9 (0.81)	28.2 (0.62)	18.5 (0.49)		24.0 (0.43)	

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Table 5.7.3 Continued

Fruit, vegetables, sugar, meat and fat intakes and intake scores	Data collection	Methodology	Categories	Per category												
NATIONAL SURVEYS																
SANHANES-1 Shisana *et al.*, 2013[7]	2012	Fat, sugar, F&V intake scores based on a FFQ		**Gender (%)**			**Age (%)**						**Ethnicity (%)**			
				All	M	F	15–24	25–34	35–44	45–54	55–64	≥ 65	B	C	W	A/I
			Fat intake score													
			Mean	7.3	7.4	7.2	7.9	7.7	7.2	6.9	6.1	5.5	7.1	7.2	8.5	7.1
			Low (0-5)	35.3	34.1	36.3	28.9	30.5	35.5	38.5	47.1	55.0	36.8	32.7	27.1	33.7
			Moderate (6-10)	46.4	47.1	45.7	46.8	49.6	48.0	46.8	40.9	35.7	44.7	55.0	49.1	54.7
			High (11-20)	18.3	18.7	18.0	24,3	19.9	16.5	14.7	11.9	9.3	18.5	12.3	23.7	11.7
			Sugar score													
			Mean	3.0	22.6	3.1	3.5	3.2	2.9	2.7	2.5	2.2	2.9	3.2	3.4	3.2
			Low (0-2)	42.1	43.5	40.9	32.5	38.4	44.7	47.9	54.1	59.4	44.7	31.8	31.7	33.9
			Moderate (3-4)	38.2	37.2	39.1	40.6	40.9	38.0	36.5	33.5	29.8	35,5	48.1	47.2	50.1
			High (5-8)	19.7	19.3	20.0	27.0	20.7	17.3	15.7	12.4	10.7	19.9	17.1	21.1	16.1
			Fruit and vegetable score													
			Mean	3.8	3.8	3.8	3.7	3.8	3.8	3.9	3.8	3.7	3.6	3.7	4.8	4.1
			Low (0-2)	25.6	25.6	25.5	27.4	24.7	25.4	24.6	24.0	25.7	28.3	22.3	10.7	17.5
			Moderate (3-4)	45.3	45.4	45.1	44.8	46.6	46.6	43.7	48.0	44.1	44.6	52.9	42.8	49.6
			High (5-8)	29.1	28.9	29.3	27.8	28.7	30.0	31.7	27.9	30.2	27.1	24.8	46.3	32.9
				Provinces (%)									**Area (%)**			
				WC	EC	NC	FS	KZN	NW	GP	MP	LP	UF	UI	RF	RI
			Fat intake score													
			Mean	7.3	7.4	7.2	7.9	7.7	7.2	6.9	6.1	5.5	7.1	7.2	8.5	7.1
			Low (0-5)	38.1	57.8	40.7	31.0	39.1	48.9	16.0	31.0	55.3	23.6	40.1	54.2	54.4
			Moderate (6-10)	50.9	35.2	50.9	51.7	45.3	33.6	54.5	45.3	36.8	53.3	44.8	36.0	34.3
			High (11-20)	11.0	7.0	8.4	17.3	15.6	17.5	29.5	20.7	7,9	23.1	15.1	9.8	11.3

Table 5.7.3 Continued

Fruit, vegetables, sugar, meat and fat intakes and intake scores	Data collection	Methodology	Categories	Per category												
NATIONAL SURVEYS																
				Provinces (%)									**Area (%)**			
				WC	EC	NC	FS	KZN	NW	GP	MP	LP	UF	UI	RF	RI
			Sugar score													
			Mean	3.0	22.6	3.1	3.5	3.2	2.9	2.7	2.5	2.2	2.9	3.2	3.4	3.2
			Low (0-2)	41.0	60.4	40.0	44.0	40.8	56.5	29.4	42.0	54.2	33.8	48.3	58.4	53.7
			Moderate (3-4)	43.1	32.0	42.9	39.2	40.2	25.5	42.7	37.2	32.6	43.1	33.5	29.9	31.5
			High (5-8)	15.9	7.7	17.2	16.8	19.0	18.0	28.0	20.8	13.2	23.1	18.2	11.7	14.7
			Fruit and vegetable score													
			Mean	3.8	3.8	3.8	3.7	3.8	3.8	3.9	3.8	3.7	3.6	3.7	4.8	4.1
			Low (0-2)	23.5	38.2	34.9	35.3	29.0	31.3	15.4	26.9	29.7	18.8	32.8	36.7	34.8
			Moderate (3-4)	52.1	44.3	49.9	41.9	48.2	38.5	44.0	42.4	47.4	46.6	45.0	38.8	44.4
			High (5-8)	24,4	17.5	15.1	22.8	22.9	30.2	40.6	30.7	22.9	34.5	22.1	24.5	20.9
SADHS 2016 SADHS Report, 2016[6]	2016	Percentage that ate fruit, vegetables, SSB, and fruit juice, fried foods, fast foods, salty snacks, and processed meats the day and night before the survey (based on 1 x 24 recall)			**Gender (%)**		**Age (%)**						**Ethnicity (%)**			
				All	M	F	15–24	25–34	35–44	45–54	55–64	≥ 65	B	C	W	A/I
			Any fruit	48.8	45.2	51.2	47.7	49.6	50.6	49.1	47.7	47.1	46.2	56.4	71.4	61.6
			Any vegetables	58.9	51.8	63.8	55.0	60.1	57.7	61.6	62.2	61.1	56.8	62.0	83.5	66.7
			Drank any SSB	35.7	39.9	32.9	42.1	42.5	36.5	31.0	26.9	18.8	36.1	37.7	29.0	30.2
			Drank any fruit juice	14.0	12.5	15.1	13.9	16.4	12.5	14.6	12.3	13.0	12.9	17.7	24.4	20.1
			Ate fried foods every day	10.1	11.9	8.9	14.9	11.1	9.4	8.7	4.9	4.4	10.1	12.6	8.0	7.2
			Ate fried foods at least 1x / week	36.5	39.9	34.2	39.3	41.0	38.3	35.3	28.7	26.8	35.4	40.1	42.9	53.9
			Ate fast foods every day	2.4	2.5	2.4	2.9	2.9	2.1	2.4	1.7	1.3	2.3	3.1	3.0	2.3
			Ate fast foods at least 1x /week	18.3	17.7	18.8	21.0	24.4	20.1	14.8	10.2	8.3	17.6	18.9	23.1	34.8
			Ate salty snacks every day	12.8	11.0	14.0	25.2	14.1	8.7	5.7	4.6	3.5	12.6	20.3	6.4	8.7
			Ate salty snacks at least 1x / week	28.5	26.4	30.0	32.7	33.6	31.4	25.5	18.5	16.9	27.9	29.8	33.3	39.5
			Ate processed meats every day	14.4	15.3	13.7	20.4	18.2	14.6	10.2	5.6	5.4	14.5	15.8	11.5	12.4
			Ate processed meats at least 1x /week	28.8	29.5	28.3	30.5	32.3	31.3	27.6	23.8	19.1	28.3	36.0	23.9	33.6

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Table 5.7.3 Continued

Fruit, vegetables, sugar, meat and fat intakes and intake scores	Data collection	Methodology	Categories	Per category												
NATIONAL SURVEYS																
				Provinces (%)									**Area (%)**		**WQL (%)**	
				WC	EC	NC	FS	KZN	NW	GP	MP	LP	U	R	L	H
			Any fruit	63.9	44.3	32.3	47.3	50.1	44.8	44.4	47.8	53.8	50.5	45.4	37.0	59.8
			Any vegetables	69.2	62.5	46.4	56.7	58.0	51.8	59.7	52.7	55.6	60.8	55.0	50.4	72.3
			Drank any SSB	37.0	29.1	37.3	29.8	31.5	45.3	36.7	41.7	38.6	37.1	33.0	28.0	39.3
			Drank any fruit juice	18.9	14.0	13.6	11.1	14.0	12.6	14.3	13.9	10.5	15.7	10.9	8.7	22.5
			Ate fried foods every day	12.0	8.8	6.7	9.6	10.6	6.8	11.6	12.4	6.1	11.5	7.3	6.3	9.6
			Ate fried foods at least once a week	39.3	24.9	38.2	38.6	38.1	40.6	38.9	41.3	30.1	38.9	31.9	26.7	44.9
			Ate fast foods every day	3.1	1.5	1.3	2.4	2.5	1.2	3.6	2.1	0.5	2.9	1.5	1.0	2.9
			Ate fast foods at least once a week	16.6	12.2	18.1	18.5	22.0	16.0	22.2	23.0	8.6	21.0	13.2	10.3	28.0
			Ate salty snacks every day	20.0	11.3	13.3	13.2	9.0	15.7	13.4	13.0	9.5	14.1	10.3	8.3	11.7
			Ate salty snacks at least once a week	29.7	23.1	25.0	30.8	29.8	35.6	27.7	34.5	24.0	29.4	26.9	20.9	34.0
			Ate processed meats every day	16.9	9.6	6.2	12.8	15.4	11.5	19.7	12.5	7.1	17.3	8.6	5.0	17.5
			Ate processed meats at least once a week	32.9	24.2	35.5	29.8	32.2	33.4	26.2	37.4	18.2	30.1	26.0	20.0	32.3
INTERNATIONAL STUDIES WITH A SA COMPONENT																
WHO-SAGE Wave 1 2007-2008 Wu *et al.*, 2015[131]	2007 – 2008	Fruit and vegetable intake		All (%)	**Gender (%)**								**Area (%)**		**WQL (%)**	
					Males				Females							
			Less than 5 servings of fruit and vegetables on average per day.	68.4	67.9	60.1	60.3	70.1	71.0	73.4	67.2	77.9	65.0	75.1	75.3	54.9
STOP-SA study Okop *et al.*, 2019[35]	2015 – 2016	Intake of SSB, and fruits and vegetables (based on FFQ)		All (%)	Gender (%)				Age categories (%)				Food secure (%)			
					Males		Females		< 39yrs		≥ 40		Yes		No	
			Vegetable intake													
			Daily intake	13.9	16.0	13.1										
			Weekly intake	77.8	76.9	77.7										
			Monthly/ seldom	8.6	7.1	9.2										

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Table 5.7.3 Continued

Fruit, vegetables, sugar, meat and fat intakes and intake scores	Data collection	Methodology	Categories	All (%)	Gender (%) Males	Gender (%) Females	Age categories (%) < 39yrs	Age categories (%) ≥ 40	Food secure (%) Yes	Food secure (%) No
			Fruit intake							
			Daily intake	14.9	17.9	73.6				
			Weekly intake	72.5	69.3	73.6				
			Monthly/ seldom	12.6	12.7	1.6				
			SSB intake							
			Total SSB servings/week	9.9	9.1	10.3	12.7	5.7	10.8	8.7
			% consuming > 5 servings of SSB/ week	82.0	81.1	82.3	90.7	77.3	85.3	79.8
			% consuming > 10 servings of SSB/week	28.7	27.8	29.1	44.3	20.4	38.1	22.5

Fruit, vegetables, sugar, meat and fat intakes and intake scores	Data collection	Methodology	Categories	Per category
WC fruit factory study Wolmarans *et al.*, 2003[40]	n/d	Consumption of red meat, chicken and fish	**Frequency**	**Consumed red meat, chicken or fish per frequency (%)**
			7 days per week	+ 66
			0-4 times per week	<10

Fruit, vegetables, sugar, meat and fat intakes and intake scores	Data collection	Methodology	Categories	(n=517) Times per day Mean (SD)	(n=517) Times per day Median (IQR)	Males (n=196) Times per day Mean (SD)	Males (n=196) Times per day Median (IQR)	Females (n=321) Times per day Mean (SD)	Females (n=321) Times per day Median (IQR)
HealthKick study: Educators Senekal *et al.*, 2015[43] Seme *et al.*, 2017[28]	2007	Frequency of poor and healthy food choices (based on self-administered non-quantified 36 category FFQ)	Fruit and vegetables	1.9 + 1.2	2 (1;3)	1.7 + 1.1	2 (1;2)	2.0 + 1.2	2 (1;3)
			High fat foods	1.9 + 1.0	2 (1;2)	2.1 + 1.0	2 (2;3)	1.8 + 0.9	2 (1;2)
			Energy-dense snacks	1.4 + 0.9	1 (1;2)	1.4 + 0.9	1 (1;2)	1.4 + 0.9	1 (1;2)
			White bread	0.5 + 0.4	0.4 (0; 0.9)	0.6 + 0.4	0.7 (0.1; 0.8)	0.4 + 0.4	0.3 (0; 0.7)
			Cereals and legumes	0.98 + 0.76	1 (0;1)	0.98 + 0.8	1 (0;1)	0.99 + 0.74	1 (0;1)
			Processed (high salt) foods	2.7 + 1.2	3 (2;3)	2.8 + 1.1	3 (2;4)	2.5 + 1.2	3 (2;3)

Fruit, vegetables, sugar, meat and fat intakes and intake scores	Data collection	Methodology	Categories	All (%) (95% CI)	Males (n=528) (%) (95% CI)	Females (n=876) (%) (95% CI)
Dikgale HDSS Study Maimela *et al.*, 2016[51]	2011 – 2012	Fruit and vegetable daily intakes	> 5 servings (> 400g) of fruit & vegetables/day	88.6 (87.0–90.4)	88.8 (86.1–91.5)	88.6 (86.5–90.7)

Fruit, vegetables, sugar, meat and fat intakes and intake scores	Data collection	Methodology	Categories	Males (%) Black (n=883)	Males (%) Coloured (n=503)	Males (%) White (n=529)	Males (%) Indian (n=432)	Females (%) Black (n=1884)	Females (%) Coloured (n=1270)	Females (%) White (n=1070)	Females (%) Indian (n=806)
HSFSA study Peer *et al.*, 2018[211] Peer *et al.*, 2018b[26]	2013	Intake of fruit and vegetables, and foods high in salt and fats (based on HSFSA's "Cardiovascular Health Check" form)	> 5 fruit & vegetables/day	53.9	45.1	47.6	54.9	64.0	48.0	55.1	63.5
			High fat foods	63.8	62.6	38.8	53.7	63.2	50.6	24.9	43.2
			High salt foods	67.4	58.7	35.9	46.9	66.8	52.2	26.0	30.8

Table 5.7.3 Continued

Fruit, vegetables, sugar, meat and fat intakes and intake scores	Data collection	Methodology	Categories	Per category			
INTERNATIONAL STUDIES WITH A SA COMPONENT							
Africa Wits-INDEPTH Study Micklesfield *et al.*, 2018[129]	2014 – 2016	Bread, fruit and vegetable and SSB (sugary drinks and fruit juices) consumption		Servings/day (median (IQR))			
				Males (n=347)		Females (n=796)	
			Bread	1.7 (0.6–3.0)		1.7 (0.9–3.0)	
			Fruit and vegetable	1.3 (0.9–2.3)		1.3 (0.9–2.3)	
			SSB	0.3 (0.3–0.7)		0.3 (0.3–0.6	
Health professionals study Kunene *et al.*, 2017[208]	2012	Food choices, types and drinks; intake of breakfast, lunch and dinner (based on dietary and eating habits questionnaire)	n=109	Frequently (%)		Rarely (%)	
			Breakfast	49		51	
			Lunch	80		20	
			Dinner	89		11	
			Dairy foods	74		26	
			Fruits	23		77	
			Vegetables	27		73	
			Meat	91		9	
			Sweet foods	60		40	
			Carbonated SSBs	55		45	
			Tea	31		69	
			Coffee	64		36	
			Alcohol	65		35	
			Fruit juice	57		43	
			Water	32		68	
Nkonkobe Municipality of the Eastern Cape study Otang-Mbeng *et al.*, 2017[127]	2015	Consumption of fast foods, fruit and vegetables; food preparation methods (based on validated questionnaire)		Normal (%)	Overweight (%)	Obese (%)	Underweight (%)
			Fast foods				
			Always	21.2	30.3	48.5	0.0
			Sometimes	51.5	16.7	28.8	3.0
			Never	35.7	7.1	57.1	0.0
			Vegetables				
			Always	11.5	28.8	11.5	48.1
			Sometimes	21.3	25.5	25.5	27.7
			Never	42.9	7.1	85.7	7.1

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Table 5.7.3 Continued

Fruit, vegetables, sugar, meat and fat intakes and intake scores	Data collection	Methodology	Categories	Per category				
INTERNATIONAL STUDIES WITH A SA COMPONENT								
			Fruit					
			Always	38.9	13.9	44.4	2.8	
			Sometimes	42,9	17.5	38.1	1.6	
			Never	50.0	50.0	0.00	0.0	
AWI-GEN Agincourt site study Wagner *et al.*, 2018[65]	2015 – 2016	Consumption of carbohydrates such as juice, SSB and bread		Overall (n=1388) median (IQR) / week	Males (n=542) median (IQR) / week	Females (n=846) median (IQR) / week		
			Bread consumption (slices)	16 (8–28)	16 (6–28)	16 (9–28)		
			Vegetable consumption (servings)	4 (2–8)	4 (2–6)	5 (3–8)		
			Fruit consumption (servings)	3 (1–6)	3 (1–6)	3 (0–6)		
			Sugary beverage intake (drinks)	2 (1–3)	2 (1–2)	2 (1–3)		
			Juice intake (days)	1 (0–2)	1 (0–2)	1 (0–2)		
EARISA Study Phatlhane *et al.*, 2016[214]	2014	Frequency of consumption of meat and vegetables		Iron deficient females (%)	Iron replete females (%)			
			Consumed meat 1-2 times a week	34.1	65.9			
			Consumed meat 3-4 times a week	60.1	39.9			
			Did not eat meat	5.6	2.8			
			Did not eat fish	12.5	5.6			
			Consumed vegetables every day	11.6	44.9			
Letaba study Mbhenyane *et al.*, 2017[119]	n/d	Dietary patterns (based on a standardised questionnaire based on the eleven SAFBDGs)	N=160	Daily (%)	Weekly (%)	Monthly (%)	Yearly (%)	Never%
			Starches					
			Maize porridge	92.0	6.9	0.6	0.0	0.0
			Bread	28.1	30.0	8.1	28.8	44.6
			Rice	3.1	25.2	11.9	46.5	13.3
			Potatoes	1,3	27.4	14.6	44.6	12.1
			Macaroni	0.0	15.1	12.5	21.4	51.0
			Samp	0.6	1.9	5.6	17.5	55.2

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Table 5.7.3 Continued

Fruit, vegetables, sugar, meat and fat intakes and intake scores	Data collection	Methodology	Categories	Per category				
INTERNATIONAL STUDIES WITH A SA COMPONENT								
			Vegetables and fruit					
			Vegetables (in season)	15.6	74.4	1.9	8.1	0.0
			Fruit (in season)	8.8	22.0	8.8	49.4	10.6
			Legumes					
			Beans	1.3	20.0	18.1	29.4	31.3
			Peas	2.5	3.8	6.9	86.8	0.0
			Soy	0.6	8.2	1.9	7.5	81.0
			Lentils	0.0	0.0	0.6	3.8	95.6
			Protein foods					
			Chicken	10.0	65.0	13.8	9.4	1.9
			Fish	0.0	48.1	12.5	24.4	15.0
			Eggs	5.6	37.5	5.0	23.8	28.9
			Milk	5.6	17.5	10.0	33.8	32.2
			Red meat	1.9	14.4	21.9	38.1	23.8
			Pork	0.0	1.3	3.1	9.4	86.3
			Other					
			Fat	97.6	0.0	0.0	0.0	2.4
			Salt	97.5	0.0	0.0	0.0	2.5
			Water	98.0	1.4	0.0	0.0	0.6
			Alcohol	0.0	3.1	1.9	5.7	89.3

Table 5.7.3 Continued

Fruit, vegetables, sugar, meat and fat intakes and intake scores	Data collection	Methodology	Categories	Per category				
INTERNATIONAL STUDIES WITH A SA COMPONENT								
Health Kick study De Villiers *et al.*, 2018[44]	n/d	Frequency of poor and healthy food choices focusing specifically on foods/drinks/snacks associated with the development / prevention of obesity, diabetes and other NCDs (based on FFQ)		Mean (SD) times per day				
				Male (n=20)	Female (n=155)	Normal weight (n=40)	Overweight (n=47)	Obese (n=83
			Fruit and vegetables	2.6 (1.38)	2.9 (1.59)	2.6 (1.57)	2.9 (1.69)	3.0 (1.49)
			High-fat foods	2.6 (0.95)	2.3 (0.98)	2.3 (0.96)	2.2 (0.99)	2.5 (0.98)
			Energy-dense foods	2.8 (1.25)	2.8 (1.38)	2.8 (1.63)	2.7 (1.25)	2.9 (1.28)
			White bread and starches	1.7 (0.53)	1.7 (0.62)	1.7 (0.72)	1.7 (0.61)	1.7 (0.56)
			Cereals, brown bread and legumes	1.1 (0.49)	1.1 (0.64)	1.0 (0.55)	1.1 (0.70)	1.2 (0.64)
			Processed foods high in salt and fat	4.0 (1.22)	3.7 (1.38)	3.7 (1.38)	3.5 (1.45)	3.9 (1.31)
STUDIES IN SA STUDENTS								
University of Fort Hare Van den Berg et al 2012[132]	2008	Intake from food groups (based on FFQ) in comparison to recommendations		Recommendations		% (n=161)		
			Bread, Cereal, Rice and Pasta					
			Below recommendations	<6 servings per day		3.7		
			Within recommendations	6–11 servings per day		83.2		
			High intakes	> 11 servings per day		13.1		
			Vegetables					
			Below recommendations	< 3 servings per day		97.5		
			Within recommendations	3-5 servings per day		2.5		
			Fruits					
			Below recommendations	< 2 servings per day		42.2		
			Within recommendations	2-4 servings per day		48.5		
			High intakes	>4 servings per day		9.3		
			Milk and milk products					
			Below recommendations	< 2 servings per day		92.6		
			Within recommendations	2-3 servings per day		7.5		
			Meat and meat alternatives					

Table 5.7.3 Continued

Fruit, vegetables, sugar, meat and fat intakes and intake scores	Data collection	Methodology	Categories	Per category	
INTERNATIONAL STUDIES WITH A SA COMPONENT					
			Below recommendations	<2 servings per day	3.1
			Within recommendations	2-3 servings per day	16.2
			High intakes	>3 servings per day	80.8
			Fats and oils		
			-	≤ 4 servings (20g) per day	49.7
			-	> 4 4 servings (20g) per day	50.3
			Sweets and sugar		
			-	≤ 4 servings (40g) per day	21.7
			-	>4 servings (40g) per day	78.3
			Alcohol		
			Recommended allowance	≤ 2 units per day§	98.8
			Above allowance	>2 units per day§	1.2
University of the Free State Van den Berg *et al.* 2013[126]	2011	Food group and dietary patterns (based on usual daily intake and FFQ)	Food groups	Recommendations	%
			Bread, Cereal, Rice and Pasta		
			Below recommendations	<6 servings per day	43.7
			Within recommendations	6–11 servings per day	41.9
			High intakes	> 11 servings per day	14.4
			Vegetables		
			Below recommendations	< 3 servings per day	98.1
			Within recommendations	3-5 servings per day	1.3
			High intake	>5 servings per day	0.6
			Fruits		
			Below recommendations	< 2 servings per day	58.4
			Within recommendations	2-4 servings per day	29.2
			High intakes	>4 servings per day	12.4
			Beta-carotene-rich fruits and vegetables		
			Below recommendations	< 1 serving per day	60.2
			Within recommendations	>1 servings per day	39.8

Table 5.7.3 Continued

Fruit, vegetables, sugar, meat and fat intakes and intake scores	Data collection	Methodology	Categories	Per category	
INTERNATIONAL STUDIES WITH A SA COMPONENT					
			Vitamin C-rich fruits and vegetables		
			Below recommendations	< 1 serving per day	30.6
			Within recommendations	>1 servings per day	69.4
			Milk and milk products		
			Below recommendations	< 2 servings per day	82.6
			Within recommendations	2-3 servings per day	14.9
			High intake	>3 servings per day	2.5
			Meat, poultry, fish, legumes, eggs and nuts		
			Below recommendations	<2 servings per day	3.1
			Within recommendations	2-3 servings per day	16.2
			High intakes	>3 servings per day	80.8
			Fats, oils and sweets		
			Small quantities		57.1
			Large quantities		42.9
University of Pretoria Madiba, Bhayat and Nkambule, 2018[130]	2015	SSB intake (based on FFQ)		**Mean + SD**	**%**
			Mean daily teaspoons of sugar from SSB	5.8 ± 9.5	
			No intake of SSBs		35
			1–4 teaspoons of sugar from SSBs		32
			5-9 teaspoons of sugar from SSBs		13
			>10 teaspoons of sugar from SSBs		20

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Table 5.7.4: Dietary quality of South African adults

Dietary quality	Data collection	Methodology	Categories	Per category			
				Males (%)		Females (%)	
				Rural (n=314)	Urban (n=328)	Rural (n=588)	Urban (n=480
PURE-NWP-SA Dolman *et al.*, 2013[105]	2005 2010	**1. Diet Quality Index** Score developed by Thiele *et al.* which was adapted to the South African diet and renamed the Adapted Thiele Score (Deficiency Score/ Excess Score). Nineteen nutrients used for the Deficiency Score and six nutrients in an Excess Score. The EAR or AI used as cut-off points in the score (26–30). Scores were added up, giving a total of 1900 for the Deficiency Score and 600 for the Excess Score. To simplify interpretation, the Deficiency Score and Excess Score were combined into one score by subtracting the Excess Score from the Deficiency Score, called the Adapted Thiele Score **2. Healthy Diet Indicator (HDI):** Original HDI score adapted by first using the more recent WHO prevention of CVD guidelines for the cut-off points and second by changing the scoring system from a dichotomous variable (1 or 0) to a continuous score. Modification regarding Na intake made, due to fact that QFFQ did not evaluate intake of discretionary salt. Charlton *et al.* showed that discretionary salt intake made up 45.5% of total Na intake in black South Africans. The Na intake therefore adjusted by adding 46% to the Na intake. Modification regarding cut-off point for fat, since the fat intake of this population was quite low with a mean of 24% of total energy. The cut-off for total fat intake in the Excess Score was lowered from 35% to 30%, so that those taking a higher fat intake within the study population would be 'penalized'. Adjustment made to remove contribution of alcohol to total energy intake.	Fruit & vegetables (g)	58.9	129.0	69.3	148
			Pulses, nuts, seeds (g)	0.0	9.6	0.0	11.0
			Adapted Thiele Score (median)	1364	1594	1381	1592
			% of total score	72	84	72	84
			Deficiency Score (median)	1409	1649	1413	1657
			New Excess Score (median)	583	595	553	555
			Healthy Diet Indicator Score	6.46	6.94	6.48	6.82
			% of total HDI score	72	77	72	76

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Table 5.7.4 Continued

Dietary quality	Data collection	Methodology	Categories	Per category				
Embo study Msaki and Hendricks, 2013[118] Msaki and Hendricks, 2014[133]	2004	**Dietary quality:** Household food intake (HFI) strata were developed by combining matrices obtained from the Household Food Intake Index and Nutritional Adequacy Ratios.	**Households classified according to HFI index**	**Households classified according to Nutritional Adequacy Ratio (%)**				
				Inadequate HFI	**Moderate HFI**	**Adequate HFI**		
			Data for November 2004					
			Inadequate household food intakes	**63**	**3**	**0**		
			Moderate household food intakes	**2**	**59**	**7**		
			Adequate household food intakes	**1**	**5**	**60**		
			Total	**66**	**67**	**67**		
	2005		**Data for March 2005**					
			Inadequate household food intakes	37	19	10		
			Moderate household food intakes	16	23	28		
			Adequate household food intakes	13	25	29		
			Total	**66**	**67**	**67**		
	2004	**Food quality** was measured using mean diversity in 5 food groups, namely, starches, vegetables, animal sourced food, fats, and legumes. The food intake categories developed using both the Household Food Intake Index and Nutritional Adequacy Ratios were regressed to respective dietary diversity for each round.		**Starches**	**Legumes**	**F&V**	**Fats**	**Animal source foods**
			Data for November 2040					
			Household Food Intake Index					
			Inadequate household food intakes	7.05	0.97	4.80	1.65	5.24
			Moderate household food intakes	6.90	0.96	4.94	1.69	5.10
			Adequate household food intakes	6.47	0.93	5.13	1.59	4.67
			Nutrient adequacy ratios					
			Inadequate household food intakes	6.94	0.97	4.66	1.67	5.14
			Moderate household food intakes	6.85	0.97	4.95	1.64	4.93
			Adequate household food intakes	6.63	0.93	5.24	1.60	4.96
	2005		**Data for March 2005**					
			Household Food Intake Index					
			Inadequate household food intakes	8.95	1.18	6.27	2.05	5.20
			Moderate household food intakes	8.82	1.00	5.63	2.25	5.49
			Adequate household food intakes	8.23	0.99	5.44	2.21	5.30

Table 5.7.4 Continued

Dietary quality	Data collection	Methodology	Categories	Per category				
			Nutrient adequacy ratios					
			Inadequate household food intakes	7.97	1.02	4.67	1.89	4.64
			Moderate household food intakes	8.73	0.99	5.88	2.16	5.22
			Adequate household food intakes	9.30	1.16	6.78	2.45	6.12
Bt20 study Mtintsilana *et al.*, 2019[134]	2015 2016	Dietary Inflammatory Index (21 parameters) - Scores based on 7-day FFQ. The association between various dietary factors and six inflammatory markers (IL-1 , IL-4, IL-6, IL-10, TNF , and CRP).	**Positive Dietary Inflammatory Index (most proinflammatory) n=83 (%)**		**Negative Dietary Inflammatory Index (most anti-inflammatory) n=107 (%)**			
			43.7		56.3			

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Table 5.7.5: Dietary behaviour of South African adults

Dietary quality	Data collection	Methodology	Categories	Per category			
SA National Database Senekal *et al.*, 2003[66]	n/d	SA National Database Senekal *et al.*, 2003[66]	**Binge eating**	**(%)**			
			Never/ Hardly	427			
			1-3 times a week	66			
			Tried to lose weight in the last year				
			Yes	184			
			No	307			
University of the Witwatersrand Gradidgea and Cohen, 2018[128]		Eating behaviour (based on Questionnaire)	**Eating behaviour Total sample (n=110)**	**Yes (%) /**			
				Total sample (n=110	**Normal (n=50)**	**Overweight (n=41)**	**Obese (n=19)**
			Do you walk < 500 m to get to the food vendor	69.1	56.0	75.6	89.5
			Do you spend > R100/week on purchases at the food vendor	15.5	20.0	9.75	15.8
			Do you feel that the food bought at the food vendors is mostly considered as unhealthy?	92.7	92.0	92.7	94.7
			Do you feel that you buy food from vendors because your friends are buying?	20.9	12.0	19.5	47.4
				% ≥ 4 times/week			
			How many times per week do you buy fried foods?	30.9	16	39	52.6
			How often do you purchase food from food vendors?				
			Low (%)	23.6	57.7	23.1	19.2
			Moderate (%)	33.6	62.2	32.4	5.4
			High (%)	42.7	25.5	48.9	25.6
			Food vendor purchases/week	**Number of purchases / week (mean + SD)**			
			Vegetables	3.39 + 1.87	3.84 + 2.11	3.01 + 1.54	3.00 + 1.67
			Salads	2.21 +1.90	2.66 + 2.01	1.87 + 1.79	1.74 + 1.63
			Fruits	3.55 + 2.34	3.88 + 2.31	3.73 + 2.66	2.26 + 0.93
			Fish	1.46 + 1.45	1.50 + 1.42	1.39 + 1.66	1.53 + 1.07
			Meats	3.85 + 2.28	4.02 + 2.17	3.73 + 2.50	3.68 + 2.14

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