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Determinants of dietary diversity and drivers of food choice among low-income consumers in urban Kenya, Malawi and Zimbabwe

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Abstract

Introduction: Rapid urbanisation affects lifestyle and eating habits, predominantly causing a dietary shift that adds challenges to meet dietary recommendations within a complex food system. This research investigated dietary diversity and food choice drivers among low-income consumers in three urban settlements (Nairobi, Kenya; Bulawayo, Zimbabwe and Lilongwe, Malawi, representing rapid, moderate and slow urban growth patterns, respectively) as a first step towards improving diets across cultures and geographies.

Methods: Mixed methods data collection was employed for this study. Qualitative methods such as rapid foodscape appraisal workshops and food stories in selected low-income settlements in Nairobi, Bulawayo and Lilongwe were utilised to collect information on the food environments (food balances, infrastructure, safety, policies and institutions). Quantitative data such as socio-demographic characteristics and dietary diversity were collected via structured questionnaires using Cognitive Edge's SenseMaker® ($n = 890$, 450 and 440 for Nairobi, Bulawayo and Lilongwe, respectively). The dietary intake of respondents was assessed using a 24-h recall, which was then converted to the food group diversity score (FGDS).

Results: Different levels of compounded stress affected dietary diversity and quality, including high food prices, concerns about sanitation and hygiene and the role of food standards regulation bodies. The mean FGDS across all locations was lower than the recommended cut-off of 5 (4.5, 2.8 and 2.6 across Nairobi, Zimbabwe and Lilongwe, respectively). Additionally, in Nairobi, there were gender differences in diet diversity, with men having a higher dietary diversity score than women (4.6% vs. 4.3%; $p = 0.004$). The majority of respondents in Lilongwe (65%) reported price as the most important driver of food choice, compared to 38% in Nairobi and 42% in Bulawayo.

Discussion/Conclusions: Our observation of poor-quality diets provides further evidence of the need for food policies that are cognisant of the nutrition and health of the growing population of the urban poor. Such policies would focus on lowering the costs of nutritious foods as well as ensuring food safety within the complex food system observed in the urban low-income environment.

KEYWORDS

consumers, diets, food choice, LMIC

Key points

- An investigation conducted in contrasting food environments in three urban low-income settlements in Lilongwe, Bulawayo and Nairobi suggests low

consumption of nutrient-dense foods, such as fruits and animal-source foods.
- Several drivers of dietary diversity and food choice, as well as perceptions, were identified. Price and convenience were identified as key drivers of food choice, with gender differences reported in dietary diversity.
- Policies and programmes need to consider steering diets towards higher consumption of nutrient-dense foods while taking into account price, convenience and environmental sustainability.

INTRODUCTION

There has been significant urban growth in low- and middle-income countries (LMICs) over the past 50 years. In 1950, only 18% of the population lived in urban areas, increasing to 40% in 2000, and it is projected to reach 56% of the total population by 2030. This growth has been characterised by extensive informal and low-income settlements that are now home to greater than 50% of the population.[1] Inhabitants of low-income settlements are among the groups at the highest risk of poor diets, malnutrition and its consequences.[2–4] For example, among women and children, poor diet quality and dietary diversity have been observed,[3] potentially driving up overweight/obesity as well as non-communicable diseases (NCDs).[5] Also, intra-urban differences in child malnutrition and mortality are becoming more apparent compared to rural–urban differences, mainly due to the growth of low-income settlements.[6] Nutrition transitions driven by urbanisation, commercialisation of agri-food value chains and the reliance on purchased foods partly undermine food security in these low-income settings.[7,8] Without resolute policy and programmatic action, the nutrition and health crisis in urban areas across LMICs will worsen due to multiple pressures, which include globalisation, rural–urban migration, population growth, income inequality, increasing pressures on land and water for food production and climate change.[9] The policies and programmes will need to consider the peculiarities of low income, and often informal settlements to ensure availability of safe, affordable and healthy foods.

This study was designed to investigate the unique determinants of dietary diversity and drivers of food choice among selected low-income consumers in urban Nairobi (Kenya), Bulawayo (Zimbabwe) and Lilongwe (Malawi). The three locations have different sizes of economies based on the World Bank gross domestic product (GDP) data[10] and are influenced by country-specific food policies and institutional arrangements. The research was conducted under the Grain Legumes and Dryland Cereals (GLDC) Program of the Consortium of International Agricultural Research Centres (CGIAR).[11] As such, it was planned that the results of this study would inform potential leverage points for increasing safe consumption of grain legumes and dryland cereals, which would contribute to improving food security, dietary diversity and, thereby, nutrition of urban populations targeted.

To present our findings, our article results and discussion are structured as follows: first, we provide an overview of results from the focus group discussion aimed at obtaining general information on the three locations investigated. We then present the study findings on the mixed method approach in which various aspects of the food environment are described, and the determinants of dietary diversity and drivers of food choice were identified. We finally discuss the findings and present implications for policies and programme design.

METHODS

Study design

This investigation was a cross-sectional study involving participants from three different low-income settlements located in Nairobi, Bulawayo and Lilongwe.

Figure 1 summarises the conceptual framework that guided data collection and analysis, with theoretical perspectives to explain food choice, food intake and nutrition outcomes. Foodscapes in this case are not only the environment external to individuals but also the landscape including perceived and socially shaped by individuals and policies.[12] Interactions with individual socio-economic status, social norms and behaviour choices and changes shape people's food choices, acquisitions and consumption patterns and impact households and communities in achieving food and nutrition security.[13]

Assessments were conducted using qualitative and quantitative research methods. Details of data collection methods are described in subsequent sections.

Study area

The study areas were chosen in Nairobi (Kenya), Bulawayo (Zimbabwe) and Lilongwe (Malawi), where low-income settlements with more than 100,000 inhabitants represent typical urban low-income populations and ensure that variability in responses was captured.

These areas were also chosen to indicate settlements with dense populations where future nutrition interventions and programmes could be implemented. The specific settlements chosen were Mathare in Nairobi, Makokoba and Old Pumula wards in Bulawayo and Mgona settlement in Malawi.

Mathare is one of the four clustered low-income settlements in Starehe Sub-County of Nairobi County, Kenya. It is an urban area 7 km northeast of Nairobi's central business district with a diverse, multi-ethnic population representing several parts of Kenya. The settlement currently has more than 150,000 people who often suffer from food insecurity.[14,15] Makokoba and Old Pumula have approximately 20,000 inhabitants, with high unemployment and poverty rates and different access to food and food services.[16] For Lilongwe, the highest-density low-income settlement, Mgona, was selected. It is situated in the north of Lilongwe with a total of 117,800 inhabitants and characterised by high unemployment and poverty rates.[17] For the purposes of this study, we refer to the site locations in Kenya, Malawi and Zimbabwe as Nairobi, Lilongwe and Bulawayo, respectively.

A map showing the cities in which the settlements are located is shown in Figure 2.

In each city, the study was formally introduced to senior officials; after this, sites were identified that would fulfil the study requirements and where good collaboration with local offices and stakeholder participation in the workshops could be expected.

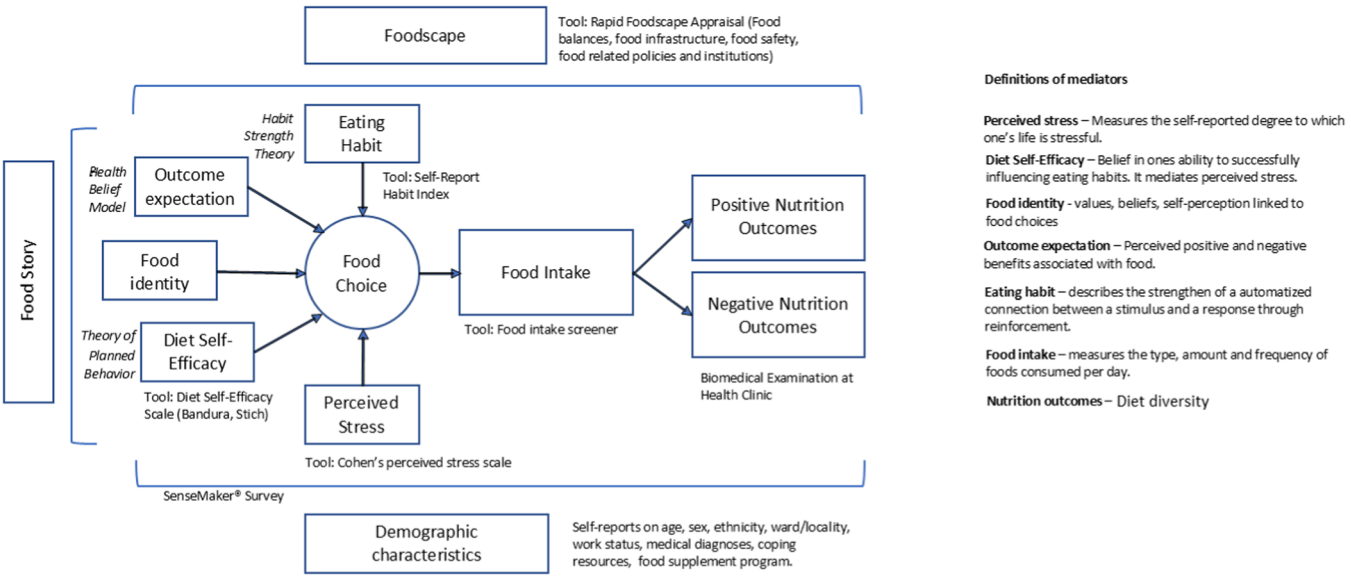

FIGURE 1 Study conceptual framework.

FIGURE 2 Nairobi (Kenya), Bulawayo (Zimbabwe) and Lilongwe (Malawi). *Source: Centers for Disease Control and Prevention Traveler's Health.*[18–20]

Ethical approval

For Nairobi, the study received approval from the Nairobi County health directorate. In Bulawayo, the study was approved at the national level by the Ministry of Health and Child. In Lilongwe, approval was obtained from the Lilongwe town council, as well as local administrative officials. All participants who completed the SenseMaker questionnaire also provided oral informed consent in the form of a voice recording.

Study participants

We included participants who were over 18 years of age for consent purposes and who had lived in the settlements for at least 2 years for the foodscape appraisal workshops and 1 year for the questionnaire administration. A duration of 2 years was chosen to ensure that respondents participating in the foodscape appraisal workshop had in-depth knowledge of the food system within the settlement. For questionnaire respondents, this duration was selected to ensure they had sufficient experience with the food environment and food acquisition. Literacy was not a requirement, as respondents provided verbal consent that was recorded.

Rapid foodscape appraisal workshops

This data collection exercise was utilised to complement and refine the information that would be collected using the questionnaire (later referred to as the SenseMaker questionnaire). A representation of different stakeholders was required as we anticipated the food systems within the low-income settlements to be intricate. Representation from various levels of civic leadership (including key opinion leaders and health workers), as well as business people, including green grocers, food vendors and millers, was sought. These respondents were identified using local leadership together with local active civil society organisations and non-governmental organisations, depending on which one was more active or visible in the location. In this case, greengrocers refer to stationary individuals within the settlements, often with makeshift structures that sell vegetables and fruits in small quantities as their main goods. They often purchase their items from open-air markets and resell them in affordable quantities. Food vendors selected were stationary or mobile, including those who sold processed and/or unprocessed food items and also those who sold ready-to-eat foods. An intentional effort was made to ensure equitable gender, age and social status representation at the workshops. Each workshop brought together 5–15 participants. In each city, more than one workshop was held.

SenseMaker questionnaire study sampling

For the SenseMaker questionnaire study sampling, based on similar previous studies, a convenience sample size of 400 participants was considered sufficient to investigate the research questions based on the design of similar studies.[21,22]

The following sampling criteria were considered:

a) Hundred households with a pregnant woman
b) Hundred households with a child between 0 and 2 years
c) Hundred households with children aged over 2 years
d) Fifty single unmarried, non-pregnant, non-lactating women
e) Fifty single unmarried men

This distribution was considered in line with the assumption that future dietary interventions may have to consider issues such as stage in the life cycle, gender and marital status. For example, future interventions may target pregnant women to influence changes in food choices with the assumption that this stage of the life cycle might serve as a nudge for behaviour change at the individual and household levels.

Households with eligible respondents were identified by community health workers. In Nairobi only, respondents were split evenly for all categories across the three wards from which the rapid foodscape appraisal workshop participants came from. This was because, in this location, the wards were expected to have peculiar differences in food systems.

Because the low-income settlement in Nairobi was huge and had various ethnic groups residing therein, the sample size was doubled ($n = 890$). Bulawayo and Lilongwe had sample sizes within the required numbers, $n = 450$ and $n = 440$, respectively, as these settlements were not as densely populated as that in Nairobi and with less variation in ethnicity.

Data collection methods and tools

Several data collection methods and tools were used. The rapid foodscape appraisal workshop and the food story that was part of the SenseMaker questionnaire were used to collect qualitative data. All other data collected using the triads were quantitative. Details of the tools and methods are described in the following sections.

Rapid foodscape appraisal workshops

Structured topic guidelines Supporting Information: Appendix I for the foodscape appraisal workshops were generated by the lead researchers in each site. Once this was done, each lead researcher met with research teams

across the sites, to contextualise the guide to capture local particularities. The guides allowed deepening contents as they arose in the different socio-cultural settings but also ensured consistency in data collection across locations. Workshops were conducted as half-day audio-recorded workshops that were later transcribed into reports. Workshops were moderated by the first three authors, who had no relationship with participants, together with a local translator. All workshop discussions were audio recorded and later transcribed by a trained enumerator who understood the local language. During the workshop, stakeholders provided information on the demographic characteristics of the population in the settlement, the food environment, food sources and food flows, food safety, sanitation and hygiene and meals and snack purchasing behaviour. These themes were selected as they would offer helpful information for identifying leverage points for future interventions aimed at diversifying diets.

SenseMaker questionnaire

The SenseMaker tool captures and makes sense of people's perceptions, experiences and attitudes regarding the selected topic.[23] In this study, the SenseMaker questions were designed by research teams across the study locations and administered using handheld tablets. An example of this questionnaire used in Nairobi is available in Supporting Information: Appendix II. One master questionnaire was designed with specific countries making changes to capture location-specific nuances. These location-specific changes were particularly for the food lists that captured dietary diversity. To ensure consistency between the questionnaires across locations, the lead researchers from Lilongwe and Bulawayo joined the enumerator training in Nairobi. During the training, they addressed any challenges they expected to face during questionnaire administration in their sites and solutions.

This would ensure that all enumerators received a similar understanding of all questions when trained by lead researchers. The survey was written in English, then translated into the local language and independently back-translated to ensure accuracy and to resolve translation discrepancies. It was then administered in the local language.

Across all sites, enumerators selected had previous experience of administering questionnaires as part of a research survey. The team completed a 4-day training immediately before data collection, covering research ethical principles, data collection procedures, an introduction to SenseMaker methodology and reporting any challenges in the field. The research assistant administered the survey questions in the local language and facilitated the completion of questionnaires with the participants. The questionnaire combined multiple-choice, open and Likert-scale questions in five different themes: socio-demographic characteristics, food story, dietary diversity, drivers of food choice and diversification. This allowed for the collection of both qualitative and quantitative data. In detail, the following data were collected.

Socio-demographic characteristics

The household socio-demographic characteristics collected consisted of the following aspects: age, gender, size, marital status and employment status. Other information collected was self-reported amount spent on food per day, distance to the nearest food outlet, sources of food ingredients and whether families purchased ready-made food or prepared it at home.

Food story

The food story was an open-ended prompt that allowed study participants to share stories or micro-narratives of their own choosing on food. In this case, respondents were asked to imagine that they have a friend who had moved from the rural area to a house next to them. They were then asked what they would tell this neighbour about food, considering that food is important to this new neighbour. In addition, they were asked to summarise the story in three to five words. Recorded micro-narratives were later transcribed and translated into English by professional translators.

Dietary diversity assessment

For the Nairobi participants, a pre-defined food list developed from the stakeholder focus group discussions was used to place foods in the appropriate food group. Before this, stakeholder focus group discussions were utilised to refine and contextualise the 24-h dietary recall so that local foods mentioned were grouped into the correct categories. For Bulawayo and Lilongwe participants, the 24-h recall was administered without a pre-defined list. During the 24-h recall questionnaire administration, the participants were asked to describe food and beverages consumed in the past 24 h. Each food was recorded only when consumed over 15 g (FAO, 2021). It is possible to assert whether the amount consumed is 15 g based on a record of recipes from food composition tables indicating different ingredients in standard recipes. The 24-h recall also included condiments, spices and accompaniments. The dietary diversity score was calculated following the guidelines for the Minimum Dietary Diversity for Women (MDD-W) of reproductive age (FAO, 2021). The nine food groups consist of all starchy staples, beans and peas, nuts and

seeds, all dairy, flesh foods, eggs, vitamin A-rich dark green leafy vegetables, other vitamin A-rich fruits and vegetables, other vegetables and fruits. We then presented the results as the food group diversity score (FGDS).[24] The FGDS could range from zero to 10, with a higher FGDS indicating a relatively better-quality diet in terms of micronutrient content. An FGDS cut-off of 5 and above is recommended to signal that the diet is likely sufficient in micronutrients. We used the MDD-W cut-offs for both men and women because, in general, women of reproductive age have higher micronutrient needs than men of a similar age. Diets sufficient to meet women's micronutrient needs would also likely meet men's.

Drivers of food choice

After participants shared their micro-narrative on food, they then interpreted their own experiences using a series of questions that requested them to quantitatively 'plot' their perspectives about the experiences described in the story. The questions were divided into triads where participants weighted their responses between three possible options or dyads when it was a continuum of two possible options. These choices are made by moving a ball indicator. For the triads, if all three responses mattered to the respondents, the indicator ball could be placed in the middle of the triad. Examples of a triad and a dyad are presented in Figures 3 and 4.

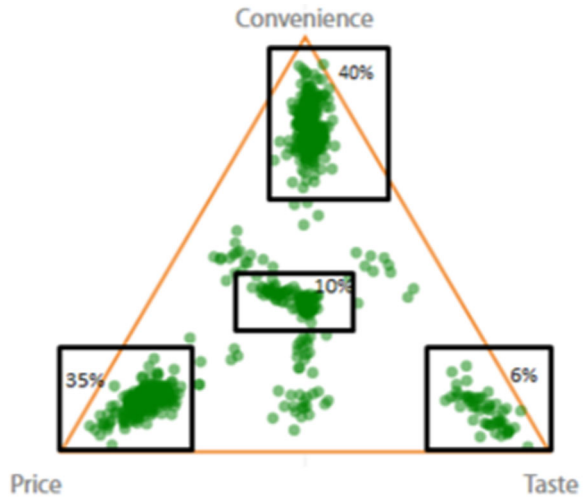

FIGURE 3 Example of a triad as it appeared on the tablet.

What influences your decisions about food?

The indicator is moved onto the triangle and positioned where it best describes the participant's perspective. It may reflect a unique combination of the three possible responses depending on its location. The options in the triads were selected based on information from the rapid foodscape appraisal workshops.

Overall, how satisfied are you with the safety of food in your area right now?

The indicator is moved left or right along the line and positioned where it best describes the participant's perspective on the question asked.

Data analysis

Rapid foodscape appraisal workshops

The audio recordings (qualitative data) were summarised similarly based on themes investigated: demographic characteristics of the population in the settlement, the food environment, food sources and flows, food safety, sanitation and hygiene and meals and snack purchasing behaviour. The information for Nairobi was summarised by wards, whereas for Bulawayo, it was based on two different locations (Makoboba and Old Pumula) within the settlement of interest.

SenseMaker questionnaire

Data obtained from the questionnaire were both qualitative (socio-demographic, dietary diversity and drivers of food choice) and quantitative (food story) with different analysis methods. The different sections were analysed as follows.

Socio-demographic characteristics

The socio-demographic characteristics were analysed using descriptive statistics and frequencies in SPSS statistics version 22. All variables were checked on normality using Kolmogorov–Smirnov and Shapiro–Wilk tests. QQ plots were made for an additional check on normality. Moreover, all tests were set on a significance level of $p < 0.05$.

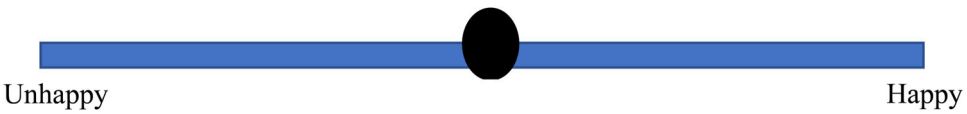

FIGURE 4 Example of a dyad as it appeared on the tablet.

Food story

The food stories were first translated where responses were in the local language. The qualitative analysis then followed the framework analysis approach, which involved organising and analysing the transcribed data using a thematic framework derived from the research questions and the tool used to collect the data. Through this approach, we identified patterns, themes and relatedness in the data – a pre-defined analytical framework. Familiarisation with the data was achieved through transcribing and reading the transcripts. The data were coded and displayed in Excel sheets. Analysis was conducted by examining the relationship between different themes or categories and by exploring the implications and meanings of the findings in relation to the research question. The findings are presented using key quotes from the three study sites for illustration.

Dietary diversity assessment

The dietary diversity assessment results from the 24-h recall are presented in graphs of frequencies of consumed food items per settlement. The frequencies of consumed food items per settlement were adjusted for the study sample size. This was done by multiplying the frequencies of consumed food items in Lilongwe and Bulawayo with a factor calculated by dividing the population of Nairobi by the sum of the population of Bulawayo and Lilongwe. This calculation was performed on frequencies, as this variable was not given in proportions, and sample sizes differed between the low-income settlements. Therefore, the relative differences in frequencies of consumed food items could be evaluated unbiased of sample size. Several steps were needed to convert the 24-h recall into the FGDS in Microsoft Excel version 2019. Firstly, food intake data from the 24-h recall were assigned to the food groups from the FGDS (scores could range between 0 and 10). Consumption status was converted to a binary outcome with 0 as 'not consumed' and 1 as 'consumed'. Lastly, the sum of the FGDS of the three low-income settlements was compared using the statistical programme SPSS version 22. The differences in means between FGDS of the three locations, and the mean differences between FGDS and gender, were assessed using a one-way ANOVA and presented in means, confidence intervals and minimum and maximum scores. Post-hoc analysis was performed to provide specific information on what locations differed.

Drivers of food choice

SenseMaker's data on drivers of food choice or dietary diversification were generated from participants' interpretation of their shared experiences in the form of plotted perspectives of the three options. SenseMaker plots were visualised in Tableau V.2020.4 (Tableau, Seattle, WA, USA) to identify response patterns.[25] Dyad data were generated into histograms with nine equal bars representing a frequency distribution of responses between two extremes.

RESULTS

Foodscape characteristics as identified from the rapid foodscape appraisal workshops

Together, the first three authors summarised the results (obtained from the foodscape appraisal workshops) on the foodscapes into major themes based on discussions with various stakeholders (Table 1). In addition to the information received from the focus group discussions, we included additional information from web-based sources. All low-income settlements consisted of a mix of ethnic groups, with the Mathare low-income settlement in Nairobi having the largest number of inhabitants. We expected respondents to mention food remittances as crucial for food security. However, across all settlements, open-air markets, vendors and stalls are the main food sources, with the open-air markets supplying mainly fruits and vegetables. Vendors mostly sold sweets/confectionery, raw vegetables, fried starches and fruits. Stalls mostly sold processed foods (typically high fat, sugar and/or salt) that would typically be found in supermarkets only in smaller quantities and with the possibility of obtaining these items on credit. In Makokoba and Old Pumula, reliance on supermarkets was also mentioned. Additionally, in Old Pumula, their own production of food as a source of food was also highlighted. To obtain foods for sale, open-air market vendors source foods from more significant markets that serve the cities in which they are located. However, in Nairobi, there was sourcing of certain foods by vendors directly from farmers in certain seasons. All settlements reported clean water accessibility and waste management as food safety issues of concern.

SenseMaker questionnaire results

Socio-demographic characteristics

We observed that the respondents from Nairobi ($n = 810$) had the lowest median age (29 years), whereas those from Bulawayo ($n = 439$) had the highest median age (39 years). The majority of respondents from Nairobi (59.1%) and Zimbabwe (55.3%) were male. Less than half of the respondents from Bulawayo were married (35.6%). A family size of one to three persons was most common in Nairobi (60%), whereas the biggest family size of more than three persons was observed in Lilongwe (80.2%). There was a higher proportion of

TABLE 1 Foodscape characteristics as identified from the rapid foodscape appraisal workshops.

City	Nairobi			Bulawayo		Lilongwe
Settlement	Kiamaiko ward	Mabatini ward	Mlango Kubwa ward	Makoboba	Old Pumula	Mgona
Theme						
Participants	1 FGD with youth coordinator (1); green grocer (3); food outlet worker (2); street food vendor (5); social worker (2); community health volunteer (1); civil society organisation representative (1)	1 FGD with street food vendors (18); miller (1)	1 FGD with street food vendors (11); green grocers (3); food outlet worker (1); caterer (1)	1 FGD with local leadership representatives (6); youth representative (1); local civil society organisation representatives (2); community leader (1); area councillor (1)	1 FGD with youth representative (1); youth representative (1); local civil society organisation representatives (2); community leader (1); area councillor (1)	1 FGD with market vendors (11); youth representative (1); local leader (1).
Demographic characteristics	Four villages: Ghetto village, Lower Kiamaiko, Upper Kiamaiko and Kambi moto, which are highly populated with an estimated population of 0.5 million. All the main ethnic groups of Kenya are represented. The major religions are Islam and Christianity, whereas the main economic activities are slaughtering and selling goat meat, operating small businesses and casual jobs around the goat meat business https://mohiafrica.org/	There are six villages in the Mabatini ward (Kwa Kariuki, Mathare 3 C, Mathare 3 A, Mathare No. 10, and Mashimoni). Population as per 2022 was 105,648 https://static1.squarespace.com/static/58d4504db8a79b27eb388c91/t/63849962a69e574c786e9a9c/1669634487063/Mathare+Profiling+Report_2022+Final.pdf The major religions are Islam and Christianity.	Mlango Kubwa ward comprises Kiamutisya, village 2, and Mathare 3B villages. Population as of 2022 was 101,436 https://static1.squarespace.com/static/58d4504db8a79b27eb388c91/t/63849962a69e574c786e9a9c/1669634487063/Mathare+Profiling+Report_2022+Final.pdf The major religions are Islam and Christianity	Approximately 20,000 inhabitants each, with an average household size of four people per family. There are mixed ethnic groups (Shona and Ndebele) and immigrants from Malawi.	Approximately 20,000 inhabitants each, with mixed ethnic groups (Shona and Ndebele).	In 2009, the population was about 14,333. According to Lilongwe City figures, Mgona has a household size of 3.3, and 4355 households of mainly single families, as most residents are labourers in households and industrial sites https://www.iied.org/10569iied

(Continues)

TABLE 1 (Continued)

City	Nairobi			Bulawayo		Lilongwe
Settlement	Kiamaiko ward	Mabatini ward	Mlango Kubwa ward	Makoboba	Old Pumula	Mgona
Food environment	Food vendors are common for deep-fried foods, meat off-cuts and pre-boiled maize and beans mix. Of the three surveyed wards, food is cheapest here due to the ward's proximity to the open-air market. https://mohiafrica.org/communities/kiamaiko/ Stalls supply items that could be purchased in supermarkets only in smaller quantities. Of the three wards in the low-income settlement, the food here is the cheapest due to the proximity to large open-air markets.	The presence of food vendors is common. Vendors typically open from 5 am to midnight. Stalls supply items that could be purchased in supermarkets only in smaller quantities.	Similar to Mabatini ward	Less than 10% of the population has gardens or cultivate for their own consumption. Few people keep chickens in their yards. Open markets sell grain, which people then mill at local millers. There are also stalls and vendors where people buy vegetables.	People grow maize, kale, sweet potatoes and vegetables in their kitchen gardens. There are also open fields where people plant maize and vegetables on burst sewage pipes. An open space is cultivated mainly by child-headed families, widows and older people.	Residents purchase cereals, vegetables, fruit and animal-source food from local markets. Local vendors mostly sell deep-fried wheat or corn-based snacks and grilled pork, beef, chicken and goat parts, including offals, feet, etc. Stalls or corner shops sell processed food items such as margarine, oil and spices in small quantities. Often these can be purchased on credit as well.
Food sources and food flows	Sources of food are fresh food markets that serve Nairobi (Korogocho, Gikomba, Nyamakima and Marikiti) except during harvest seasons when vendors obtain food directly from farmers in Western (Kisii and Kitale), Central and Eastern (Machakos, Kitui and Makueni	Food consumed here is reported to be from different markets and stores, just like in Kiamaiko ward. Most vendors purchase rice outside the settlement. Green maize is purchased at markets that serve Nairobi (Korogocho, Gikomba, Nyamakima and Marikiti), whereas dry maize for millers is mostly purchased at a wholesale shop within the settlement.	Food sources in Kiamaiko-major wet markets (Korogocho, Gikomba, Nyamakima and Marikiti) in Nairobi with specific markets for particular food items except during harvest seasons when vendors source food (vegetables, maize, beans and black beans) directly from farmers in Central and Western Kenya and Eastern Kenya (pigeon peas and cowpeas).	Grains are purchased in open-air markets. Vegetables and snacks are purchased from vendors on the streets. Indigenous fruits are seasonal and available in rural areas in small quantities.	Residents purchase food items both from local markets and nearby supermarkets. Items bought from different vendors are similar to Makoboba. People supplement purchased food from own production. Dairy (fresh and fermented milk) is mainly sourced	Households rely primarily on purchasing from informal sources. There is little purchase of foods (mostly processed) from supermarkets.

TABLE 1 (Continued)

City	Nairobi			Bulawayo		Lilongwe
Settlement	Kiamaiko ward	Mabatini ward	Mlango Kubwa ward	Makoboba	Old Pumula	Mgona
	counties) Kenya and Kitale. Farmers from Kisii and central Kenya supply vegetables, maize, beans and black beans, whereas farmers from the Eastern region supply pigeon peas and cowpeas. Nyamakima market sells dry cereals.				from peri-urban areas, and vegetables are grown in local gardens and supplemented from markets. Meat is sold in the open-air market, mostly offals and cheap off-cuts. High density and reliance on supermarkets for food is common in Old Pumula. Because people keep chicken, they can access eggs.	
Food safety, sanitation and hygiene	Vendors often complain of a lack of storage facilities, particularly for perishable foods. None of the food vendors had storage facilities for the foods they prepare, especially the remnant foods after sales, so from time to time, they are compelled to stay longer in the streets to ensure that all their food is sold. Clean water and waste management are common complaints.	Similar to Kiamaiko ward.	Similar to Kiamaiko ward.	Food infrastructure mostly informal and poorly maintained. Poor infrastructure results in poor food quality, spoiled food, aflatoxin contaminated, unhygienic conditions, especially in areas with sewage systems.	Vendors have dilapidated structures to sell their foods. The marketplace has no adequate infrastructure, no clean water and is contaminated by sewage water. In Old Pumula, residents are concerned about the safety of food due to the quality of water available.	There is poor waste disposal that blocks drainage systems, affecting water flow and exposing most residents to cholera. There is also a problem of open defecation, including near food sources https://scholars.wlu.ca/cgi/viewcontent.cgi?article=1024&context=afsun

(Continues)

TABLE 1 (Continued)

City	Nairobi			Bulawayo		Lilongwe
Settlement	**Kiamaiko ward**	**Mabatini ward**	**Mlango Kubwa ward**	**Makoboba**	**Old Pumula**	**Mgona**
Meals and snacks purchasing habits	Food consumption patterns and prices vary depending on location. Commonly bought meals from local food stalls are 'chapati' made from wheat and rice accompanied with a legume. In these stalls, ugali (stiff maize porridge) is rarely purchased. Maize and beans mix (githeri) is also commonly purchased with price varying on whether it is boiled or fried, the latter being more expensive. French fries are also commonly consumed as a snack.	Most customers consume boiled or fried githeri (a mixture of maize and beans) and rice (served with meat or beans) from the vendors. Other foods consumed include chapati (served with beans), french fries, spiced rice and ugali (served with meat and/or kale). Most vendors don't consume what they sell, but rather prepare their meals at home, except when there is leftover food that they must eat so that it does not go bad.	Similar to Mabatini ward.	More food prepared at home instead of purchasing; trends for fast food such as french fries increasing.	Similar to Makoboba.	Most people prepare meals at home and purchase deep-fried or roasted (maize and meat off-cuts) snacks from vendors.

Abbreviation: FGD, focus group discussion.

unemployment in Bulawayo (44.3%) and Lilongwe (29.3%) compared to Nairobi (17.2%; $p < 0.001$). There was a difference in per capita food expenditure across the three locations investigated ($p < 0.001$), with the highest expenditure observed in Bulawayo. In terms of food acquisition, more than 70% of all respondents had a food outlet within 1 km of their location, while more than 80% of respondents obtained food ingredients from open-air markets, food vendors or local shops. In this case, open-air markets refer to public areas within the settlements designated as markets, with vendors having temporary or semi-permanent structures from which they mostly sell fruits and vegetables in season. Food vendors sell a variety of food items at different stages of preparation and are located throughout the local settlements rather than being concentrated in one designated area. Local shops often are semi-permanent or permanent structures where retail sales of processed food items are sold. They did not include super- or hypermarkets. They were the most common sources of pasteurised milk, bread, condiments and spices used for food preparation. Across all locations, food transfers from village farms were uncommon, with less than 20% of respondents indicating this as a source of food. Village farm, in this case, referred to a farm in a faraway area where respondents often identified this as their rural home.

Almost all (>70%) of the food preparation took place inside the house, with little purchase of ready-made food took place outside the home. Details of these findings are presented in Table 2.

Food stories/story prompt

Content analysis of the food stories revealed several major themes as follows.

Quality of food/food safety

All respondents, particularly those in Nairobi, indicated they were concerned about the food they consumed. In addition, there was the general perception that some of the food that was available in low-income settlements was exposed to too many chemicals from the sewer system (where they get their water for irrigation), pesticides, excessive amounts of food additives and poor storage post-harvest of market produce.

> *'Food in Nairobi has a lot of chemicals you find that when you go to buy vegetables in the market you will get vegetables which have white substances, which I call chemicals, especially tomatoes and green pepper'. (Nairobi, Kenya)*

> *'Currently, my perception about food around is that it is mostly harvested from the sewer lines in Nairobi river. Here in Nairobi, we lack farms to practice agricultural farming of foodstuffs; thus, most of these food crops are harvested from the sewer lines, which in turn the food crops are later sold in our vibandas, thus increasing disease attacks, so the mode of harvesting and planting these crops is a challenge'. (Nairobi, Kenya)*

Price of food

For the urban poor, the challenges of achieving food security and accessing a healthy diet arise from some of the specific features of urban life. The most prominent concern among respondent in all locations was the difficulty in affording food, as highlighted in the following narrative:

> *'Food is a necessity, but we mostly miss it due to financial status. My family takes black tea in the morning when they go to school during the day; at times, I eat beans and maize from outside at Ksh. 20 so that whatever I have earned, we can manage it for dinner. A snack in between is unheard of, but we survive'. (Nairobi, Kenya)*

> *'Food is good, but we can't afford to buy the nutritious ones; we eat anything that comes our way to fill our stomachs'. (Nairobi, Kenya)*

> *'Food in urban areas is expensive compared to rural areas. This is because food is transported from the rural areas to the city. So, there's a cost incurred'. (Nairobi, Kenya)*

> *'Food is readily available in our area. In my family, we only eat the main meal once during the day. It mainly depends on the money I have made that day. On a good day, I am able to buy meat; most of the times, it's vegetables, beans, small dried fish and nsima for lunch…' (Lilongwe, Malawi)*

> *'Food is available in the shops, but the prices are very high, and it is difficult for people who are not working like me to be able to buy enough food for the family'. (Bulawayo, Zimbabwe)*

> *'Prices are very high, and they escalate almost daily. As for food availability, it's fair, but the issue now is affordability. Most people are failing to buy enough healthy and nutritious food for their families. There are no jobs, but*

TABLE 2 Demographic characteristics of study participants.

Variable	Nairobi (Kenya)[a]	Bulawayo (Zimbabwe)[a]	Lilongwe (Malawi)[a]	All	*p*-Value
Age, years					
n	810	410	439	1659	
Median (range)	29.0 (15, 88)	31.0 (17, 87)	39.0 (16, 89)	31.0 (15, 89)	<0.001[b]
Gender					0.01[c]
Male, *n*/*N* (%)	517/874 (59.1)	247//447 (55.3)	214/434 (49.3)	977/1754 (55.7)	
Marital status					<0.001[c]
Married, *n*/*N* (%)	466/877 (53.1)	160/447 (35.6)	326/434 (75.1)	952/1758 (54.2)	
Household size, n/*N (%)*					
1–3 persons	527/877 (60.1)	100/447 (22.4)	86/434 (19.8)	713/1758 (40.6)	<0.001[c]
>3 persons	350/877 (39.9)	347/447 (77.6)	348/434 (80.2)	1045/1758 (59.4)	
Employment status					<0.001[c]
Unemployed, *n*/*N* (%)	151/877 (17.2)	198/447 (44.3)	127/434 (29.3)	476/1758 (27.1)	
Money spent on food per individual per day, USD[d]					
Married, *n*	466	160	326	952	
Amount, median (range)	1.02 (0, 48.5)	3.6 (0, 15)	0.7 (0, 7)	1.7 (0, 48.5)	
Single, *n*	411	108	108	627	0.74[b]
Amount, median (range)	1.0 (0, 4.9)	4.9 (0, 15)	0.7 (0, 4.2)	1.0 (0, 80)	
All, *n*	876	442	434	1758	
Amount, median (range)	1.0 (), 48.5)	4.2 (0, 80)	0.7 (0, 7)	1.0 (0, 80)	<0.001[b]
Distance to the nearest food outlet, n/*N (%)*					
<1 km	747/873 (85.6)	339/446 (76.0)	319/422 (75.6)	1401/1741 (80.5)	0.001[c]
1–2 km	118/873 (13.5)	74/446 (16.6)	90/422 (21.3)	282/1741 (16.2)	
3–5 km	2/873 (0.2)	28/446 (6.3)	9/422 (2.1)	39/1741 (2.2)	
6–10 km	4/873 (0.4)	3/446 (0.7)	1/422 (0.2)	8/1741 (0.5)	
11 km or more	2/873 (0.2)	2/446 (0.4)	3/422 (0.7)	7/1741 (0.4)	
Sources of food ingredients, n/*N (%)*					
Village farm	61/1449 (4.2)	215/1259 (17.1)	123/872 (14.1)	399/3580 (11)	0.001[c]
Food vendor	765/1449 (52.8)	1011/1259 (80.3)	330/872 (37.8)	2106/3580 (58.8)	
Local shop	598/1449 (41.3)	1175/1259 (93.3)	426/872 (48.8)	2199/3589 (61.4)	
Open-air market	919/1449 (63.4)	781/1259 (62)	840/872 (96.3)	2540/3580 (70.9)	
Food preparation, n/*N (%)*					
Inside house	681/873 (78)	366/446 (82)	385/433 (89)	1463/1762 (83)	0.001[c]
Purchase of ready-made food	192/873 (22)	80/446 (18)	48/433 (11)	299/1762 (17)	

Note: *p*-Value cut-off is set at <0.05.

[a]Presented as city (country).

[b]*p*-Value is obtained via ANOVA testing of means.

[c]*p*-Value is obtained via Chi square testing of means.

[d]The currencies were converted to US dollars by applying appropriate currency conversion of the Kenyan Shilling, Zimbabwean dollar and Malawian exchange rates at 103:1, 1:1 and 715:1, respectively, at the time of data collection in 2019 (Google currency converter).

you have to have money for you to buy food. I skip meals daily, and at the same time, I have to take medication, and it becomes hard for me as I depend on other people to give me food. I have even learnt to limit portions of food to save for another day'. (Bulawayo, Zimbabwe)

As much as the respondents took responsibility for their food security, there was agreement that the government needed to support them to improve their food security and their health status.

'Food is life. We have to eat at all times to survive. I argue that the government to think of us people from the low-income settlements by lowering the price of the food'. (Nairobi, Kenya)

Food availability/seasonality

The respondents also indicated that they bought food that was available at the time (in season), given that foods that were not in season were often very expensive. The availability of food was greatly influenced by the success of the season, as well as the agricultural inputs needed for the production of the food, as indicated by the following statement:

'Sometimes food can be in scarce, especially when there is no rain'. (Nairobi, Kenya)

In Lilongwe, it was indicated that most of the foods that constitute their staple diet are often available but became expensive during the off season. In this case, they chose to consume only foods that were in season.

'There is a lot of food around, including sweet potatoes and cassava, but all this depends on money because it depends on the father to find food. But there also a lot of around like vegetables, fish and meat. As for breakfast and supper, we mostly consume foods that are in season, like sweet potatoes, Irish and cassava'. (Lilongwe, Malawi)

'Food is available at the market, mostly in a good condition, and affordability is dependent on your income. But it becomes cheaper if it is in season'. (Lilongwe, Malawi)

A notable observation in the factors that influence the decisions regarding food is the interrelatedness of the factors. Although price is a key issue, it is directly affected by food availability and food quality/safety, all of which are determined by external forces such as climate, government policies and enforcements and the economic environment, among others. This means these respondents who are living in low-income neighbourhoods must cope with multiple issues, most of which are beyond their individual control.

Responsibility for the food situation

Many of the respondents interviewed indicated in their stories that they were responsible for the decisions they took regarding food and nutrition. However, they indicated that the decisions were influenced by some forces beyond their ability, including the market situation, which was viewed as a responsibility of the government to stabilise. For example, in Nairobi, the increase in fuel prices was indicated to have a huge impact on the price of food, leading to the respondents' decisions to buy what they could afford, and the lack of food subsidies by the government in Lilongwe meant that individuals were left to fend for themselves.

'Food is expensive nowadays; times have changed, and unlike years back where you would have proper meals now, I no longer afford. My breakfast is usually porridge, and it is really hard. It's now survival of the fittest. I have to work extra hard for my family to survive. I do not have a permanent job, but as a casual laborer, I make sure I feed my family. It is difficult now as the money I get from piece jobs only buys basic commodities. I have a child who is two months old, but we have already introduced supplementary foods as the mother is not producing enough breast milk because of hunger'. (Bulawayo, Zimbabwe)

'Food is and will be more expensive. This is because of the increase in fuel prices, thus affecting transportation. This makes food prices increase'. (Nairobi, Kenya)

'Food is a problem in the area, and because of a lack of money to buy food, my husband has to work hard to get enough money. The area doesn't receive donations from the government, hence a major problem with food security'. (Lilongwe, Malawi)

In addition, the respondents indicated that it was the responsibility of the government to ensure that food safety standards were adhered to. Their perception was that the government seemed to be unable to uphold its responsibility, as there were a lot of unsafe environments and food in their neighbourhoods, and they felt helpless as they were unable to address the issues as individuals.

'The government is less concerned of how food is handled and where it is grown from'. (Nairobi, Kenya)

Drivers of dietary diversification

The most frequently mentioned driver of poor dietary diversification was the cost of food. Due to the poor economic status of the respondents, most indicated that they could only afford to buy cheap and available foods (mostly carbohydrates).

'Dietary diversity is also dependent on the economic situation of the people, poverty does not allow us to diversify, and we end up eating what is available'. (Bulawayo, Zimbabwe)

Nutritional knowledge was mentioned by many as a challenge for food diversification. Although the respondents were aware of the basic tenets of a balanced diet, most of them did not understand the food alternatives available to them and thus would end up eating the same and familiar foods.

'The food around is very common to everyone. Most foods sold around here are kale, spinach, and cabbages, which at times affect our daily diet, since diet diversification becomes tough and hard because there is no money to eat a balanced diet'. (Nairobi, Kenya)

'I always eat food that comes my way because I do not have any idea on balanced diet food or nutritious foods'. (Nairobi, Kenya)

'We eat different kinds of foods, and all have different tastes and preferences, and we eat in the afternoon and evening usually, but you cannot be choosy when it comes to food because of the economic situation'. (Bulawayo, Zimbabwe)

Some respondents indicated that they prefer certain tastes in their diet, and, therefore, find it difficult to diversify and include other tastes. An example was given in Lilongwe of nsima (maize meal), which they said was a staple in their diet and whose taste was loved by many. They would find it difficult to replace it with something else. Similar examples were given in Bulawayo as well.

'Nsima is the food we love because it's gives us energy'. (Lilongwe, Malawi)

'They usually eat staple diet and other cheaper foodstuff; they rely mostly on staple food mainly the maize because of the food prices which are now above the average income of most residents'. (Bulawayo, Zimbabwe)

Food safety

Generally, the respondents were concerned about the safety of the food they consumed, especially the production process (sewage water, pesticides), storage and transportation from the rural areas, as well as safety in public eateries. As such, most of the respondents indicated that they took extra steps to ensure the safety of their food at home by washing it and ensuring that the food was safely stored and cooked. However, a few respondents said that the preparation of food is unhygienic due to the lack of water both at home and in the food stalls.

'I cross-check and wash properly my raw food before I cook food'. (Nairobi, Kenya)

'Food safety is an issue at the market. Food vendors are not under any strict rules of hygiene, so its mostly dependent on them'. (Lilongwe, Malawi)

'Food safety is mostly an issue when it comes to meat sold at the market. We are not assured whether it meets the Malawi Bureau of Standards (MBS) requirements'. (Lilongwe, Malawi)

'It depends on the person preparing the food. Some foods are not safe, some places where food is sold is dirty and not appropriate. I prefer making the food my own way, and my safety is guaranteed'. (Lilongwe, Malawi)

Preferences of food preparation location

Many respondents indicated lacking resources such as soap, water, firewood and time to practice safe food preparation and hygiene practices:

'Food from Kiamaiko is not healthy, my experience is where I live, the people who sell food, especially vegetables they don't like spending money on buying clean water, so you will find them fetching from open water pipes where the water is contaminated, and they wash once without checking if there are worms, they just cut into small pieces, and I just cook it like that without washing again

because I don't have time. so I get cheaper food at my health expense'. (Nairobi, Kenya)

'In the house, the food will be safe and away from dust. I prefer food prepared in the house for hygiene purposes. Also, if I want more, I would be added'. (Nairobi, Kenya)

'Because I don't know how the other people prepare food outside my house, I don't have enough resources for my food to be prepared outside my home'. (Lilongwe, Malawi)

'It is cheaper to buy groceries and cook in my house than to buy food from outside, which is expensive and at times not hygienic'. (Bulawayo, Zimbabwe)

Diet quality

The mean FGDS was 3.6 (standard deviation [SD] 1.5). Bulawayo and Lilongwe had lower FGDS than Nairobi ($p < 0.0001$). When analyses were stratified by gender, it was observed that female respondents in Nairobi and Lilongwe had lower FGDS compared to their male counterparts ($p = 0.004$ and $p = 0.03$, respectively). Details of FGDS values are presented in Table 3.

Figure 5 summarises the intake of individual food groups within 24 h preceding the survey date. More than 90% of participants reported that they had consumed starchy staples. In all locations, less than 40% of respondents reported consuming milk products, meat and fish, vitamin A-rich fruit and vegetables and organ meats.

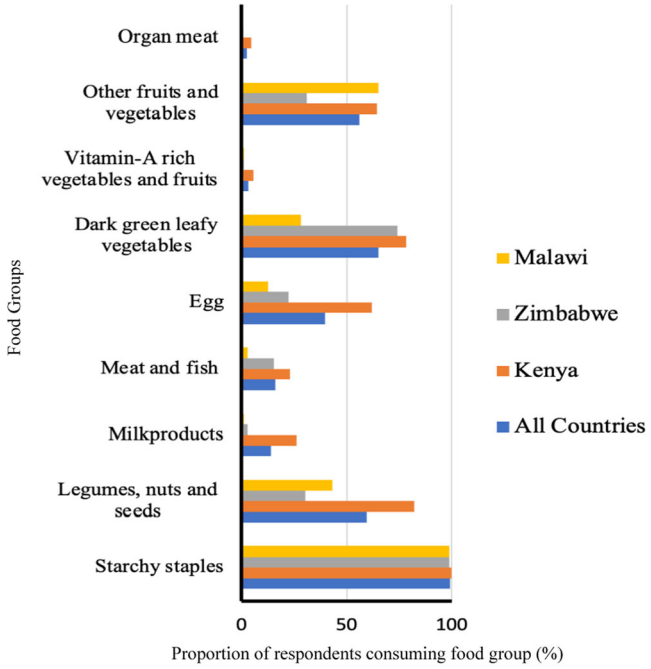

FIGURE 5 Food group consumption patterns across study locations. *Kenya refers to the location in Mathare, Zimbabwe refers to locations in Bulawayo and Malawi refers to Mgona informal settlement.*

TABLE 3 Food group diversity scores of study participants.

Settlement		*n*	FGDS (mean ± SD)	*p*-Value	Minimum FGDS	Maximum FGDS
Nairobi (Kenya)[a]		850	4.5 ± 1.4	Ref	1	8
Bulawayo (Zimbabwe)[a]		447	2.8 ± 1.2	<0.0001	0	6
Lilongwe (Malawi)[a]		434	2.6 ± 1.0	<0.0001	0	7
All		1758	3.6 ± 1.5		0	8
Gender-stratified FGDS						
Nairobi (Kenya)[a]	Male	491	4.6 ± 1.3	Ref	1	8
	Female	356	4.3 ± 1.4	0.004	1	8
Bulawayo (Zimbabwe)[a]	Male	247	2.8 ± 1.1	Ref	0	6
	Female	200	2.8 ± 1.3	0.7	0	6
Lilongwe (Malawi)[a]	Male	214	2.8 ± 1.1	Ref	1	7
	Female	219	2.5 ± 0.9	0.03	0	5
All locations	Male	952	3.7 ± 1.5	Ref	0	8
	Female	775	3.4 ± 1.5	<0.0001	0	8

Note: The abbreviation Ref means reference group. *p*-Value cut-off is set at <0.05. *p*-Values presented in location comparisons are based on ANOVA comparisons of the mean FGDS of all respondents, with Nairobi as the reference. All other *p*-values are obtained through *t*-test comparisons of mean FGDS of male and female respondents per location.

[a]Presented as city (country).

Drivers of food choice

We then investigated drivers of food choice (Figure 6). From the responses in Nairobi, convenience (40%) was the main factor influencing food choice. Price was also a reasonable consideration, as 35% of the stories clustered around price, with only 6% of the responses focused on taste. There were no differences in drivers of food choice between male and female respondents. In Bulawayo, 31% of the responses identified price, 26% identified convenience and 12% identified a combination of price and convenience as drivers of food choice. When data were stratified by gender, price (29%) and convenience (28%) were more important drivers of food choice for females. Of respondents from Lilongwe, 67% of the stories fell towards the price element of the triad. There were no gender differences in drivers of food choice in Lilongwe.

Drivers of dietary diversification

Overall, all respondents identified their change in attitude as drivers of dietary diversification (Figure 7). In this case, they were asserting an internal locus of control in diversifying diets, that it was dependent on them and that diversifying diets was not dependent on support from their family or a change in the whole community. Of the 560 responses from Nairobi, 56% focused on 'change in attitude' as the main motivator in diversification. From Bulawayo ($n = 430$), most of the stories (45%) focused on 'change in attitude' as the main motivation for the diversification of diets. Only 5% of the stories identified the community norms or practices influencing dietary diversity. There were no differences between men and women ($p > 0.05$) regarding drivers of diversification in Nairobi and Bulawayo. Of the 414 responses from Lilongwe, 43% of respondents reported support from family and 39% reported change in attitude as drivers of food diversification. In Lilongwe, there was a difference in drivers of diversification between male and female respondents. In fact, 43% of female respondents from Lilongwe ($n = 197$) reported that a change of attitude was more important in motivating them to diversify their diets. On the contrary, 53% of the male respondents interviewed ($n = 215$) reported support from family as a key driver of dietary diversification.

Across all populations, majority of all respondents (>50%) perceived food as not enough (Supporting Information: Figure SI) and were almost unhappy with

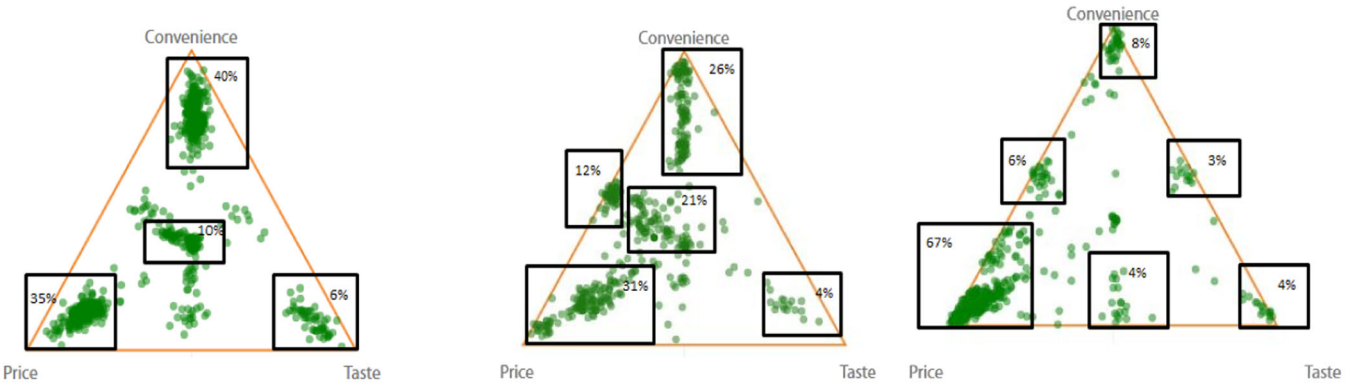

FIGURE 6 Triad showcasing drivers of food choice among respondents from low-income settlements in Nairobi (Kenya), Bulawayo (Zimbabwe) and Lilongwe (Malawi).

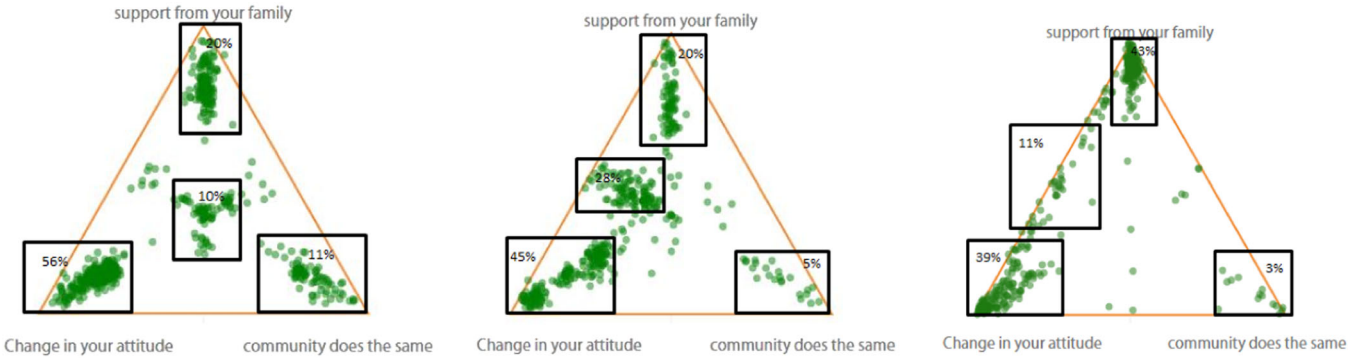

FIGURE 7 Triad showcasing drivers of food diversification among respondents from low-income settlements in Nairobi (Kenya), Bulawayo (Zimbabwe) and Lilongwe (Malawi).

the safety of their food (Supporting Information: Figure SII). When assessing perceptions of food associations with health, it was found that 45% of respondents in Nairobi did not perceive the food they consumed as a risk to their health. In contrast, 50% of respondents in Bulawayo and 70% of respondents in Lilongwe viewed the foods they consume as a risk to their health (Supporting Information: Figure SIII).

DISCUSSION

This study collected both quantitative and qualitative data on dietary diversity and drivers of food choice from three low-income urban locations in Kenya, Zimbabwe and Malawi. Conducting the study in different foodscapes and characterising the food environments are important to identify context-specific leverage points for improving diets and, in turn, nutrition and health. Gender was an important factor in the choice of food and diversification, with female respondents showing lower FGDS compared to male respondents among respondents from Kenya and Malawi. Across all locations, respondents were concerned about food availability, price, as well as safety. We illustrated deficiencies in dietary diversity influenced by the food environments and various factors that drive food choices. Our approach aims to improve the nutrition and health outcomes within low-income urban populations, who depend on income for food and yet are most income constrained, and therefore have the poorest nutrition and health outcomes compared to the rest of the population.

In all the locations we investigated, there were poor average dietary diversity scores, indicating diets that are likely low in micronutrients. Similar to our study, several studies have observed that the poorest communities are at the highest risk of insufficient micronutrient intake due to low consumption of vegetables and fruits, as well as animal-sourced foods and other sources of protein.[26–30] Sub-optimal diets predispose low-income urban populations to undernutrition, poor micronutrient status and, when combined with shifts towards urban lifestyles, NCDs. Our observation of poor-quality diets provide further evidence of the need for food policies and programmes that are cognisant of the nutrition and health of the growing population of the urban poor. Such policies and programmes would focus on lowering the costs of nutritious foods and increasing the costs of unhealthy foods.

At the macro level, policies employed to address the affordability of diets should consider agri-food systems in the rural–urban continuum. The rural–urban continuum presents both challenges and opportunities when addressing diet quality, particularly among low-income populations. On the contrary, the rural end of the continuum faces the exclusion of small-scale farmers from formal value chains, and the loss of lands and natural capital due to urban expansion combine to complicate food systems. For example, in our study populations, maize is the dominant staple,[31] often resulting in the exclusion of small-scale farmers who grow nutrient-dense cereals such as millet and sorghum. To address these challenges and improve diet quality, multi-sectoral approaches that seek to increase varieties of nutritious foods and perceive urban growth as opportunities to expand income for generation, both through market creation and off-farm employment, should be considered. In addition, to ensure that food value chains are responsive to the urban poor, behaviour campaigns need to go along with the enforcement of enabling policies, as well as education and capacity development along the entire food value chains. Such policies should consider unique population dynamics, for example, variation in income, age, gender, culture, religion and lack of time and facilities for home meal preparation.

This work focused on the spatial foodscapes, that is all the local shops, markets, restaurants and sales outlets that provide food supplies in a given area. We observed that across all the locations, there was a high dependence on informal retail structures, open-air markets, food vendors and local shops for food ingredients, with little or no mention of formal markets, such as supermarkets. Often, informal markets intersect with formal markets for mutual benefits and are, therefore, critical partners when influencing food and nutrition. It is thus important to include consumers, street food vendors and other informal retailers in nutrition strategies, as well as representatives of the formal sector, supermarkets as wholesalers, in stakeholder consultative planning and policy development structures and processes to improve food systems in low-income settlements.

Our findings of reliance on informal markets, and thus limited investment in and control of food quality and safety, were observed in studies in several African cities.[32,33] Further, there were differentials in the type of goods obtained from different vendors, a finding that has previously been reported.[26,34,35] For this reason, the impacts of rapidly changing food environments within evolving food systems and their effects on food choices, nutrition and health in the context of LMICs need to be further investigated. Such efforts should take into account forecasts for urban cities, particularly in LMICs, such as population growth, increases in (consumers') income and urbanisation.[36]

In combination with the kinds of foods sold in markets and local shops, respondents in the locations surveyed expressed concern about safety, focusing particularly on hygiene, the use of pesticides and the role of standards regulatory bodies. The conditions in which the informal food market sector in LMICs operate and the lack of controls relating to the safety and quality of food sold are of public health concern.[37–39] Although the quality of foods is addressed, low-cost, locally

appropriate food hygiene interventions that can reduce foodborne exposure to enteric pathogens and the resulting infection and disease need to be promoted. In addition, regulation around the quality of food grown in and out of informal settlements and sold should be enforced to reduce exposure to contaminants such as pesticides. Normally, it would be easier to foster regulation in an environment where food was purchased from 'controlled' environments, such as supermarkets, which is not the case in low-income settlements.

Price consistently emerged as a driver of food choice across all three locations. Food price is a macro-level factor outside of an individual's control. Price volatility is an important source of risk, especially for low-income households in sub-Saharan Africa.[40] Due to these drastic changes in food prices, residents of low-income settlements employ coping mechanisms such as reducing the purchase of more expensive nutrient-dense foods.[40–43] Such choices contribute to poor nutrition and health outcomes, such as the highest overweight and obesity among urban low-income populations, as observed in several African cities.[44] To promote healthy diets, existing fiscal and regulatory policies that make unhealthy diets unaffordable in developed countries[45–47] may be adapted to suit the situation of urban low-income populations in LMICs. These policies, need to consider multiple levels and broader drivers of food choice and consumption. This is because individual level factors, such as the cost of food, interact with the bigger social and physical food environment.[48,49]

In Nairobi, convenience was identified as a key factor influencing food choice, confirming previous observations by Downs et al.[26] We did not collect additional information on the issues around convenience, such as perceived cost savings, ease of access to street vendors versus open-air markets and use of fuel. Nevertheless, for Nairobi, improving the quality of food from vendors and retailers or kiosks would be a key strategy so that convenient food is also healthful and available within short walking distances.

STRENGTHS AND LIMITATIONS

Although this study has strengths that are useful in capturing the nuances around diet quality across varied populations and identifying leverage points for intervention, it also has some weaknesses. First, the locations we collected information from are vast, and our data may not fully represent the variations in diet quality, food availability and perceptions around food quality across different ethnicities, income groups and/or ages as we employed a convenient sampling method. Second, we were also unable to conduct further qualitative interviews to obtain in-depth information about why the drivers of food choice differed across locations, income use or the prices of different foods within that setting. Finally, dietary intake data were collected via qualitative 24-h recalls at one time point, and therefore, seasonality was not factored into observations. The study did not also collect information on the consumption of high-fat, high-sugar and ultra-processed foods due to the notable rise of NCDs in low-income populations.

CONCLUSIONS

This study adds to the knowledge that would be crucial for improving the food environment and guiding dietetic practice among urban, low-income populations in LMICs. At the policy and programme level, we identified possible levers or entry points to improve diet quality. Our findings show that addressing dietary diversity and food environment issues across different locations or communities in low-income urban settings cannot follow a 'one-size-fits-all' approach. Attention has to be paid to differences in spatial arrangements, drivers of food choice, as well as perceptions of food availability, food quality, food safety and the role of food in health. Agriculture-nutrition pathways need to be pursued that link agricultural activities to positive nutrition outcomes and, therefore, involve multiple rural-to-urban layers and stakeholder networks. In addition to these efforts, robust and well-aligned food policies and safety net programmes are required to increase access to affordable, safe, nutrient-dense crop and animal-source foods, as well as fruits that were not commonly consumed across all populations. Certainly, approaches aimed at improving diverse food groups should leverage programmes and interventions that aim at mitigating the risk of NCDs and are environmentally unsustainable, emphasising the role of research in informing multi-sectorial approaches, agriculture, nutrition, health, education, trade and environment.

AUTHOR CONTRIBUTIONS

Conceptualisation, M.H, S.H.K-T, I.E and W.N.G-W; Data collection, S.H.K-T, I.E and W.N.G-W; methodology, M.H, S.H.K-T, I.E and W.N.G-W.; data analysis, M.Z. and W.N.G-W; writing – original draft preparation, M.Z. and W.N.G-W.; writing – review and editing, M.H, S.H.K-T, I.E, E.F.T and W.N.G-W; supervision, M.H. All authors have read and agreed to the published version of the manuscript.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

ETHICS STATEMENT

For Kenya, the study received approval from the Nairobi County health directorate. In Zimbabwe, the study was approved at the national level by the Ministry of Health and Child. In Malawi, approval was obtained from the Lilongwe town council, as well as local administrative officials. All participants who conducted the SenseMaker questionnaire also provided oral informed consent in the form of a voice recording.

TRANSPARENCY DECLARATION

The lead author affirms that this manuscript is an honest, accurate and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if registered) have been explained.

PEER REVIEW

The peer review history for this article is available at https://www.webofscience.com/api/gateway/wos/peer-review/10.1111/jhn.13244

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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