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Coping strategies for food insecurity among rural households: an observational study of adaptive mechanisms

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Background: Despite South Africa being food secure at the national level, overall food insecurity persists in rural communities with inadequate resources. The current study aims to investigate the state of food security and identify the coping strategies employed by households in response to food shortages within the rural communities.

Methods: The design was a cross-sectional descriptive survey. Two rural communities were purposefully selected; thereafter, household informants were conveniently selected. A researcher-administered validated questionnaire was used to collect data on demographic characteristics, food security and coping strategies from 280 households with 2,300 family members. Quantitative analysis was done using SPSS version 26.0.

Results: Food insecurity remains a major concern as 36.8% of households are still experiencing hunger and employed 25 strategies during periods of food shortages. The top adaptive strategies were reliance on inexpensive and culturally less favored foods (50.3%) and getting food from friends and relatives (40%).

Conclusion: Food insecurity was remarkably high; however, households devised coping strategies for survival. The development of interventions to eradicate hunger should remain a key commitment of decision-makers and be informed by the coping strategies.

KEYWORDS

coping behavior, households, food insecurity, hunger, rural population, South Africa

1 Introduction

Household food insecurity occurs when food is limited or cannot be accessed with certainty in terms of quality, quantity, safety and in culturally or socially acceptable ways at the level of household (FAO, IFAD, UNICEF, WFP and WHO, 2019). While food security is defined as a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, IFAD, UNICEF, WFP and WHO, 2022). The four main pillars of food security are accessibility, availability, utilization and stability. According to Food and Agricultural Organization of the United Nations (FAO), an estimated

2.3 billion people in the world were moderately or severely food insecure in 2021, and 11.7% of the global population faced food insecurity at severe levels. Notably, the majority of these individuals reside in developing countries, particularly in Asia and Africa (FAO, IFAD, UNICEF, WFP and WHO, 2022).

Food insecurity remains a pervasive challenge across low- and middle-income countries, driven by a convergence of economic hardship, climate shocks, and social inequalities. In Asia, the situation has intensified due to rising food prices, extreme weather events, and displacement crises, with over 88 million people facing acute food insecurity in 2024 alone [World Food Programme (WFP), 2025]. Families respond through diverse coping strategies, ranging from reducing meal frequency and relying on informal networks to seeking government aid and diversifying income sources (Morgan et al., 2024; Childs et al., 2017). These responses are shaped by access to economic, social, and cultural capital, as illustrated in studies from Uruguay (Brunet et al., 2024) and Southeast Asia (Randhawa, 2024). Ansah et al. (2020) further highlights how shock interactions influence household strategy choices, underscoring the need for nuanced, context-specific interventions.

Despite the overall progress made globally, food insecurity has persisted in the developing world with Sub-Saharan Africa (SSA) reporting inadequate progress in recent years (FAO, IFAD, UNICEF, WFP and WHO, 2022; FAO, IFAD and WFP, 2013). This might thwart the attainment of Sustainable Development Goals (SDG) 2 and 3 by 2035. Bjornlund et al. (2022) argue that despite SSA being a net exporter of agricultural products, food security remains persistent and is worsening. They attribute this paradox largely to the legacy of colonial export-oriented agricultural systems, which redirected fertile land, water and labor toward serving the needs of industries and consumers in the Global North. Another review identified key determinants of household food insecurity in SSA, including the gender of the household head, age, educational attainment, household size, income level, poverty status and food prices—all of which also contribute to child malnutrition (Drammeh et al., 2019). Between 2009 and 2018, famines in SSA were intricately linked to the dual impacts of conflict and drought, both of which significantly undermined food security. Anderson et al. (2021) found that violent conflict intensified the effects of drought-related food insecurity during the 2009–2019 period. Moreover, food insecurity has emerged as a critical driver of migration. Evidence suggests that as food insecurity worsens, the likelihood of individuals desiring to migrate internationally increase (Sadiddin et al., 2019). The consequences of food insecurity extend beyond malnutrition and migration. Migrants often face exploitation, while host countries may experience increased pressure on public services, challenges with integration, and social tensions with local populations (Sadiddin et al., 2019).

Although South Africa is considered food-secure at the national level—producing or importing sufficient food to meet the needs of its population—significant disparities persist at the household level, particularly in rural areas (John-Langba, 2012). Many poor households continue to face inadequate access to safe and nutritious food due to poverty and rising food costs (Mbhenyane et al., 2020). Between 2011 and 2019, household access to adequate food fluctuated, with data from 2012 indicating that 28.3% of households were at risk of hunger, and 45.6% were already experiencing it (Shisana et al., 2013). These challenges are more pronounced in rural provinces such as the Eastern Cape, Limpopo, Northern Cape and Northwest, which

consistently report the highest rates of food insecurity (Shisana et al., 2013). A systematic review of 48 studies conducted between 1991 and 2021 revealed a gradual decline in food insecurity and hunger, yet the issue remains a pressing concern (Labadarios et al., 2011). Complicating efforts to assess and address the problem is the use of 27 different measures of food insecurity across studies, which hinders comparative analysis at the national level (van den Berg and Walsh, 2023). While social grants have provided some relief, researchers argue that escalating food prices and unaffordable diets remain the primary drivers of food insecurity. Consequently, there is a critical need for in-depth analysis of the challenges faced by rural populations and the coping mechanisms they employ. It is also recommended that policymakers collaborate with researchers to integrate sub-national findings into food security planning, monitoring, and evaluation frameworks.

Food insecurity remains disproportionately high in South Africa's rural areas (Misselhorn and Hendriks, 2017). The 2016 South African Demographic and Health Survey revealed that while 82% of adults and 80% of children nationally had not experienced hunger in the previous year, these figures dropped to 77.0 and 74.4%, respectively, in rural areas [National Department of Health (NDoH), Statistics South Africa (Stats SA), South African Medical Research Council (SAMRC), and ICF, 2019]. Localized studies further highlight the severity of the issue in Limpopo Province, where 23.6% of children under 12 months in Lebowakgomo were food insecure (Ntila et al., 2017), 31.3% of adults in Vhembe and Mopani districts experienced hunger (Mbhotsani et al., 2021), and 41.6% of households across five districts reported moderate to severe hunger (Sithole et al., 2023). These findings underscore the vulnerability of rural households to food insecurity. In response, households adopt various coping strategies—temporary or permanent measures to manage food shortages and economic shocks (Cordero-Ahiman et al., 2018). These strategies vary widely and include borrowing money or food, receiving assistance from relatives or neighbors, and relying on less preferred or cheaper foods (Grobler and Dunga, 2017; Akerele et al., 2013; Ngidi and Hendriks, 2014). While both food and cash safety nets are employed across SSA, evidence suggests that cash transfers may be slightly more effective in reducing food insecurity (Dasgupta and Robinson, 2021). However, a concerning trend is the shift toward energy dense, low-nutrient globalized foods, contributing to rising obesity and child stunting (Chagomoka et al., 2016). Despite these insights, there is limited research exploring the relationship between food insecurity status and the coping strategies employed in rural communities of Limpopo, particularly in the Vhembe District (Mkhawani et al., 2016). This study seeks to address this gap by examining the types of coping strategies used and how they vary according to the severity of food insecurity.

2 Materials and methods

2.1 Study design

This study utilized a descriptive cross-sectional survey design, conducted in two purposively selected rural communities, here referred to as village 1 and 2, within the Vhembe District of Limpopo Province, South Africa. The district is predominantly rural in character, comprising 576 scattered villages, many of which face

persistent infrastructural and economic challenges. According to the 2016 Census, village one and two together accounted for 736 households. Village one features higher population density, while village two shows signs of emerging agricultural organization through small cooperative initiatives. Both areas have historically lacked consistent access to water, prompting ongoing development interventions such as standpipe installations and borehole rehabilitation. These structural conditions, combined with limited formal employment opportunities and a youthful population profile, shape the food insecurity coping strategies commonly adopted by households, including subsistence farming, food rationing, informal borrowing, and reliance on social networks.

The population and sample were selected as depicted in the Figure 1.

The total number of households for the two villages at the time was 736, based on Statistics South Africa's Census 2016. A sample size of 280 households was calculated using a 95% confidence interval and a significant level of 0.05 based on a 30.8% food insecurity rate in the Limpopo Province (Shisana et al., 2013). Within each selected household, participants were conveniently sampled based on predefined eligibility criteria. Eligible participants were adults aged 18 years or older, of any gender, who were actively involved in food-related responsibilities such as cooking and purchasing, and who were knowledgeable about the household's food security status.

2.2 Measured variables

2.2.1 Socio-economic characteristics and household assets

A structured researcher-administered questionnaire was used to collect data on socio-economic characteristics and house assets. The study also used the Household Food Insecurity Access Scale (HFIAS; Coates et al., 2007) and Coping Strategy Index (CSI) (Mbhenyane et al., 2020; Maxwell and Caldwell, 2008) to establish the food security status and coping strategies consumed by households, respectively.

2.2.2 Household food security

The validated HFIAS used to assess the food security status of households is a nine-item food insecurity scale that measures whether adults and/or children in the households were affected by food insecurity, food shortages, perceived food insufficiency or

altered food intake due to constraints on resources (Deitchler et al., 2020; Knueppel et al., 2010). Each of the nine questions of the questionnaire had follow-up sub-questions, which were aimed at determining the extent of such food insecurity over the past 30 days.

2.2.3 Food coping strategies

A food coping strategy is any fallback, short-term, temporary adaptive mechanism devised by households when they face food shortages. The CSI is a new concept with an inverse function approach, which implies that a decrease in the use of coping strategies indicates an increase in food security and vice versa. The CSI suggested by Maxwell and Caldwell (2008) has been employed in many studies conducted in Africa, including South Africa, to identify the coping strategies used by households in both rural and urban areas (Grobler and Dunga, 2017; Akerele et al., 2013; Ndhleve et al., 2013). A validated CSI tool was used, and households were requested to rank each coping strategy based on its perceived frequency and severity.

2.3 Data collection

Data was collected between February 2017 and December 2019 through household-based, face-to-face interview using a validated questionnaire. A total of 11 research assistants, each paired with a field worker, conducted the interviews. The research assistants held degrees in Dietetics or Nutrition, while the fieldworkers had completed high school education.

Training was conducted over 5 days by the principal investigator and two researchers. Research assistants participated in all 5 days, while fieldworkers joined on days four and five. The training covered recruitment procedures, informed written consent, how to obtain signed consent forms from participants, interview techniques, and the identification of households experiencing distress.

As part of the training, the questionnaire was piloted by the research assistants on the fieldworkers to assess its clarity and usability. The fieldworkers were members of the two communities and thus represented the sample characteristics.

Of the fieldworkers, five were from village one and six from village two. They were responsible for recruiting participants and obtaining consent before the scheduled interview day. Interviews were conducted by the research assistants in the local languages, Xitsonga

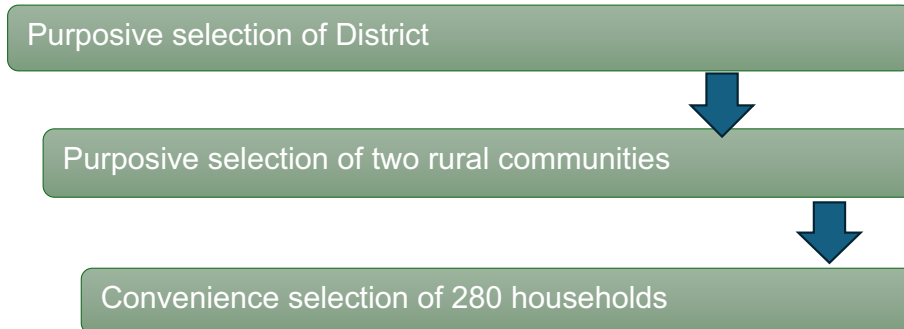


FIGURE 1
Sample selection process.

or Tshivenda, and typically in outdoor spaces adjacent to the house, such as the veranda or yard, lasting between 30 and 45 min.

2.4 Data processing and analysis

Data was coded and entered in Microsoft Excel, cleaned and exported to Statistical Package for Social Scientist (SPSS) version 26.0 for data analysis. Descriptive statistics were presented in the form of means and standard deviations for continuous variables that were normally distributed, and median with the interquartile range (IQR) for numerical data that was not normally distributed, while frequencies and percentages were presented for categorical variables.

The HFIAS and CSI scores were used to determine the status of households. For HFIAS, the questions determine the temporal severity and periodicity of hunger. The household received a score out of nine according to how many “yes” answers were provided. A score of zero (0) indicates food security, a score of 1 to 4 indicates risk of hunger and a score of 5 to 9 is equal to food insecurity or experiencing hunger.

The frequency of using coping strategies was assessed ranging from “never” (0) to “every day” (7), and the severity from “least severe” (1) to “most severe” (4). The CSI score was established for every coping strategy by multiplying the frequency of application of the strategies and the relevant severity weighting of that strategy. As increasing frequency and severity are both represented by increasing values, a high CSI consequently portrays a serious situation of food insecurity. This situation is marked by the frequent application of coping strategies that are perceived as severe or very severe. In contrast, a low CSI stands for little dependence on severe coping strategies and thus more secure food.

Spearman's correlation coefficients were used to determine which coping strategies correlated with HFIAS scores. Significance was set as $p < 0.05$.

3 Results

3.1 Sociodemographic characteristics of the household and food assets

A total of 280 households were included in the current study, however, data from 279 households are reported due to one incomplete questionnaire. Less than one-third (27.6%) of the household informants were employed. Findings revealed that 70.3% of the households had adults 18 to 35 years while 48.7% had children under 5 years. Most (91.8%) of the households had fields in the household where they cultivated food for household consumption, 31.9% owned orchards or had fruit trees, 20.8% had fields away from household and 19.4% had gardens.

Water and sanitation conditions were also evaluated. Most households (85.7%) relied on communal taps and protected water sources, including outdoor taps (15.4%). However, a sizable portion of households used unprotected water sources such as tanks or rainwater harvesting systems (38.0%), rivers (35.5%), and springs or wells (20.8%). In terms of sanitation, pit latrines were the most used toilet facilities, utilized by 83.9% of households. Only a small percentage had access to flushing toilets, with 1.1% having them inside the house and 0.3% using flushing toilets located outside. Almost all

(95.3%) of the households used firewood while 36.9% used both electricity and firewood. See [Table 1](#) for details.

3.2 Household food insecurity

Findings revealed that 36.8% of households were experiencing hunger, 39.6% at risk of hunger, while 23.6% were food secure.

3.3 Household food coping strategies

Current findings showed that 25 coping strategies were employed by the households in the two villages. The five most used coping strategies included: eating less preferred and more affordable foods (50.3%), getting food from friends and relative (40%), the limiting of portion size at mealtimes (34.3%), reducing number of meals eaten in a day (31.3%) and household accessing food from neighbors (26.7%) due to lack of money to buy food, as depicted in [Table 2](#).

The correlation between HFIAS score and food coping strategies also showed that household with prominent level of food insecurity limited portion size at mealtimes ($r = 0.240$, $p = 0.015$) but relied less on feeding of adult members of the household at the expense of children members ($r = 0.949$, $p = 0.014$).

A significantly strong positive correlation was found between CSI and HFIAS ($\rho = 0.615$, 95% CI 0.54–0.68, $p < 0.001$). Higher use of coping strategies was associated with food insecurity. Both the CSI and HFIAS methods are used to measure the severity of household food insecurity (see [Table 3](#)).

Results from the analysis of two regression models are presented in [Table 4](#). Model 1 shows the correlation between household biophysical environment factors, such as type of house, source of water, type of toilet facility, and type of energy used for cooking, and CSI. This model revealed that the use of river water for household activities and drinking, and the use of electricity for cooking, positively influenced CSI. Model 1 was extended to Model 2 by including household food production and food storage. The same variables that were significant in Model 1 remained significant in Model 2. With the addition of smallholder farm ownership as a factor influencing CSI in the study areas.

4 Discussion

The findings revealed high levels of food insecurity, with more than half of the households resorting to consuming unpreferred foods and employing various coping strategies. In total, 25 coping strategies related to food deprivation were identified. The CSI was positively associated with the HFIAS, indicating that as food insecurity increases, households tend to adopt a greater number of coping mechanisms.

The findings from HFIAS suggest that food insecurity was a widespread concern in the study population. Only about a quarter of households were food secure, while the majority faced varying degrees of vulnerability. A substantial portion were already experiencing hunger, and an even larger share were on the brink, indicating a fragile food environment. This pattern reflects not only limited access to adequate food but also the precariousness of household coping strategies. The data point to systemic challenges in food availability,

TABLE 1 Sociodemographic characteristics of the participants in the households ($n = 279$).

Characteristics	Frequency	Percentage
Participant		
Age group of participants ($n = 689$; Mean \pm SD = 36.2 \pm 17.6)		
< 18	60	8.7
18–35	330	47.9
36–60	219	31.8
60–80	68	9.9
80 plus	12	1.8
Gender of participant ($n = 697$)		
Female	557	79.9
Male	140	20.1
Marital status of the head of the household		
Married	273	39.2
Single	322	46.2
Divorced	60	8.6
Widowed	42	6.0
Education level of the participant		
No education	82	11.8
Primary education	148	21.2
Secondary education	414	59.4
Short courses	6	0.68
Employment status of participants*		
Employment	77	27.6
Household		
Age group of household members (years)* ($n = 963$)		
Under five	136	48.7
+5–8	101	36.2
+8–12	123	44.1
+12–18	141	50.5
+18–35	196	70.3
+35–55	147	52.7
+55 and older	119	42.7
Household food production (plants)* ($n = 279$)		
Field in the household	256	91.8
Orchard/fruit tree	89	31.9
Fields away from the household	58	20.8
Garden	54	19.4
Smallholder farm	5	1.8
Source of water* ($n = 279$)		
Communal tap	239	85.7
Tank (rainwater harvest)	106	38.0
River	99	35.5
Spring/well	58	20.8
Tap outside	43	15.4
Borehole	25	9.0

(Continued)

TABLE 1 (Continued)

Characteristics	Frequency	Percentage
Tap in the house	5	1.8
Toilet facility (<i>n</i> = 279)		
Pit latrine	234	83.9
Bush	13	4.7
Flush toilet in the house	3	1.1
Flush toilet outside	1	0.3
Non-response	28	10.0
Sources of energy* (<i>n</i> = 279)		
Firewood	266	95.3
Electricity	103	36.9
Paraffin	1	0.4
Cow dung	1	0.4
Solar energy	1	0.4

*Variables with multiple responses. Source: research data.

TABLE 2 Coping strategies undertaken by households for food security (*n* = 279).

Behaviors	n	Total %	Mean (days)	6–7 times	4–6 times	1–3 times
1. Rely on less preferred and less expensive foods	151	50.3	3.4	8.0	21.7	20.7
2. Borrow food, or rely on help from a friend or relative	120	40.0	2.7	3.7	12.7	23.7
3. Limit portion size at mealtimes	103	34.3	3.1	3.7	15.0	15.7
4. Households reduce portion sizes	102	34.0	2.9	2.7	15.3	16.0
5. Reduce the number of meals eaten in a day	94	31.3	3.0	3.3	13.3	14.7
6. Household gets food from neighbors	80	26.7	2.0	0.3	6.3	20.0
7. Restrict consumption by adults for small children to eat	70	23.3	3.2	2.7	10.3	10.3
8. Borrowed money to buy food from neighbors	63	21.0	1.9	0	4.7	16.3
9. It never happens that there have been times when you did not have enough food or money to buy food?	60	20.0	2.9	2.7	6.0	11.3
10. Purchase food on credit	59	19.7	2.3	2.0	4.0	13.7
11. Send household members to beg	57	19.0	1.9	0.3	4.0	14.7
12. Sent children to neighbors or relatives	43	14.3	2.1	0.3	3.3	10.7
13. Gather wild food, hunt, or harvest immature crops.	42	14.0	2.8	2.3	3.3	8.3
14. Consume seed stock held for next season	42	14.0	2.0	1.0	2.3	10.7
15. Household slept without food	41	13.7	2.2	1.0	3.0	9.7
16. Drank tea only	40	13.3	2.5	0.7	4.3	8.3
17. Send household members to eat elsewhere	33	11.0	2.7	1.0	3.7	6.3
18. Household skip meals	30	10.0	2.5	1.3	3.0	5.7
19. Household had to take other measures	20	6.7	3.3	1.7	1.7	3.3
20. Feed working members at the expense of non-working members	12	4.0	2.8	0.7	0.7	2.7
21. Feed female members of household at the expense of male members	11	3.7	2.4	0	1.3	2.3
22. Sold traditional beer and buy food with the profit	10	3.3	3.0	0.7	0.7	0.7
23. Feed adult members of household at the expense of child members	5	1.7	2.0	0	0.3	1.3
24. Feed male members of household at the expense of female members	5	1.7	1.0	0	0	1.7
25. Exchange sorghum/green mealies with white mealie meal from local shops or mobile vendors	4	1.3	1.5	0	0	1.3

TABLE 3 Coping strategy index (CSI) / HFIAS scores correlations with household consumption coping strategies ($n = 280$).

Behaviors	CSI score		HFIAS	
	Spearman's rho correlation	p -value	Spearman's rho correlation	p -value
Rely on less preferred and less expensive foods	0.330	0.000	0.127	0.120
Borrow food, or rely on help from a friend or relative	0.604	0.000	0.145	0.114
Purchase food on credit.	0.428	0.001	0.019	0.884
Gather wild food, hunt, or harvest immature crops.	0.446	0.003	0.190	0.228
Consume seed stock held for next season	0.232	0.139	−0.100	0.528
Send household members to eat elsewhere	0.137	0.448	0.039	0.829
Send household members to beg	0.382	0.003	−0.009	0.945
Limit portion size at mealtimes	0.571	0.000	0.240	0.015
Restrict consumption by adults for small children to eat	0.490	0.000	0.168	0.165
Feed working members of HH at the expense of non-working members	0.143	0.658	0.110	0.734
Feed adult members of HH at the expense of child members	−0.053	0.933	−0.949	0.014
Feed female members of HH at the expense of male members	0.057	0.869	0.073	0.831
Reduce number of meals eaten in a day	0.481	0.000	0.000	0.997
Household skips meals	0.303	0.043	0.273	0.070
Household gets food from neighbors	0.562	0.000	0.103	0.363
Household slept without food	0.307	0.054	0.285	0.071
Household reduces portion sizes	0.520	0.000	0.112	0.261
Borrowed money to buy food from neighbors	0.276	0.029	0.216	0.090
Sent children to neighbors or relatives	0.407	0.007	0.071	0.653
Drank tea only	0.300	0.060	0.096	0.556
Sold traditional beer and bought food with the profit	0.475	0.165	0.481	0.159
It never happens that there have been times when you did not have enough food or money to buy food?	−0.236	0.764	0.102	0.437
Household had to take other measures	0.307	0.017	0.194	0.412

Bold indicates highlights significant results.

affordability, or utilization, and underscore the importance of strengthening social safety nets, community-based support systems, and sustainable livelihood interventions. These findings on the rate of food insecurity are higher than rates reported in 2013 in Limpopo province (30.8%) and South Africa (26.0%) (Shisana et al., 2013), and lower when compared to a study conducted between 2008 and 2015 by Mbhenyane et al. (2020a). Additionally, the proportion of households experiencing hunger has remained consistent with findings from previous studies. The current rate (36.8%) aligns closely with those reported in other regions, showing no substantial improvement. For instance, the prevalence of hunger in this study mirrors that of a neighboring district, which recorded slightly higher levels (44.4%), and is comparable to provincial estimates (30.8%; Shisana et al., 2013). This persistence suggests that food insecurity remains a systemic issue, requiring sustained and context-specific interventions to address underlying causes.

The persistent and multidimensional nature of food insecurity demands a nuanced understanding of how socio-demographic vulnerabilities intersect and compound risk. Drawing on Amartya Sen's entitlement and capability frameworks, it becomes evident that food insecurity is not merely a matter of supply, but of access, agency, and structural inequality (Sen, 1981). While African scholarship on

this intersectionality remains limited, the longitudinal study by dos Santos et al. (2024) in Brazil offers a compelling parallel, demonstrating how prolonged exposure to food insecurity correlates with entrenched socio-demographic disadvantages such as low income, limited education, and geographic isolation. Their findings underscore the importance of temporal and contextual analysis in shaping policy responses. Bridging this gap in African research could illuminate region-specific dynamics and inform more equitable, resilience-focused interventions. Ultimately, addressing food insecurity requires not only alleviating hunger but dismantling the systemic barriers that perpetuate it (Mbhenyane and Tambe, 2024; De Cock et al., 2013).

These differences in findings of this study and those before might be attributed to different tools used, the earlier studies used Household hunger scale (HHS) whereas this study used HFIAS. According to the FAO in Maxwell hunger scale (Maxwell et al., 2003) HHS captures the most extreme manifestations of insufficiency, while HFIAS captures a mix of sufficiency and psychological factors. Another reason could be the seasonal variation (harvest season) at the time of collecting the data. Additionally, geographic variations in the sites of the studies could be the reason. Notwithstanding all the dissimilar findings of the numerous studies, it is evident that food insecurity in Limpopo province is of public health concern based on the findings of this study.

TABLE 4 The ordinary least squares (OLS) regression analysis for household coping strategies.

Dependent variable: household food security	Model 1		Model 2	
	Coef.	SE	Coef.	SE
Household sociodemographic characteristics				
Employment status	−1.475	−0.046	−0.061	1.962
Biophysical environment				
Type of house				
Hut	−0.101	1.908	−0.091	1.972
Brick and mortar	0.057	2.171	−0.049	2.209
Shack	0.047	2.272	−0.023	2.286
Source of water				
Tap in the house	0.075	7.082	−0.077	7.363
Tap outside the house	0.013	3.039	0.001	3.238
Communal tap	−0.009	3.137	0.006	3.142
River	0.396***	1.801	0.375***	1.859
Tank (rainwater harvest)	−0.162*	2.113	−0.157*	2.103
Borehole	0.046	2.964	0.046	3.017
Spring/wells	−0.008	2.450	0.013	2.555
Type of toilet facility				
Flush toilet in house	−0.017	9.045	−0.002	9.172
Flush toilet outside	0.033	13.229	0.032	13.101
Pit latrine	0.026	2.265	0.015	2.284
Type of energy used for cooking in the household				
Firewood	−0.025	4.091	−0.043	4.133
Electricity	0.167**	1.852	0.161**	1.908
Cow dung	−0.096	13.522	−0.099	13.390
Domestic animal	0.129	1.985	0.124	1.980
Household food production (plants)				
Garden			0.036	2.267
Orchard/fruit tree			0.013	2.052
Field in the household			−0.128	5.242
Fields away from household			−0.012	2.109
Smallholder farm			0.137*	6.143
Food storage				
Food production			0.045	6.324
Storage facility			0.085	5.360
Number of storage facilities			−0.103	1.103
N	280		280	
R square	0.231		0.248	

* $p < 0.05$, ** $p < 0.001$, *** $p < 0.0001$. Bold indicates highlights significant results.

Furthermore, in this study, 72% of the participants were unemployed and mostly female. The benefits of employment include sufficient financial resources and acceptable purchasing power. In this study, most households had low purchasing power due to unemployment. Food insecurity indicates inadequate food accessibility due to poor financial resources and poor food availability from own production. This means that most of the households

experienced food instability. Food stability is when a household, or in this instance, the individual, always has access to food and does not risk losing access as a consequence of events such as the dry season or loss of employment. When an individual experience food stability, they can develop malnutrition due to a lack of essential nutrients. Siddiqui et al. (2020) argue that access to food, stability of supply and safety, and healthy food prevents malnutrition and makes individuals

less vulnerable to food insecurity. Furthermore, factors such as extreme weather (e.g., floods and droughts), inadequate roads and transport, social conflict, and ineffectual government policy may limit the ability to produce, distribute, and/or access food and stability thereof (Simelane and Worth, 2020).

Women are reported to have a higher probability of being food insecure relative to men, according to Broussard (2019). A review of 42 studies with a total population of 233,153 confirms the existence of gender differences in reporting household food insecurity (Jung et al., 2017). The magnitude of the gender gap in food insecurity is said to vary across regions. Ruiter and Wildschutt (2010) highlighted the importance of gender-sensitive development policies, localized contextual knowledge, and innovative strategies that would assist women in their efforts to become food secure, particularly in rural areas across South Africa. This study was conducted in a rural setting with a female-dominated sample, thus gender-sensitive policies advocated above would likely benefit the women in these areas.

Sociodemographic and biophysical environments have been reported to be positively associated with food insecurity. Rusere et al. (2023) in their investigation of the nexus between summer climate variability and household food security in rural Mpumalanga province, South Africa revealed significant impact on food security from high inter-annual rainfall variability though fluctuations in food consumption, dietary diversity, and the experience of hunger. Likewise, Setsoafia et al. (2022) concur that climate change was found to harm the food security status of households. Furthermore, they report that crop production was constrained by poor rainfall, severe erosion and increases in temperature, and the unpredictability of rainfall, pests and disease also contribute to food security. This study did not investigate climate change or variability's impact on food security or influence on coping strategies employed but rather the seasonal availability of food. Nevertheless, in this study, no sociodemographic and other household environment factors influenced food security status. This can be attributed to the fact that the sample was homogenous in terms of both individual and household characteristics. Furthermore, the data was collected during the dry seasons.

Households in this study reported that they have adopted single or multiple coping strategies to cushion food shortages. The 25 food coping strategies adopted by the households are similar to those identified in other studies. Coping strategies were reported to be practices increasing the accessibility of food in Malaysian households (Sulaiman et al., 2021). Moreover, Setsoafia et al. (2022) assert that food security is captured by the reduced coping strategy index and household dietary diversity in their study conducted in Ghana. This study investigated household dietary diversity, which was lower than expected, but the results are not reported in this paper.

In this study, the eating of less preferred and less expensive foods, and accessing food from friends or relatives were the most commonly used coping strategies by households where food insecurity was severe, which concurs with studies conducted in India (Gupta et al., 2015) and Southwest Nigeria (Akerele et al., 2013). Other prevailing strategies in descending order were limiting portion size during mealtimes, households limiting the items they purchased, reducing the number of meals eaten in a day, and getting food from neighbors. This might imply that participants and their children in the study area might be undernourished, eventually leading to a high burden of malnutrition and related disease (Gubert et al., 2017; Mahmudiono

et al., 2018). A wide range of lived experiences and coping strategies were reported, including cooking whatever is available, skipping meals, receiving money or food from friends and relatives, eating unsafe and low-quality foods, taking on additional work, cooking least-preferred foods, and having monotonous and less nutritious meals. Jafri et al. (2021) in their review using data from West and Southern Africa observed that participants reported having less variety (50.4%), quality (30.2%) and quantity (39.2%) of foods, with disparities across regions. To cope with food shortages, participants in their review mostly relied on less preferred foods (49%), reduced portion sizes (30%) and/or reduced the number of meals (25.7%). This study is comparable, because half (50.3%) ate less preferred foods, over a third (34.3%) reduced portion sizes, and a third (30%) reduced the number of meals. The findings from this study in South Africa closely mirror regional trends observed across West and Southern Africa, as reported by Jafri et al. (2021). Coping strategies such as consuming less preferred foods, reducing portion sizes, and skipping meals are prevalent across both contexts, underscoring a shared experience of food insecurity. Notably, the proportions in South Africa, 50.3% eating less preferred foods, 34.3% reducing portion sizes, and 30% reducing meal frequency, align closely with regional averages (49, 30, and 25.7% respectively). This convergence highlights the widespread nature of food-related coping mechanisms across the continent, while also emphasizing the need for targeted interventions that address both the quality and quantity of food access in vulnerable communities.

The coping strategies in this study can further be categorized under individual, household, support from neighbors or relatives or social networks and innovative approaches. Five strategies were related to what the individual does when faced with food shortages. The individual coping mechanisms include limiting food portions, reducing the number of meals, and sleeping without eating or drinking tea alone. Fourteen strategies were employed at the household level, and these varied. Children would be sent to neighbors or relatives or would eat more affordable and minimally preferred foods. The household would share the food that is available through limiting portion sizes and the number of meals. Seven strategies could be categorized under support from neighbors, relatives and food supply stores. These included accessing food from friends or neighbors, or buying food on credit, a practice done in rural areas. The practice seeking credit for the primary purpose of food and borrowing money from the village collectors has been reported in Latin America (Weerabahu et al., 2022).

Households were innovative and devised self-sufficiency strategies, which were observed in this particular community. Sixty households foraged forest food, hunted traditional game, or harvested immature crops to supplement food stocks. Moore et al. (2022) in their study on accessing food during the lean season in Madagascar, focusing on foraging for forest food, hunting, or harvesting immature crops, observed that wealthier households were less likely to consume them. In concurrence, Mutie et al. (2020) also reported on the conservation of forest food plants and their potential for combating food insecurity in Kenya.

Another innovative strategy was the consumption of seed stock held for the next season. Some households sold African traditional alcohol beverages and bought food with the profit, similar to other studies conducted in the same province (Mbhenyane et al., 2020). Furthermore, some households exchanged sorghum and/or green mealies for white mealie meal from local shops or mobile vendors.

Mbhenyane et al. (2020a) reported similar observations in the Sekhukhune district of Limpopo province.

The present study found a strong positive correlation between HFIAS score and coping strategies, such as limiting portion size at mealtimes, which was also observed by others (Mjonono et al., 2009; Grobler, 2014). Further analysis revealed that most households refrained from feeding adult members of the household to benefit child members. The positive correlations are an indication that food-insecure households in rural communities experienced limited food consumption, which has potential negative health consequences on the household members.

The study reports limited weak association between household biophysical environment factors: the type of house, source of water, type of toilet facility, type of energy used for cooking and household coping strategies associated with poverty or the low economic status of a household, which can lead to food insecurity. The nexus between food security, water availability and quality has been widely reported (Hadley and Wutich, 2009).

The observed positive correlation between HFIAS scores and coping strategies, such as limiting portion sizes and prioritizing child nutrition over adult consumption, highlights the severity of food insecurity in rural households and underscores the need for targeted public policy interventions. These findings align with broader evidence that food-insecure households often adopt strategies that compromise nutritional adequacy, particularly among adults, to buffer children from the worst effects of scarcity (Maxwell et al., 2014; Coates et al., 2007).

Further, the weak associations found between household biophysical factors, such as housing, water source, sanitation, and cooking energy, and coping strategies linked to poverty suggest a structural vulnerability that exacerbates food insecurity. The linkage between food access, water availability, and sanitation has also been widely reported in related literature (Mazenda and Nkwana, 2025).

In light of this, existing government programs in South Africa such as the Integrated Food Security Strategy (IFSS) and the Comprehensive Rural Development Program (CRDP) aim to tackle these socioeconomic and infrastructural conditions (Government of South Africa, 2009; Department of Agriculture, 2002). The IFSS focuses on improving food production and household nutrition, while the CRDP supports rural development through participatory planning, infrastructure investment, and land access, targeting many of the factors identified in this study.

Looking beyond national borders, programs such as the Food Systems Resilience Program for Eastern and Southern Africa, backed by the World Bank, exemplify successful interventions (World Bank Publication Group, 2025). Community-driven efforts like urban agriculture networks in Brazil or farmer cooperatives in Southeast Asia also offer proven strategies to improve food access and strengthen household resilience.

Integrating both local and international insights into policy design can help ensure that public interventions effectively respond to the lived experiences and coping strategies of food-insecure households.

The original CSI, developed by Coates et al. (2007), included 13 items. This study, along with that of Mbhenyane et al. (2020), expanded the tool by incorporating 12 additional coping strategies identified in Limpopo Province. These additions reflect innovative and context-specific approaches that are particularly relevant within rural

settings, where food insecurity is often shaped by unique socio-economic and environmental factors. Customizing the tool to reflect local realities ensures that culturally embedded practices and community-specific coping mechanisms are accurately captured, thereby enhancing the tool's sensitivity, relevance, and applicability in rural African contexts.

The findings of this study should be interpreted with caution due to its cross-sectional design and the use of a geographically limited sample. As the participants were drawn from a single rural area, the results may not be generalizable to the broader rural population of South Africa. This limits the extent to which the findings can be applied to other contexts with differing socio-economic, cultural, or environmental conditions. Another limitation was that the data collection tools used were the HFIAS and CSI, which record only the food-related coping behaviors and thus are limited in their ability to provide a comprehensive interpretation of the behavioral responses to the food security of the communities. Nevertheless, this study provides vital information to understand the food situation of rural households in the Limpopo province and would contribute to the growing body of knowledge in food insecurity and coping strategies among rural communities in South Africa.

5 Conclusion

In summary, the study reported high food insecurity and 25 coping strategies used by households in the study area. The coping strategies employed by the households to address the problem of inadequate access to food included eating less expensive food, getting food from friends or family, limiting portions sizes at meals and reducing the number of meals eaten in a day, among others. The reduction of portion sizes and the number of meals eaten a day is a concern as it has been associated with negative health consequences. The findings of this study contribute to the United Nations SDG 2—Zero Hunger—by identifying coping strategies that households employ to manage food shortages. These insights are critical for informing targeted interventions that support vulnerable populations, enhance food security, and promote resilience in rural communities.

This implies that food insecurity remains a challenge in the rural communities of South Africa, and the development of interventions to eradicate hunger should remain a key commitment of decision-makers at all levels. In addition, the study recommends that policymakers consider designing a comprehensive food security strategy framework that promotes growth in the agricultural sector, enhances social inclusion, and improves food security and nutrition in rural communities. Households continue to devise various strategies to cope with food insecurity, often influenced by climate variability. These coping mechanisms warrant further exploration in future studies. Moreover, further research should investigate the characteristics of households that are more resilient during periods of food shortages. Given the study's cross-sectional design and geographically limited sample, future research should also explore longitudinal approaches to assess changes in coping strategies over time and conduct comparative studies across diverse rural regions in South Africa to enhance generalizability and contextual understanding.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The ethical clearance was obtained from the Health and Research Ethics Committee of Stellenbosch University (Ref #: N16/06/083). Further permission was obtained from Xikundu traditional leadership of the surveyed villages. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

XM: Visualization, Formal analysis, Project administration, Validation, Resources, Methodology, Conceptualization, Writing – review & editing, Investigation, Writing – original draft, Funding acquisition. SM: Conceptualization, Writing – review & editing, Supervision, Methodology, Investigation, Data curation, Writing – original draft, Validation. AT: Writing – original draft, Formal analysis, Software, Visualization, Validation, Methodology, Project administration, Data curation, Writing – review & editing. MZ: Investigation, Visualization, Software, Validation, Writing – review & editing, Formal analysis, Writing – original draft, Methodology, Data curation.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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