South African Journal of Clinical Nutrition 2026; 39(3):156–161
https://doi.org/10.1080/16070658.2026.2654314

SAJCN
ISSN 1607-0658 EISSN 2221-1268

RESEARCH ARTICLE

Food insecurity and dietary diversity among women of reproductive age in an informal settlement in Tshwane, South Africa

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Objectives Household food insecurity (HFI) is a public health concern, particularly in informal settlements, where women of reproductive age (WRA) are vulnerable to malnutrition. This study aimed to determine the HFI, dietary diversity and anthropometric status of WRA (18–49 years) residing in an informal settlement in Tshwane, South Africa. Additionally, differences between moderately food-insecure (MFI) and severely food-insecure (SFI) women were determined.
Design Descriptive, cross-sectional study.
Setting An informal settlement in Tshwane, South Africa.
Subjects A convenience sample of WRA ($n = 103$).
Outcome measures HFI and dietary diversity were assessed using the Household Food Insecurity Access Scale (HFIAS) and the Minimum Dietary Diversity for Women (MDD-W) tool, respectively. Anthropometric measurements were recorded, including mid-upper-arm circumference, height and weight.
Results The median age of the participants was 30 (23.0–37.0) years, with a mean HFIAS of 14.0 (10.0–18.0). Most women were either moderately (17.5%) or severely (75.7%) food insecure. The median MDD score was 3.0 (2.0–4.0), and only 20.4% of study participants met the minimum dietary diversity criterion. A significant difference between MFI and SFI women was observed only in the consumption of the pulse food group (33.3% vs. 14.1%; $p = 0.002$). High rates of overweight (36.9%) and obesity (30.1%) were recorded in the study population, with no significant differences between MFI and SFI groups.
Conclusion Most WRA in this informal settlement were SFI, overweight or obese and exhibited low dietary diversity, underscoring the importance of further research to identify strategies that improve access to affordable, diverse diets for households living in poverty.

Keywords : dietary diversity, food insecurity, informal settlements, overweight and obesity, women of reproductive age

Introduction

Household food insecurity (HFI), also known as inadequate access to sufficient, safe and nutritious food required for health,[1] remains a public health concern. Globally, in 2021, 2.3 billion people lacked access to adequate food, with more than 700 million people experiencing hunger, contributing to increased food insecurity rates.[1]

HFI is a well-documented problem, particularly affecting women of reproductive age (WRA) in low- and middle-income countries.[2–4]

These women face daily challenges in obtaining sufficient, safe and nutritious food. WRA (18–49 years) are especially vulnerable to HFI due to their increased nutritional requirements during pregnancy and lactation. The aggravated impact of food insecurity in this group has significant consequences for maternal and child health, making it a vital public health concern.[1]

Research highlights that WRA in informal settlements often rely on cheap, calorie-dense, nutrient-poor food, increasing the risk of micronutrient deficiencies such as iron, folate and calcium.[5] These deficiencies contribute to adverse health outcomes, including anaemia and low birthweight, worsening the cycle of poor maternal and child health.[6] The Food and Agriculture Organization of the United Nations, along with various partners, developed the MDD-W to address the need for an affordable food-based indicator to measure dietary diversity as a proxy for micronutrient adequacy.[7] The MDD-W measures diet diversity, which forms a key aspect of diet quality. Consuming a diverse diet ensures that nutrient requirements are met, as no single food provides all the necessary nutrients.

Informal settlements are characterised by poor environmental conditions, poverty, decreased job opportunities, limited access to education and unsafe living conditions, contributing to a worsened HFI among the residents.[8] Informal settlements often lack formal planning and infrastructure development, leaving residents with limited access to clean water, sanitation and healthcare, all of which are essential for maintaining good nutrition.[5] The limited availability of grocery stores, combined with an increasing reliance on informal and unregulated food vendors, often characterised by high prices and inconsistent food quality, poses a significant challenge[6] contributing to high levels of HFI. Despite the global recognition of HFI, data on WRA living in urban informal settlements in South Africa remain limited.

Limited data exist regarding the food security, dietary diversity and anthropometric status of WRA in a Tshwane informal settlement in South Africa. Evidence from other settlements, often including older women,[7] underscores the need for recent, targeted studies in this population. Therefore, this study aimed to assess HFI, dietary diversity and anthropometric outcomes among WRA in the Tshwane informal settlement.

Methods

Setting and study design

This was a descriptive cross-sectional study conducted on WRA residing in an informal settlement. The informal settlement is characterised by a lack of running water, electricity and proper infrastructure. It covers an area of 80 000 m^2 and is home to citizens of South Africa, along with numerous political and economic refugees from neighbouring countries. The settlement has grown from 846 households (3 000 people) a decade ago to 10 000 people in households made from tin that vary in size from 12 to 15 m^2. The study was conducted at the Plastic View (also known as Woodlands) informal settlement located on the outskirts of Moreleta Park in the East of Tshwane, Gauteng, in April 2022. Data collection occurred at Woodlands Village clinic, an on-site Community Oriented Primary Health Care clinic that serves the Plastic View community.

Study population

Participants were recruited through nonprobability convenience sampling by community health workers (CHWs) from the informal settlement. The study was conducted according to the guidelines of the Declaration of Helsinki, and ethics approval was sought from the Research Ethics Committee (Ref: 740/2022). Written informed consent was obtained from all potential participants before data collection. Leadership was also informed about the study, as facilitated by the Woodlands Village clinic project manager. The CHWs acted as gatekeepers and assisted with translation when needed. Dietetic students asked the questions in English, or in the participant's home language if they were able to, or the CHWs translated when participants could not understand. No translation of questionnaires was done.

During recruitment, the fieldworkers (dietetics students and CHWs) walked through the informal settlement and informed community members about the study procedures. Participants were recruited at the household level, and eligible participants were asked to go to the clinic where other fieldworkers and CHWs completed the questionnaires and measurements. All women aged 18–49 who visited the clinic during the data collection period were included. Participants were allowed to ask questions and were informed that they could withdraw from the study at any time without consequence. All study participants lived close to the clinic and did not incur travel costs to participate (distance < 2 km). Study participants received an orange after the interview, and water was available on site. The WRA who were either younger than 18 or older than 49, as well as those who did not give informed consent, were excluded. Additionally, pregnant women ($n = 9$) were not considered in the final analysis. Consequently, the study comprised a total of 103 participants.

Materials

Sociodemographic information

A structured sociodemographic questionnaire was administered by the students to obtain information on participants, including employment, educational status, household occupancy and food preparation equipment.

Household food insecurity

The Household Food Insecurity Access Scale (HFIAS)[8] was used to measure food insecurity experienced in the previous four weeks. The HFIAS questionnaire comprises nine 'occurrence' and nine 'frequency-of-occurrence' questions that describe the prevalence and severity of food insecurity. For example, 'Did you or any household member have to eat fewer meals in a day because there was not enough food?'. If the participant answered 'yes' to a question, it was followed by Likert scale alternatives of never, rarely, sometimes or often. Questions explored anxiety about food (one question), insufficient quality of food (three questions), and inadequate food intake and consequences (five questions). Each question has a score ranging from 0 to 3, with a score of 3 indicating the highest frequency of occurrence. The scores for each of the nine questions were then summed to obtain total scores ranging from 0 to 27 for classification as follows: HFIAS score 0–1: food secure household; 2–8: mildly food insecure household; 9–16: moderately food insecure household (for this study, mild and moderate were added together as MFI); and 17–27: severely food insecure household (SFI). Higher scores indicate greater food insecurity or greater inaccessibility to food in the house.

Dietary diversity

The MDD-W tool was used to determine diet diversity as a proxy for micronutrient adequacy, comprising 10 food groups that help determine if women meet the minimum micronutrient requirements for 11 essential nutrients: vitamin A, thiamine, riboflavin, niacin, vitamin B6, folate, vitamin B12, vitamin C, calcium, iron and zinc. Food groups such as fats and oils are not included in the MDD-W, as they do not contribute significantly to micronutrient density.

From a single 24-hour recall, each food is assigned to a food group. A score of 1 is given if at least one food item from that group was consumed (at least 15 g of the food). If no foods from any groups were consumed, a score of 0 was given. The scores were used to categorise the participants into two groups. A score of < 5 indicated a failure to achieve minimum dietary diversity (low dietary diversity), whereas scores of ≥ 5 indicate that minimum dietary diversity has been achieved (high dietary diversity).[6]

Anthropometry

Anthropometric measurements were taken by dietetic students trained in standard anthropometric techniques. Height (cm) was measured using a SECA 217 stadiometer (SECA GmbH, Hamburg, Germany) and measured to the nearest 0.1 cm with the participants wearing light clothing, barefoot and with the head in the Frankfort plane. Weight (kg) was measured to the nearest 0.1 kg on an electronic scale (SECA 878). Both measurements were recorded twice, and an average was taken. Body mass index (BMI) was calculated as weight divided by height squared in accordance with the International Society for the Advancement of Kinanthropometry.[9] The participants' BMIs were classified according to the WHO BMI classification, as follows: < 18.5 kg/m^2 – underweight; 18.5–24.9 kg/m^2 – healthy weight; 25.0–29.9 kg/m^2 – overweight; > 30.0 kg/m^2 – obese; 30.0–34.9 kg/m^2 – class I obesity; 35.0–39.9 kg/m^2 – class II obesity; and > 40.0 kg/m^2 – class III obesity.[10] The mid-upper arm circumference (MUAC) was measured to the nearest 0.1 cm using a flexible measuring tape midway between the acromion process and olecranon on the left arm. A MUAC < 23 cm was classified as undernourished.[11]

Pilot

The questionnaires were tested on seven WRA (who did not form part of the main study) to confirm that the questionnaire

items were clear and understandable and to prevent logistical difficulties in the main study.

Data analysis

The study used descriptive data analysis to present continuous data. Normality was assessed using histograms and the Shapiro–Wilk test. Continuous variables with normal distribution (height) were reported as mean and standard deviations, and those with non-normal distribution (age, weight and MUAC) as median and interquartile range. Categorical variables, including WRA food security status, food groups consumed and BMI categories, were shown as frequencies and percentages. The independent *t*-test or Mann–Whitney *U* test was employed to compare data between MFI (2–16 score) and SFI participants (17–27 score), while the Pearson chi-square test was used for categorical variables. The Mann–Whitney test was used to compare the variables in WRA who are MFI or SFI, with significant differences ($p < 0.05$): *p*-values were excluded, as all were above 0.05.

Results

The study included WRA ($n = 103$), of whom 3.9% were food secure, 20.4% were MFI and 75.7% were SFI. The sociodemographic information for the study population and the MFI and SFI groups is presented in Table 1. Results for the food-secure group ($n = 4$) are not tabulated due to the small sample size.

No significant difference was found in the median age between the WRA groups (MFI and SFI; $p = 0.428$). Twice as many WRA completed high school compared with those with only a primary school education. Most participants were single (77.7%) or unemployed (91.3%), had no access to electricity, flush toilets or a clean water supply at home, and relied on JoJo tanks and municipal water trucks for water supply. No significant sociodemographic differences were observed between the MFI and SFI groups.

Figure 1 illustrates the food security status of WRA, with a mean HFIAS score of 14.0 ± 5.8. Only 3.9% of the WRA were food secure, whereas 75.7% were SFI. The food groups consumed by the WRA are presented in Table 2, with 93.2% of the study sample consuming the grains, roots and tubers group on the day before the interview. Pulse consumption was low, with a significant difference between the MFI and SFI groups ($p = 0.022$). Although egg, dairy and vitamin A-rich food consumption was generally low, no significant differences were observed between the MFI and SFI groups. Overall, 20.4% of WRA achieved the minimum dietary diversity.

Table 3 summarises the anthropometric measurements of WRA. The total median BMI (kg/m^2) was 26 (23.6–30.5) with no significant difference between the MFI and SFI groups: 28.2 (25.1–34.7) and 27.0 (23.3–30.7). The mean MUAC (cm) was high across all WRA groups (31.8 [28.6–25.1]).

Figure 2 displays the BMI distribution of the WRA, which revealed that 37% were overweight and 30% were obese. None of the WRA were underweight (0%). No significant differences were observed between the MFI and SFI groups for anthropometric measurements ($p > 0.05$).

Table 1: Characteristics of women of reproductive age living in an informal settlement in South Africa

Variables		Study population $n = 103$	Moderately food insecure ($n = 21$)	Severely food insecure ($n = 78$)
Age, *n* (%) (years)	< 20	6 (5.8)	0	5 (6.4)
	20–29	43 (41.7)	7 (33.3)	33 (42.3)
	30–39	39 (37.9)	10 (47.6)	29 (37.2)
	≥ 40	15 (14.6)	4 (19.0)	11 (14.1)
Marital status, *n* (%)	Single	80 (77.7)	18 (85.7)	59 (75.6)
	Married	14 (13.6)	2 (9.5)	12 (15.4)
	Living together	7 (6.8)	1 (4.8)	5 (6.4)
	Divorced/widow	2 (1.9)	0	2 (2.6)
Education, *n* (%)	None	4 (3.9)	2 (9.5)	2 (2.6)
	Primary school	35 (34.0)	9 (42.9)	26 (33.3)
	High school	64 (62.1)	10 (47.6)	50 (64.1)
Employment, *n* (%)	Unemployed	94 (91.3)	21 (90.5)	71 (91.0)
	Self-employed	6 (5.8)	0	3 (3.8)
	Employed part-time	3 (2.9)	1 (4.8)	2 (2.6)
Monthly amount spent on groceries ZAR median [IQR]		1000.0 [1000.0–1500.0]	1000.0 [800.0–1600.0]	1000.0 [600.0–1500.0]
Number of people living in the house median [IQR]		3.0 [3.0–4.0]	3.0 [2.0–4.0]	3.0 [3.0–4.0]
Number of children median [IQR]		2.0 [1.0–3.0]	2.0 [1.5–3.5]	2.0 [1.0–3.0]
Children living with the participant median [IQR]		1.0 [1.0–2.0]	1.0 [1.0–2.0]	1.0 [1.0–2.0]
Cooking utility n (%)	Primus stove	50 (49.0)	8 (38.1)	40 (51.3)
	Gas	21 (20.4)	6 (28.6)	14 (17.9)
	Open fire	21 (20.4)	4 (19.0)	16 (20.5)
	Wood/coal	10 (9.8)	3 (14.3)	7 (9.0)

Results for food-secure participants ($n = 4$) are not tabulated because of the small sample size. Interquartile range (IQR) (25–75 percentile). MFI includes both mild (2–7) and moderate (8–14) ranges of HFIAS. Chi-square and Mann–Whitney *U* tests were used to assess differences; no statistically significant differences were found in MFI and SFI ($p > 0.05$).

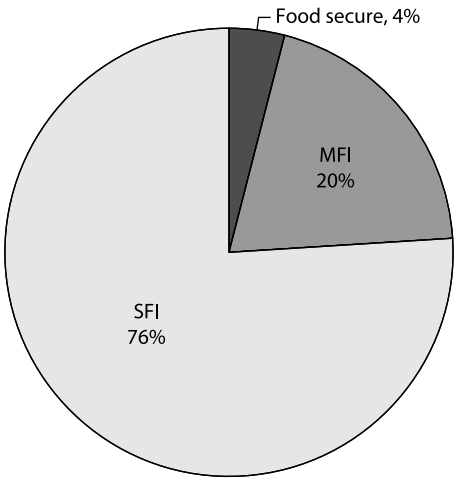

Figure 1: Categories of food insecurity in women of reproductive age. MFI: moderately food insecure, SFI: severely food insecure. MFI includes both mild (2–7) and moderate (8–14) ranges of HFIAS.

Discussion

The primary findings of this study are that most WRA in this informal settlement were SFI, overweight or obese, and had low dietary diversity. South Africa has consistently been reported as food secure at the national level, but not at the household level. By 2008, food insecurity had decreased significantly from 52.3% in 1999 to 25%.[12] In 2021, 20% of households (1 in 5) were food insecure.[13] According to Statistics South Africa, in 2022, despite provincial variations, 19.6% of households experienced limited access to food.[14]

As expected, food insecurity is generally greater in informal settlements than in surrounding urban areas.[15] In urban Johannesburg, 63% of households were food insecure, with 34% being classified as SFI,[16] whereas an informal settlement on the outskirts reported 70% food insecurity.[17] Other provinces, such as KwaZulu-Natal, reported lower rates (13–17%).[18] It is important to note that while this study used the HFIAS to determine food insecurity, these studies used a variety of food insecurity prevalence indicators, including the Household Dietary Diversity Score, Household Hunger Scale, Months of Adequate Household Food Provisioning, and the Household Food Insecurity Access Prevalence. Our study revealed a strikingly high prevalence of SFI, which was markedly higher than the global (11.7%) and African (23.4%) prevalence rates.[1,2]

Table 2: Food groups consumed by women of reproductive age based on the previous 24-hour recall

Food groups	Study population ($n = 103$)	Moderately food insecure ($n = 21$)	Severely food insecure ($n = 78$)
Grains/roots/tubers, *n* (%)	96 (93.2)	18 (85.7)	74 (94.9)
Pulses: beans/peas/lentils,, *n* (%) **	18 (17.8)	7 (33.3)	11 (14.1)
Nuts & seeds, *n* (%)	8 (7.8)	1 (4.8)	6 (7.7)
Dairy, *n* (%)	22 (21.4)	5 (23.8)	15 (19.2)
Meat/poultry/fish, *n* (%)	37 (35.9)	5 (23.8)	29 (37.2)
Eggs, *n* (%)	9 (8.7)	2 (9.5)	6 (7.7)
Dark green leafy vegetables, *n* (%)	69 (67.0)	13 (61.9)	53 (67.9)
Other Vit A: fruits/vegetables, *n* (%)	24 (23.3)	5 (23.8)	18 (23.1)
Other vegetables, *n* (%)	34 (33.0)	6 (28.6)	26 (33.3)
Other fruits, *n* (%)	9 (8.7)	3 (14.3)	6 (7.7)
Dietary diversity achieved, *n* (%)	21 (20.4)	6 (28.6)	14 (17.9)

Results for food-secure participants ($n = 4$) are not tabulated because of the small sample size. MFI includes both mildly (2–7) and moderately (8–14) ranges of HFIAS. ** A significant difference was found between MFI and SFI women (33.3 vs. 14.1; $p = 0.22$). Chi-square test used to test significant differences ($p < 0.05$)

Table 3: Anthropometric measurements of women of reproductive age

Variables	Study population $n = 103$	Moderately food insecure, $n = 21$	Severely food insecure, $n = 78$
Weight (kg), median [IQR]	70.0 [59.5–78.9]	70.2 [63.8–84.2]	69.9 [58.4–78.5]
Height (cm), mean ± SD	159.3 ± 5.8	160.0 ± 5.3	159.1 ± 6.1
Body mass index, median [IQR]	26.9 [23.6–30.5]	28.2 [25.1–34.7]	27.0 [23.3–30.6]
Mid-upper-arm circumference, median [IQR]	31.8 [28.6–35.1]	32.3 [30.8–37.0]	31.3 [28.2–35.2]

Results for food-secure participants ($n = 4$) are not tabulated because of the small sample size. MFI includes both mild (2–7) and moderate (8–14) ranges of HFIAS. Interquartile range (IQR) [25th–75th percentile]. The Mann–Whitney *U* test was used to compare the variables in WRA who are MFI or SFI; no statistically significant differences were found ($p > 0.05$).

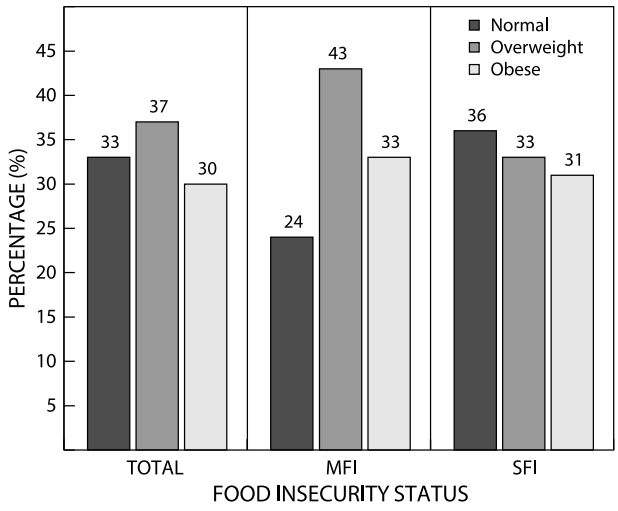

Figure 2: Body mass index classification of women of reproductive age according to food insecurity status. MFI: moderately food insecure; SFI: severely food insecure. Results for food-secure participants ($n = 4$) are not tabulated because of the small sample size. MFI includes both mild (2–7) and moderate (8–14) ranges of HFIAS. The chi-square test was used to assess differences; no statistically significant differences were found in MFI and SFI ($p > 0.05$).

Naicker (2015)[17] cited several factors contributing to food insecurity in informal settlements, such as poverty, limited education, large household size and unemployment. Poverty is a key feature of informal settlements, where low household income directly limits financial access to food, limiting dietary diversity as was evident in the current study. While South African citizens can access social grants, undocumented foreign nationals do not receive this support. Almost all the women in the present study were unemployed and occasionally relied on casual employment in the surrounding residential suburbs. The majority of the study sample were single or living alone and therefore could not benefit from supplementary partner income.[19] This is not unusual, as female-headed households are common in informal settlements. Consistent with this, MFI or SFI was higher in female-headed households than in male-headed households.[20]

Despite the high level of food insecurity and poor dietary diversity, none of the women in the present study were undernourished. The median MUAC was high, approximately 1.5 times the undernutrition cut-off of 23 cm. Approximately two-thirds of participants in the present study were overweight or obese; similar findings have been reported in other South African studies.[15,21] Excess bodyweight is a risk factor for noncommunicable diseases and increased mortality risk.[22] Furthermore, the lack of sufficient, good-quality nutrition for preconceptual health, pregnant women and lactating women and their offspring in this study sample has far-reaching implications for the future health and productivity of the population.

The rising BMI among South African women is linked to the nutrition transition, marked by increased consumption of affordable, energy-dense staple foods and a decline in nutrient-dense options such as fruits and vegetables. This shift indicates a growing reliance on processed and calorie-rich foods, leading to the coexistence of overnutrition and micronutrient deficiencies, which contribute to obesity and poor diet quality in this demographic.[23] This confirms the inverse correlation between dietary diversity and food insecurity.[24] Low dietary diversity, which has remained largely unchanged, has previously been reported in South Africa's low socioeconomic townships and urban informal localities, with values between 44.8% and 46.6%.[16,25] Busse et al.[26] reported on the food settings in an informal settlement, which are characterised by a duality of obesogenic and anti-obesogenic foods. This pattern of many nutrient-poor, highly processed foods alongside an abundance of nutrient-rich, minimally processed foods is consistent with the nutrition transition.[22] A diverse diet indicates nutrient adequacy, emphasising that no single food contains all the essential nutrients for optimal health. No significant differences were found in the food groups consumed by WRA in our study, except for the pulses group. The MFI participants consumed more pulses than the SFI group ($p = 0.022$). This contrasts with the high prevalence of pulse consumption (96.3%) observed in rural Mali but is similar to a South African study (8.2%).[25,27] The study also found high consumption of grains, tubers and roots, similar to another African study.[25] Consumption of dark green leafy vegetables was high, with no difference between MFI and SFI participants. Egg consumption was low and did not differ between groups, similar to another South African study (10.4%).[25] Eggs are a great source of iron, which is an important nutrient for WRA as it transports oxygen in the blood.[27] The DDS of WRA in our study was low, similar to studies conducted in Mali and South Africa.[25,27]

Therefore, incorporating a variety of food groups daily increases the likelihood of meeting nutrient requirements. In addition, implementing evidence-based nutrition interventions, including micronutrient supplementation, balanced energy and protein intake, and nutrition education for WRA, can assist in addressing food insecurity as well as improving their nutritional outcomes.[28]

This study was done in an informal settlement and highlights the paradoxical relationship between food insecurity and anthropometric status, and therefore the dual burden of malnutrition in marginalised communities. These findings contribute to the achievement of Sustainable Development Goals (SDG) 2 (zero hunger) and 11 (sustainable cities and communities) by identifying gaps in food accessibility and diet quality in vulnerable urban communities.[29] The generalisability of the study is limited by its small sample size and recall bias related to the 24-hour recall dietary assessment method. Future studies in this setting should include a larger sample size and evaluate aspects of the food environment to gain better insights into food accessibility.

Conclusion

This study found that a large percentage of the WRA living in an informal settlement were SFI and consumed diets with little variation, despite the majority being overweight and obese. Food insecurity was not associated with obesity or dietary diversity. However, a significant difference in the consumption of pulses was observed between the MFI and SFI women. Educational interventions are recommended to improve food security and dietary diversity, as well as to mitigate obesity in rapidly expanding informal settlements. In addition, social interventions aimed at enhancing socioeconomic status and increasing access to a diverse range of foods are also recommended.

Acknowledgements — The authors would like to acknowledge all WRA who participated in the study, and the B Dietetics fourth-year 2022 students for their assistance with data collection, and Dr C. Tosh for editing the manuscript.

Author contributions — Conceptualization: Claire Martin, Christa Ellis, Phumudzo Tshiambara, Marion Beeforth; methodology: Claire Martin, Marion Beeforth; formal analysis, investigation, and visualization: Phumudzo Tshiambara; writing – original draft preparation: Christa Ellis, Claire Martin, Phumudzo Tshiambara; writing – review and editing: Christa Ellis, Claire Martin, Phumudzo Tshiambara, Marion Beefort. All authors read and approved the final publication version.

Ethics approval and consent to participate — Ethics approval was sought and approved by the University of Pretoria, Faculty of Health Sciences Research Ethics Committee (Ref: 740/2022). The procedures used in this study adhered to the tenets of the Declaration of Helsinki. All the participants provided signed informed consent for publication.

Informed consent — Informed consent was obtained from all participants.

Disclosure statement — All authors declare that they have no competing interests directly or indirectly related to the work submitted for publication.

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Received: 27-06-2025 Accepted: 30-03-2026