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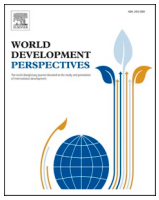

How healthy and food secure is the urban food environment in Ghana?

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ABSTRACT

The importance of the food environment in influencing dietary choices of consumers has been widely acknowledged, but little attention has been paid to the urban food environment in Africa despite the rise in incidence of obesity and other nutrition-related noncommunicable diseases (NR-NCDs). We contribute to the literature on urban food environments by conducting an observational macro-scan of the food environment in three cities – Accra, Cape Coast, and Koforidua – with a view to unravelling the nature of the urban food environment in Ghana. We examine the food environment based on two dimensions of food security – availability and accessibility (affordability) – and also assess the extent to which foods are processed. The results show that all four food categories – unprocessed, processed, processed culinary, and ultra-processed – are available, accessible, and affordable. Ultra-processed foods are just as highly available, accessible, and/or affordable as unprocessed foods. The results also show that processed foods account for the larger share of all foods in Ghana's urban food environment, and ultra-processed foods account for more than 30% of all processed foods. Overall, these results suggest that physical and economic access to food are not major constraints in urban Ghana. This is certainly a welcome finding from a food policy perspective; however, the high availability and accessibility of ultra-processed foods has serious potential health implications. Regulation will be needed to prevent overconsumption of ultra-processed foods and the resulting increase in obesity and other NR-NCDs.

1. Introduction

Food systems in many developing countries are changing rapidly due to various factors, such as urbanization, employment and income growth, modernization of the retail sector, and demand for convenience shopping arising from increasing opportunity costs of time (Wanyama et al., 2019; Reardon et al., 2021). This food systems transformation has profound implications for food environments, dietary patterns, and health. In particular, the food systems transformation has led to nutrition transition, which is the shift in dietary patterns of many developing countries from traditional diets rich in cereals or complex carbohydrates and fiber, to more westernized diets with a higher proportion of sugars, fats, and animal-source foods (Drewnowski & Popkin, 1997).

In the urban cities of many African countries, nutrition transition has been associated with an increase in the incidence of overnutrition (e.g., obesity, diabetes, cardiovascular diseases, certain types of cancers and other nutrition-related noncommunicable diseases (NR-NCDs)), coexisting with undernutrition (e.g., hunger, stunting, and wasting), and micronutrient deficiencies (e.g., in zinc, vitamin A, and iron) (Osei-Kwasi et al., 2020; Holdsworth & Landais, 2019). The coexistence of overnutrition, undernutrition, and micronutrient deficiencies has been referred to as the "triple burden of malnutrition" (Pinstrup-Andersen, 2007; Meenakshi, 2016). The triple burden of malnutrition remains a serious public health concern in sub-Saharan Africa (SSA), but it could be remedied by improving the food environment (Herforth & Ahmed, 2015; Holdsworth & Landais, 2019).

According to the FAO (2016), "the food environment includes the foods available to people in their surroundings as they go about their everyday lives, the nutritional quality, safety, price, convenience, labelling, and promotion of these foods". Other definitions in the literature also capture similar aspects of the food environment. For instance, Swinburn et al. (2013) define the food environment as "the collective

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physical, economic, policy and sociocultural surroundings, opportunities and conditions that influence people's food and beverage choices, and nutritional status", while Herforth and Ahmed (2015) define the food environment as "the availability, affordability, convenience, and desirability of various foods". The food environment, especially the market, is important since it signals to consumers which kinds of foods are available and constrains their food choices and diets to the types of food available in their surroundings (Herforth & Ahmed, 2015). Therefore, a healthy food environment – one that promotes easy access to and choice of healthy diets – can have profound positive effects on nutrition and health (Gustafson et al., 2013; FAO, 2016)[1].

There is a growing body of literature on the link between food environments and diets in SSA (Jones et al., 2014; Sibhatu & Qaim, 2018; Ogutu et al., 2020). While most of these studies focus on farm-level interventions, such as the role of farm production diversity, agricultural technology adoption, and smallholders' market access on diets, relatively fewer studies focus on the urban food environment.[2] Studies focusing on the urban food environment mostly examine the effects of consumers' demand for retail food – the demand side of the urban food environment – on diets and other nutritional outcomes (Demmler et al., 2017; Rischke et al., 2015; Wanyama et al., 2019). However, the role of the supply side of the food environment (e.g., types of actors, types of food or food categories available, accessible, or affordable) in determining food choices has received little attention. Hence, limited evidence exists on how the African urban food environment is transitioning and influencing dietary choices (Holdsworth & Landais, 2019).

Previous studies on the relationship between the supply side of the urban food environment and food choices have mostly focused on high-income economies (Caspi et al., 2012; Pitt et al., 2017).[3] The few studies that have focused on SSA countries show an increasing 50-year trend in supply of energy-dense foods (Holdsworth & Landais, 2019; Reardon et al., 2021). The studies also show that the food environment is important in influencing consumers' food choices. For instance, Reardon et al. (2021) note that the urban food environment increases consumers' propensity to purchase highly processed, energy-dense foods relative to the rural food environment. However, past studies are mainly based on systematic reviews of literature with a focus at the SSA level, hence, they provide limited insight into country-level food environments. Therefore, there is a need to study the urban food environment in relation to the changes in diets across different population groups, such as geographies, and cities in Africa (Holdsworth & Landais, 2019).

In this article, we contribute to the existing literature by conducting an observational macro-scan of the food environment in three urban cities in Ghana – Accra, Cape Coast, and Koforidua – to empirically unravel the nature of the urban food environment (e.g., types of actors and food categories available or accessible in the urban market). The observational macro-scan approach provides a tool for rapidly assessing and characterizing the food environment using a low-cost store audit technique (Lytle & Myers, 2017). We examine the food environment based on two dimensions of food security: food availability and accessibility (affordability) (FAO, 2006). In particular, we assess the extent to which four food categories (based on the NOVA classification of unprocessed, processed culinary, processed, and ultra-processed foods) are available, accessible, and affordable (Gibney, 2019). The food security dimensions that we look at are important since food environments with reduced accessibility, availability, and affordability of nutritious foods tend to constrain consumption of nutritious and heathy diets (Holsten, 2009; Pitt et al., 2017). Hence, insights into these dimensions of food security can contribute to making the food environment healthy and curb the triple burden of malnutrition.

This study focuses on Ghana because it is among the countries in SSA whose food systems and/or environments are rapidly changing and at the same time experiencing pressing malnutrition challenges, including increased rates of obesity and other NR-NCDs (Laar et al., 2020). Against this background, this study will help unpack important insights into the urban food environment in Ghana and provide relevant policy recommendations that can contribute to making the urban food environment more nutrition sensitive in Ghana and beyond.

The remainder of the article is structured as follows. The next section provides an overview of the study context. This is followed by a description of the materials and methods, the results, and the discussion. The last section concludes.

2. Study context

Ghana's current population of about 31.4 million people is growing at a rate of 2.2% annually. An estimated 56.7% of Ghana's population resides in urban centers, while the remaining 43.3% of the population lives in rural areas (UNDESA, 2018; UNDESA, 2019). Recent statistics show that Ghana is experiencing rapid urbanization, which is contributing to nutrition transition (Andam et al., 2018; Laar et al., 2020). Ghana is at an advanced stage of nutrition transition, which is associated with increased consumption of highly processed foods and refined cereals, diets rich in sugar-sweetened beverages, and health risks, such as increased rates of obesity and NR-NCDs (Laar et al., 2020).

Adult obesity rates in Ghana have increased five-fold between 1980 and 2015 (Laar et al., 2020). Currently, the prevalence of obesity among adult men and women in Ghana is 4.5% and 16%, respectively, while the rate of diabetes among adult men and women stands at 6.4% and 6.6%, respectively (GNR, 2020). Recent statistics also show that 6.8% of children under the age of five years are wasted, 17.5% are stunted, and the rate of anemia among women of reproductive age is 46.4% (GNR, 2020). The nutrition transition in Ghana has drawn the attention of policy makers and has resulted in the development of a national policy to curb increasing cases of obesity and NR-NCDs and incorporate interventions that promote healthy diets (Ministry of Health Ghana, 2012).

3. Materials and methods

3.1. Market survey using the observational macro-scan approach

The observational macro-scan approach provides a tool for conducting a rapid market survey of the food environment. The macro-scan tool is designed using a set of domains (e.g., physical food environment), sub-domains (e.g., supermarkets, and wet markets), and measurements (location, density, affordability and availability of foods, food types, etc.) (Lytle & Myers, 2017). This study focuses on the physical and economic food environment with emphasis on access, availability, and affordability indicators for four food types (unprocessed, culinary, processed, and ultra-processed foods). These indicators serve as the basis for designing the macro-scan survey tool for assessing the food retail food environment in Ghana. While absolute assessment can be conducted using secondary data, this study relies on primary data using a Likert scale approach to elicit information about the food environment.

This study was conducted between October and November 2020 in three cities in Ghana: Accra (the nation's capital), Cape Coast, and Koforidua. Due to resource constraints and COVID-19 protocols, we could not survey other important urban cities, such as Kumasi and Sekondi-Takoradi. However, the three selected cities have different levels of urbanization and are representative (capture the heterogeneity) of the urban settings in Ghana. The selected cities are the regional

[1] [1] For instance, Gustafson et al. (2013) found that high availability of healthy foods was associated with a lower likelihood of consuming sugar-sweetened beverages.

[2] [2] Much attention has been paid at the farm level because the majority of people faced with the problem of hunger and malnutrition in many developing countries are smallholder farmers.

[3] [3] Results from such studies may not provide policy-relevant insights fit for poorer socioeconomic or lower-income groups.

Table 1
Characterization of food retail outlets.

Type of retail outlet	Characteristics	Main food items
Supermarket	Self-service; large variety of foods; processed and ultra-processed foods; refrigerated foods; limited variety of fresh foods; non-food products; does not allow credit purchases	Bread, beverages, milk and milk products, cereals, fresh fruits and vegetables, frozen fish and meats, vegetable oils, snacks, sugar
Mobile mart	Shops located at fuel stations	Bread, snacks, milk and milk products, sugar-sweetened beverages, soft drinks, fruits
Container shops/kiosks	Over the counter-service; limited variety of brands; fresh fruits and vegetables; unprocessed staples; small packaging; individual ownership; allow purchases on credit	Cereals (e.g., maize, beans, green grams), bread, milk, fruits and vegetables, meat, snacks, sugar
Traditional (wet) markets	Informal markets in open spaces (i.e., open-air public markets with many retailers); clustered at specific points; operate within fixed hours of the day; number of retailers vary depending on day of the week (market days are busier).	Cereals, roots and tubers, fresh fruits and vegetables, spices, plant oils, meat, fish

Adapted from Wanyama et al. (2019).

capitals and host more of the formal (modern and ultra-modern) and informal markets (traditional) than other cities/towns located in the same regions. To select the retail outlets to include in this study, we stratified the sampling by the type of food retail outlets, population density, and density of the shops in each of the three cities. The food retail outlets include modern and ultra-modern supermarkets, local supermarkets, mobile marts (shops located at fuel stations), container shops (kiosks), and traditional (wet) markets. Further description of the retail outlets surveyed is given in Table 1.

Based on the stratification strategy, we purposively selected high- and low-income urban areas with high population density and greater availability of shops in each of the three cities. Given that census data was not available for all of the food retail outlets in each of the three cities, we used the random walk procedure as the most appropriate method to obtain a random sample of the retail outlets. To identify food retail outlets, we randomly selected a starting point in each urban area (neighborhood), then every second or third food retail outlet along the selected street (from the starting point) was chosen. However, all major wet markets identified in the selected neighborhoods were chosen. After identifying the retail outlets/shops, people responsible for the outlets and with knowledge about the products in the retail outlets (i.e., shop attendants or supervisors) were interviewed. In each retail outlet, enumerators, with assistance from the responsible person, identified the range of products that were available in the shop or market. Overall, 123 food retail outlets were sampled: 56 in Accra, 39 in Cape Coast, and 28 in Koforidua.

Using a pre-tested structured questionnaire, we conducted interviews with retailers in the local language. Our enumerators were highly trained, recent university graduates who understood the local context. The questionnaire aimed to elicit information about food categories based on four levels of processing (unprocessed foods, processed culinary ingredients, processed foods, and ultra-processed foods); shares of food retail outlets that stock each of the four food categories; availability, accessibility, and affordability of various food categories; and shares of food categories available in Ghana's urban food environment. We discuss these variables in more detail below.

3.2. Types of food retail outlets

Table 1 provides a description of the type of food retail outlets sampled in this study. The characteristics presented in Table 1 are based on information gathered during the market survey and the literature. Supermarkets are self-service retail outlets that offer a wide variety of foods and beverages to consumers. They can vary in size depending on their location but tend to be small when located in relatively poor neighborhoods. Examples of the foodstuffs commonly sold in supermarkets include bread, beverages, cereals, milk and milk products, fresh fruits and vegetables, frozen fish and meats. Mobile marts are convenience stores found in filling (fuel) stations. Traditional or local (wet) markets are food retail outlets that mainly operate in open spaces on specific days in designated locations. Where the markets operate on a daily basis, the number of stalls that open usually increases or decreases on particular days of the week depending on consumer traffic and designated market days. The main food items sold in traditional local markets include cereals, legumes, roots and tubers, and fresh fruits and vegetables. Unlike local markets, container shops/kiosks are temporary structures located close to residential areas and offer a very limited variety of foods. Examples of food items sold in kiosks include cereals, roots and tubers, fruits and vegetables, and small quantities of processed foods and beverages.

3.3. Measurement of key variables

We measure food environment based on the two dimensions of food security: food availability and accessibility (affordability) (FAO, 2006). Food availability mainly focuses on the presence or supply of food, that is, whether sufficient quantities and quality of food have been supplied to individuals or households through production or trade (food retail outlets, stores, or imports). At the local level, this dimension also captures important aspects like the location of the food retail outlets and the diversity and quality of food (Lawlis et al., 2018). Food access places emphasis on the economic and physical capacity of individuals and households to acquire and consume healthy and nutritious diets. This includes their ability to buy food (affordability) and make appropriate food choices based on their nutrition knowledge, and their time and mobility to shop for and prepare food (FAO, 2006; Lawlis et al., 2018).

We rely on these indicators to measure the urban food environment, since previous research showed that food environments with reduced accessibility, availability, and affordability of nutritious foods tend to constrain consumption of nutritious diets (Holsten, 2009; Pitt et al., 2017). In terms of variable measurement, respondents were asked to rate the availability of each of the four food categories relative to other food categories in the retail outlet based on four Likert scale responses: highly available, available, less available, and not available[4]. For instance, a certain food category was considered "highly available" rather than "available" if it was more than twice as available as other food categories. Accessibility was measured using three Likert scale responses: highly accessible, accessible, and less accessible. And affordability was measured using four Likert scale responses: very affordable, affordable, less affordable, and not affordable. Although the Likert scale macro-scan approach provides a rapid assessment to measure perceptions and obtain insights into availability, accessibility, and affordability of the four food groups in relative terms, Likert scale measures are relatively subjective and are not absolute assessments of the food

[4] [4] An analysis considering the food surface area and a dispersion measure based on store numbers, store types, and food surface area using the Berry Index (Thiele & Weiss, 2003) following Caillavet et al. (2015) would have nicely complemented our Likert scale measure of availability. However, due to data limitations, we could not pursue such an analysis. Nevertheless, the Likert scale measure still provides useful insights into the extent to which food is available in the food environment (Kent et al., 2022).

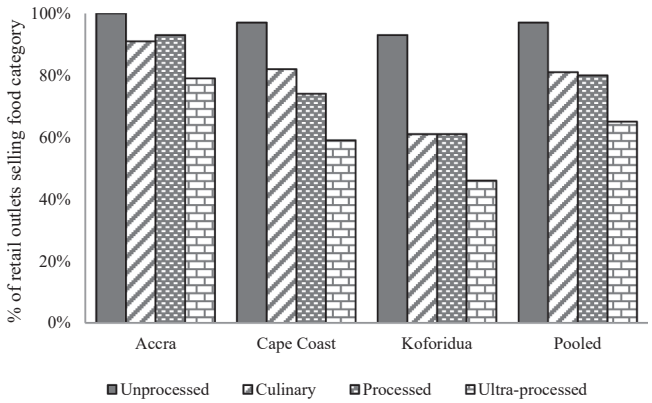

Fig. 1. Share of retail outlets that sell different categories of food.

environment.

As mentioned, our analysis also entails an assessment of the extent to which foods in the urban environment are processed. To classify food items in food retail stores based on the degree of processing, we used the NOVA classification, which places food items into four categories: (i) unprocessed or minimally processed foods, for example, edible parts of plants (seeds, fruits, leaves, stems, roots) or of animals (muscle, offal, eggs, milk), and also fungi, algae, and water, after separation from nature; (ii) processed culinary ingredients, for example, oils, butter, sugar, and salt; (iii) processed foods, for example, bread, canned fish, fruits in syrup, and cheeses; and (iv) ultra-processed foods and beverages, for example, soft drinks, chips, savory packaged snacks, and reconstituted meats (Gibney, 2019). The NOVA classification places emphasis on food processing as the primary driver of diet quality and is increasingly being used to assess the linkages between dietary habits and NR-NCDs (Gibney, 2019).

3.4. Statistical analysis

For the analysis, we use descriptive statistical methods to assess the urban food environment in the three cities in Ghana based on the dimensions of food security discussed. We also examine the extent to which foods in the urban food environment are processed. We analyze the subsamples of the three urban cities separately and for the pooled sample. In our analysis, we show the share of total retail outlets that stock different categories of food with varying degrees of processing, availability, accessibility; the affordability of the food categories; and the share of each food category in total retail outlet stock. The results are presented and discussed in the next section.

4. Results

4.1. Share of retail outlets selling different food categories

Fig. 1 presents the share of food retail outlets that stock or sell each of the four categories of food – unprocessed, culinary, processed, and ultra-processed – based on the NOVA classification of foods. The pooled sample results show that the majority of the retail outlets sell unprocessed foods (97%), followed by culinary (81%), processed (80%), and ultra-processed foods (65%). Almost all (97%) of the retail outlets sampled sell unprocessed foods, which may suggest a high availability of unprocessed foods in Ghana's urban food environment. A significant percentage of the retail outlets also sell culinary (81%), processed (80%), and ultra-processed foods (65%).

A comparison of the results across the three cities reveals that the share of food retail outlets that sell unprocessed foods is highest in Accra (100%), followed by Cape Coast (97%), and Koforidua (93%). The same trend is also observed for the share of retail outlets that sell culinary, processed, and ultra-processed foods. This is hardly surprising given that Accra is the largest city followed by Cape Coast, and Koforidua. Hence, we expect retail outlets in larger urban cities to stock or sell a variety of food items to cater for the diverse needs of a more cosmopolitan population. The Welch's *t*-test results presented in Table A1 in the Appendix confirm this proposition by showing that significant differences exist in the share of retail outlets that sell culinary foods when comparing Accra with Koforidua, and Cape Coast with Koforidua. The results also show significant differences in the share of retail outlets that sell processed and ultra-processed foods when comparing Accra with Cape Coast, and Accra with Koforidua, with retail outlets in the larger cities selling significantly larger shares of each of the food categories. These results are also consistent with the results of the chi-square tests in Table A2 in the Appendix, which show significant differences in the share of culinary, processed and ultra-processed foods sold across the three cities.

Fig. 2 shows the four different food categories by city and type of food retail outlet. The figure is based on data of the most dominant food category found in each food retail outlet. As shown, larger shares (numbers) of the retail outlets in each of the three cities have unprocessed foods as the most dominant food category in their stock. For instance, 37 out of 56 (37/56), 17/28, and 24/39 retail outlets in Accra, Koforidua, and Cape Coast, respectively, have unprocessed foods as the most dominant food category in their stock. This means that a total of 78 retail outlets in the entire sample, as shown by the middle bar in Fig. 2, have unprocessed foods dominating their stock. Ultra-processed foods

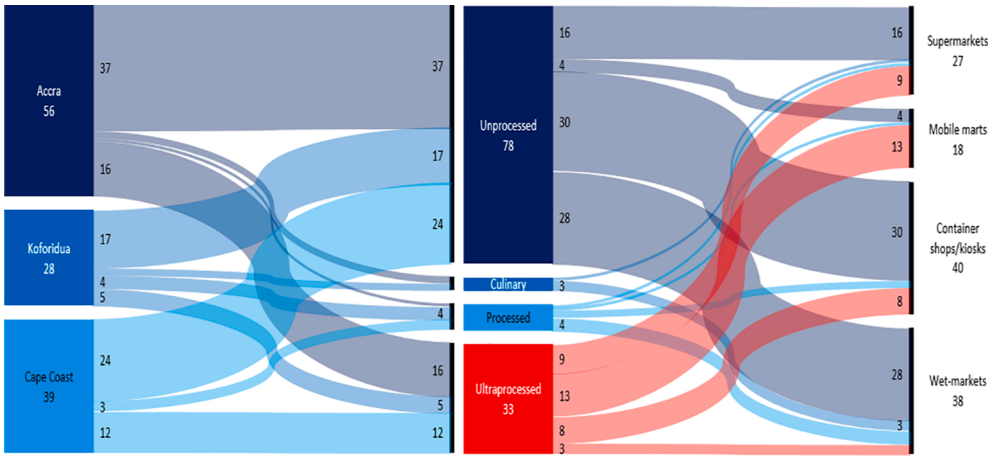

Fig. 2. Food category by city and type of retail outlet. Note: This diagram shows the relationship between the urban cities (Accra, Koforidua and Cape coast), food groups (unprocessed, culinary, processes and ultra-processed) and retail outlet types (supermarkets, culinary, wet markets, etc.). Numbers represent the sample size.

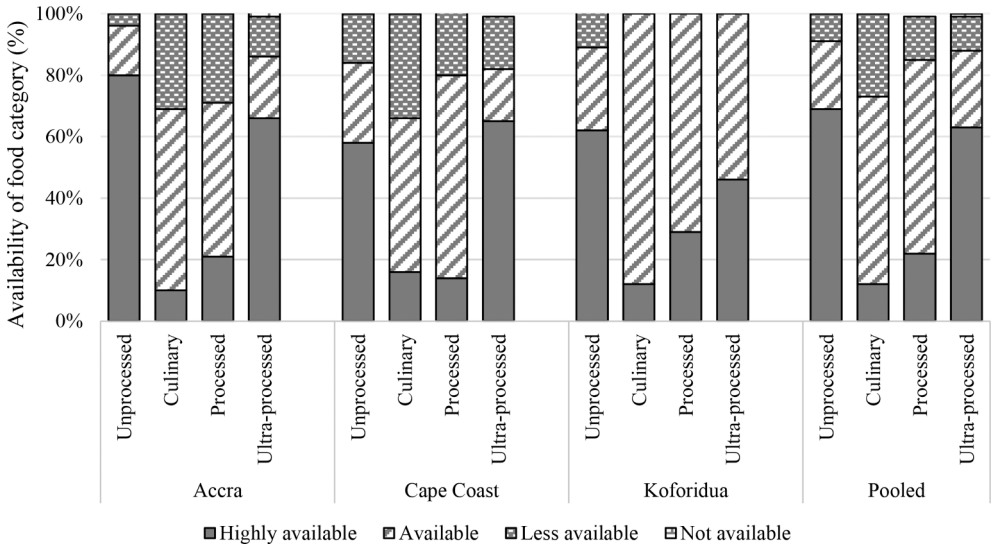

Fig. 3. Availability of food categories by city and pooled sample.

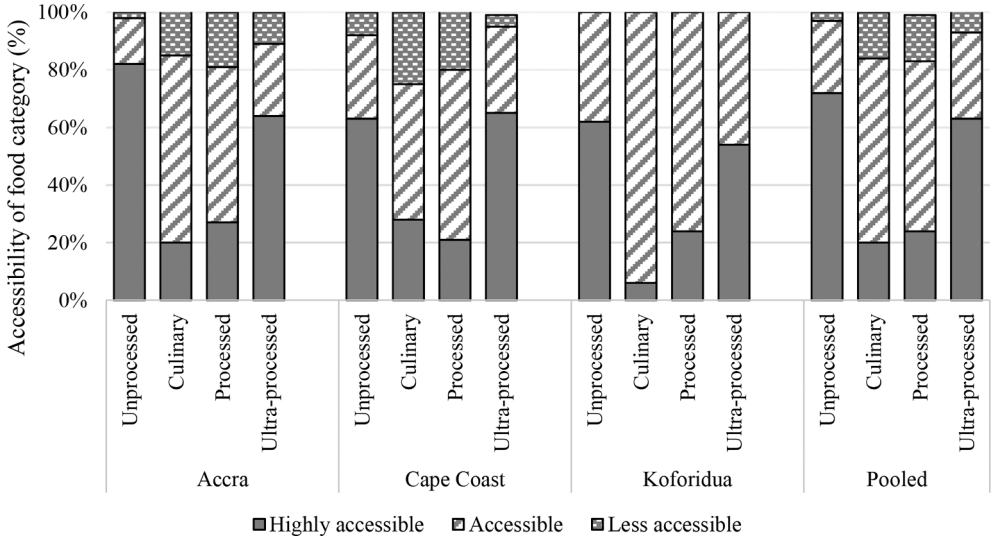

Fig. 4. Accessibility of the food categories by city and pooled sample.

also dominate a significant share of the food retail outlets. As shown, 16/56, 5/28, and 12/39 retail outlets in Accra, Koforidua, and Cape Coast, respectively, have ultra-processed foods as the most dominant food category in their stock. This implies that 33 retail outlets in the sample mostly sold ultra-processed foods. Culinary and processed foods dominate the stock of very few retail outlets. In terms of food sources, unprocessed foods are mostly sourced from or are dominant in container shops/kiosks, wet markets, and supermarkets. As expected, ultra-processed foods are mostly found in mobile marts, supermarkets, and container shops/kiosks, with a few wet markets also stocking ultra-processed foods. For instance, out of the 33 retail outlets whose stock predominantly contain ultra-processed foods, nine are supermarkets, 13 are mobile marts, eight are container shops, and three are wet markets. Culinary and processed foods are mostly sourced from wet markets.

4.2. Availability of different food categories

We now shift our focus to the discussion of the results of the two dimensions of food security. Fig. 3 presents the extent to which each of the four food categories is available based on four Likert scale responses: highly available, available, less available, and not available. Overall, the majority of the responses in the pooled sample show that all four food categories are either highly available or available in the market. Ultra-processed foods are as highly available as unprocessed foods, but culinary and processed foods are less highly available.

The high availability of unprocessed foods in Ghana's urban food environment is welcome from a food policy perspective, but the widespread availability of ultra-processed and processed foods may encourage overconsumption of energy-dense foods and cause serious public health problems. A closer look at each of the three cities reveals a similar pattern of food availability, except that all of the food categories seem to be relatively more available in Koforidua. This is plausible since Koforidua is the smallest of the three cities in terms of population and may, thus, not experience serious food shortages due to high demand compared with a larger city like Accra.

4.3. Accessibility of different food categories

Fig. 4 presents the results of the extent to which each of the four food categories is accessible based on three Likert scale responses: highly accessible, accessible, and less available. Overall, the pooled sample results show that all four food categories are highly accessible or

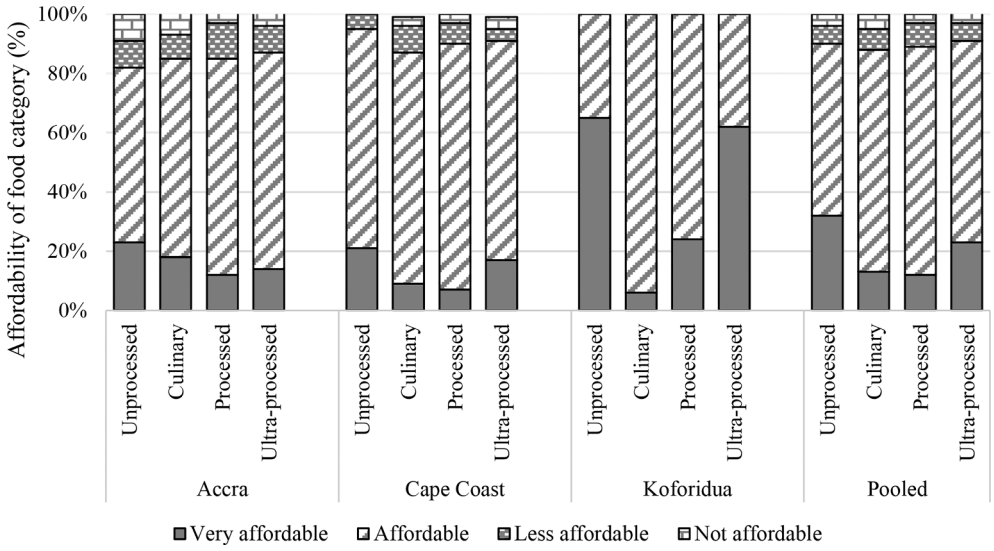

Fig. 5. Affordability of food categories by city and pooled sample.

accessible in the market. Relatively smaller shares of the pooled sample responses show that the food categories are less available: unprocessed (3%), culinary (16%), processed (16%), and ultra-processed foods (8%). Consistent with the trend observed in Fig. 2, ultra-processed and unprocessed foods are all highly accessible in almost equal measure, but ultra-processed foods are more highly accessible than culinary and processed foods.

Since diets with a strong emphasis on unprocessed foods, such as fresh fruits and vegetables, plant-based fats and proteins, legumes, whole grains, and nuts are often promoted as part of healthy diets, the high accessibility of unprocessed foods is certainly welcome. However, the high accessibility of ultra-processed foods may require policy regulation and consumer education to avert potential health risks, such as obesity and other NR-NCDs that may arise due to increased consumption of ultra-processed foods (Demmler et al., 2017; Reardon et al., 2021). Across the three cities, the results show a similar pattern of food accessibility, with the highest levels of accessibility of all food categories reported in Koforidua. Overall, these results suggest that physical and economic access to food is not a major concern in Ghana's urban food environment.

4.4. *Affordability of different food categories*

Fig. 5 shows the results of the extent to which each of the four food categories is affordable based on four Likert scale responses: highly affordable, affordable, less affordable, and not affordable. Overall, the majority of the pooled responses show that all four food categories are affordable. <12% of the responses show that each of the food categories is either less affordable or not affordable. Affordability of ultra-processed foods is similar to that of unprocessed, culinary, and processed foods. A comparison of the three urban cities shows a similar pattern of affordability of the food categories, except that the highest levels of affordability are reported in Koforidua. These results suggest that cost of food may not be a major limitation to food access in the three cities. However, this result mainly reflects the retailers' perspective of the relative affordability of the four food categories and does not consider the perspective of consumers.

The results of the two dimensions of food security – availability and accessibility (affordability) – have revealed interesting insights. The results show that ultra-processed foods are just as available, accessible, and affordable as other food categories. In some instances, ultra-processed foods are even more available, accessible, or affordable

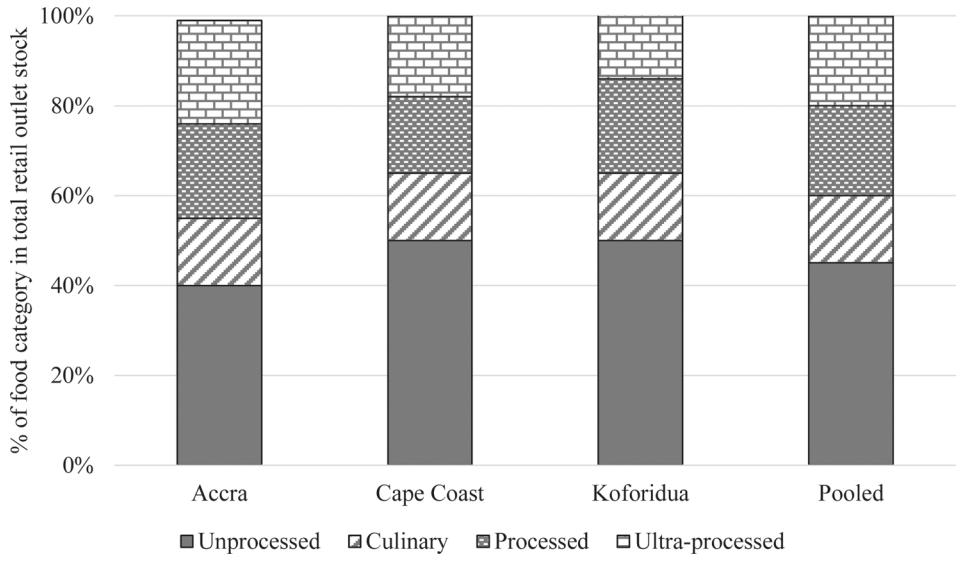

Fig. 6. Share of each food category in total quantity of retail outlet stock.

compared with other food categories. However, since these results are based on the retailers' own assessment of their urban food environment, they only provide a subjective indication that ultra-processed foods already occupy a significant space in Ghana's urban food environment. To corroborate these finding with a more objective assessment of the urban food environment in Ghana, we analyze data on the share of each food category in total quantity of retail outlets' stock. The data were collected through interviews with retailers and the details verified by observation. We discuss the results below.

4.5. Share of food categories in retail outlet stock

Fig. 6 depicts the share of each food category in total quantity of food retail outlets' stock. The pooled sample shows that the share of each of the food categories in the retail outlets' stock is as follows: unprocessed (45%), processed (20%), ultra-processed (20%), and processed culinary foods (15%). As shown, the largest share of retail outlets' stock consists of unprocessed foods, but the results underline the fact that processed and ultra-processed foods are also playing a significant role in Ghana's urban food environment. The combined share of processed and ultra-processed foods is 40%. And given that culinary foods, which consist of about 15% of the retail outlets' stock, are also processed, these results suggest that the larger share (55%) of Ghana's urban food environment probably consists of unhealthy processed foods. This is particularly the case in Accra, where the lion's share of the food retail outlets' stock consists of processed foods (processed culinary, processed foods, and ultra-processed foods).

The finding in Accra is plausible. Accra is Ghana's capital and is characterized by rapid urbanization, higher incomes, increasing opportunity costs of time, and increased demand for convenience shopping, which previous research has shown contributes to an increased demand for processed foods (Andam et al., 2018; Reardon et al., 2021). In Cape Coast and Koforidua, which are smaller cities compared with Accra, the shares of unprocessed to all processed foods in food retail outlet stock are substantial but evenly distributed.

Fig. 6 also reveals interesting findings about the share of ultra-processed foods in all processed foods. The results show that ultra-processed foods contribute more than 30% of all processed foods (culinary, processed, and ultra-processed foods), especially in Accra and Cape Coast. High levels (10–30%) of ultra-processed foods in total processed foods are associated with increased double or triple burden of malnutrition (Reardon et al., 2021). Overall, these results are consistent with the literature, which has shown that Ghana is at an advanced stage of nutrition transition characterized by consumption of energy-dense processed foods and rising cases of obesity and other NR-NCDs (Laar et al., 2020).

5. Discussion

The results have shown that processed foods contribute to the larger share of all food categories, and ultra-processed foods comprise more than 30% of all processed foods in Ghana's urban food environment with Accra having the largest share followed by Cape Coast and Koforidua. These results imply that the urban food environment in Ghana has a significant share of unhealthy foods possibly caused by rapid urbanization, higher incomes, increasing opportunity costs of time, and increased demand for convenience shopping. Specifically, Accra is the largest and most urbanized city in Ghana with a population of about 3.2 million, while Cape Coast and Koforidua have populations of 170,000 and 121,000, respectively (GSS, 2013). The high population in Accra implies a greater demand and, hence, a greater supply of food to satisfy the increasing demand of a rapidly growing population. Since Accra is highly urbanized, primary agricultural activities are reduced due to loss of arable land to residential and industrial use. Foods found in Accra travel long distances from other regions of the country and abroad. This is reflected in the results that show a low share of unprocessed food and a high proportion of processed foods (mostly imported) compared with Cape Coast and Koforidua. Cape Coast and Koforidua, on the other hand, are surrounded by many farming communities and, hence, can easily access farm produce from nearby towns and villages. This is reflected in the results that show a larger share of unprocessed foods compared with Accra.

The larger share of processed food (including ultra-processed foods) in Ghana's urban food environment could increase obesity and NR-NCDs as suggested by Dake et al. (2016) who found that the local food environment in urban Ghana (Accra) is associated with an increased risk of obesity due to increased access to convenience stores and the availability of unhealthy foods. High costs and unaffordability of foods also constrain consumption of nutritious and healthy diets in urban Ghana with potential adverse health consequences (Pradeilles et al., 2021). Hence, urgent policy action is required to nudge the food environment to offer healthy and nutritious diets. Some of the policy options that could be used on the supply side to achieve that end include taxes and subsidies, government regulation, and improvement of infrastructure. On the demand side, educating consumers could play an important role in improving consumers' food choices. Altogether, these supply- and demand-side factors can be used – not just in Ghana but also in other developing countries with unhealthy food environments – to increase or reduce availability, accessibility, and affordability of nutrient-rich foods. We briefly discuss the policy options below.

Taxes and subsidies may be used effectively to reduce or increase the amount and types of foods available in the food environment. The extent to which a tax is passed through to consumers in the form of higher prices typically depends on the responsiveness of consumers to higher prices (price elasticity of demand) of ultra-processed food commodities. The demand for ultra-processed foods has been shown to be price-elastic and, thus, any tax on such foods may result in a significant reduction in consumption (Stacey et al., 2017). A review of the literature that examines the effects of taxes on prices and consumption of unhealthy energy-dense foods and sugar-sweetened beverages showed that taxes generally had the desired effects on prices and consumption of unhealthy foods as they tend to correct for the negative externalities associated with excess consumption of these products by increasing their prices to their true social cost (Hagenaars et al., 2017). To reduce the availability, accessibility, and affordability of ultra-processed, energy-dense foods, governments could impose prohibitive (sin) taxes on such foods. This would lead to an increase in the price of ultra-processed foods, lower consumers' real income, and constrain demand for unhealthy foods. A subsidy on healthy foods, such as fresh fruits and vegetables, legumes, whole grains, and nuts, would increase availability, accessibility, and affordability of such foods by lowering commodity prices, increasing consumers' real income, and increasing demand for healthy foods. Research has shown that targeted subsidies are effective in increasing consumption of healthy foods. For example, a study conducted in South Africa showed that 10% and 25% subsidies on fruit and vegetables resulted in more consumption of such foods and less consumption of unhealthy foods (An et al., 2013). Therefore, a combination of taxes on unhealthy foods and subsidies on healthy foods would amplify the benefits of the two policy instruments (Mockshell et al., 2019).

Governments can also promote and enforce the use of accurate food labels, zoning for different types of food businesses, and investment in infrastructure to make the food environment healthier. Food labels can shift consumer attitudes and social norms about unhealthy diets and influence companies to reformulate their products to become more attractive for consumers (Brouwer et al., 2021; Scarpelli et al., 2020). For example, front-of-package warning labeling is seen as a key policy tool used to improve consumer comprehension of nutritional profiles, making it easier to identify unhealthy products and discouraging purchase of those products (Nieto et al., 2019; Taillie et al., 2020a). Zoning laws in urban Ghana could limit the density of retail outlets selling unhealthy foods and encourage the ready availability of outlets selling

healthy foods, particularly in public spaces (Sturm & Cohen, 2009). A study in Chile assessed the Chilean Law of Food Labeling and Advertising and found that this law, which includes front-of-package warning labels, child-directed marketing restrictions, and restrictions on sales in schools of unhealthy foods and beverages, led to about a 24% decrease in the consumption of sugar-sweetened beverages and encouraged the purchase of healthier alternatives (Taillie et al., 2020b). Promoting and enforcing these policies will, therefore, go a long way to limit the demand and eventually the supply of unhealthy food products while increasing the availability and accessibility of healthy food options. Investment in infrastructure, such as roads, water, and electricity, can help reduce the challenges of weak infrastructure and high transaction costs, which are major constraints to the inter-seasonal supply of perishable foods and high-quality diets (Global Panel, 2018). Policies that encourage farm production diversity could also help to increase the diversity of foods available for home consumption and market supply (Sibhatu & Qaim, 2018).

Apart from governments, food and beverage companies and consumers can also contribute toward making the food environment healthy. Food and beverage companies spend a significant share of their budgets on advertising. Most of the advertisements tend to promote less healthy foods and in some cases target children. Food companies should be encouraged to gradually reduce unhealthy ingredients (sugar, salt, and saturated fats) from foods and advertise their products responsibly, for example, by issuing disclaimers about products with potential health risks, reducing their targeting toward children of less healthy foods, and improving label legibility to enhance the use of product nutrition information. Consumers can also shape or influence the food environment through their food choices. If consumers demand healthy foods, the market (suppliers and producers) will respond by making healthy foods available. Educating consumers about the benefits of healthy dietary choices can be an important first step in helping consumers to choose healthy foods and reduce malnutrition in all its forms. Overall, consumers and the public and private sectors must work together to ensure the urban food environment delivers healthy foods.

6. Conclusion

The primacy of the food environment in influencing dietary choices of consumers has been widely acknowledged, but little attention has been paid to the urban food environment in Africa. Previous studies have mostly focused on high-income countries, yet populations (especially urban ones) in Africa and other low- and middle-income countries continue to experience rising cases of obesity and other NR-NCDs associated with shifts in dietary patterns. We contribute to the literature on urban food environments by conducting an observational macroscan of the food environment in three cities – Accra, Cape Coast, and Koforidua – with a view to unravelling the nature of the urban food environment in Ghana. We examine the food environment based on two dimensions of food security – availability and accessibility (affordability) – and assess the extent to which foods are processed based on the NOVA classification of foods.

The results of the food security dimensions show that all four food categories (unprocessed, processed, processed culinary, and ultra-processed) are available, accessible, and affordable. Interestingly, ultra-processed foods are just as highly available, accessible, and/or affordable as unprocessed foods. These results are similar across the three urban cities, but greater availability, accessibility, and affordability of food categories is observed in Koforidua, probably due to lower demand from a relatively smaller population. Overall, the results suggest that physical and economic access to food is not a major concern in the three urban cities. The high availability, accessibility, and affordability of unprocessed foods is important since diets with a strong emphasis on unprocessed foods, such as fresh fruits and vegetables, plant-based fats and proteins, legumes, whole grains, and nuts contribute to improved food and nutrition security. However, the high availability and accessibility of ultra-processed foods requires policy action to prevent potential public health problems, such as increased obesity and other NR-NCDs that may arise from increased consumption of ultra-processed foods (Demmler et al., 2017; Reardon et al., 2021).

Apart from the results of the two dimensions of food security, we also examined data on the share of each food category in total quantity of food retail outlets' stock. The results show that processed foods contribute to the larger share of all food categories, and ultra-processed foods contribute more than 30% of all processed foods combined. These results underscore the fact that the urban food environment in Ghana has a significant share of processed foods, which has far-reaching implications on health. Hence, immediate policy action is required to nudge the food environment to offer healthy and nutritious diets. Possible policy options that could be used include imposition of taxes on unhealthy foods and subsidies on healthy foods. This would reduce the availability of unhealthy foods and increase the availability of healthy foods in the urban food environment. Food and beverage companies can also be encouraged to advertise responsibly by reducing their targeting to children of less healthy foods and improving label legibility to enhance the use of nutrition information. Enforcement of food labels, consumer education about the benefits of healthy dietary choices, and improvement of food supply infrastructure (electricity, water, and cold chains) could also promote availability of healthy diets and help curb the triple burden of malnutrition in Ghana and other developing economies.

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CRediT authorship contribution statement

Jonathan Mockshell: Conceptualization, Methodology, Investigation, Formal analysis, Data curation, Visualization, Writing – original draft, Writing – review & editing, Funding acquisition, Supervision, Project administration. **Sylvester O. Ogutu:** Conceptualization, Methodology, Investigation, Formal analysis, Data curation, Visualization, Writing – original draft, Writing – review & editing. **Diego Álvarez:** Formal analysis, Data curation, Visualization, Writing – review & editing. **Collins Asante-Addo:** Methodology, Investigation, Data curation, Writing – original draft, Writing – review & editing. **Felix A. Asante:** Methodology, Investigation, Data curation, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix

Table A1
Differences in the share of retail outlets selling a food category between cities – Welch's t-tests.

		Unprocessed	Culinary	Processed	Ultra-processed
Accra vs. Cape Coast	Mean Diff.	0.026	0.090	0.185**	0.196**
	Std. Err.	0.026	0.073	0.079	0.097
Accra vs. Koforidua	Mean Diff.	0.071	0.304***	0.321***	0.321***
	Std. Err.	0.050	0.102	0.100	0.111
Cape Coast vs. Koforidua	Mean Diff.	0.046	0.213*	0.136	0.125
	Std. Err.	0.056	0.113	0.118	0.125

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A2
Share of retail outlets selling food category – Chi-square test across all cities.

	Unprocessed	Culinary	Processed	Ultra-processed
Pearson chi-square	4.006	11.337***	12.906***	9.406***
Likelihood-ratio chi-squared	4.497	10.603***	13.457***	9.541***

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

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