The promotion of ultra-processed foods in modern retail food outlets in rural and urban areas in Kenya

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Short title: The marketing and availability of ultra-processed foods in Kenya.

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Ethical Standards Disclosure: This study was conducted according to the African Medical and Research Foundation (AMREF) ethics guidelines to ensure the appropriate consenting procedures from the storeowners. The approvals were given by both AMREF (approval number: ESRC P901/2020) and National Commission for Science, Technology & Innovation (NACOSTI) (license number: NACOSTI/P/21/8429). Verbal and written consent was obtained from the store owners prior to accessing the stores for in-store food mapping and assessment.

ABSTRACT

Objective: To assess the availability and marketing of ultra-processed foods (UPFs) in modern retail food outlets (supermarkets and minimarts) in Kenya and associated factors.

Design: This cross-sectional study was conducted in Kenya from August 2021 to October 2021. Variables included; the geographic location and the socioeconomic status levels (SES), the food items displayed for sale and advertised in the stores, and locations in the stores such as the entrance.

Setting: Three counties in Kenya (Nairobi - urban, Mombasa - coastal tourist, and Baringo- rural). Each county was stratified into high and low SES using national poverty indices.

Participants: Food outlets that offered a self-service, had at least one check-out, and had a minimum of two stocked aisles were assessed.

Results: Of 115 outlets assessed, UPFs occupied 33% of the cumulative shelf space. UPFs were the most advertised foods (60%) and constituted 40% of foods available for sale. The most commonly used promotional characters were cartoon characters (18%). UPFs were significantly more available for sale in Mombasa (urban) compared to Baringo (rural) (Adjusted prevalence rate ratios (APRR): 1.13, 95% confidence interval (CI): 1.00-1.26, p=0.005). UPFs advertisements were significantly higher in Mombasa ((APRR): 2.18: 1.26-3.79, p= 0.005) compared to Baringo and Nairobi counties. There was a significantly higher rate of advertisement of UPFs in larger outlets ((APRR): 1.68: 1.06-2.67 p=0.001) compared to smaller outlets.

Conclusions: The high marketing and availability of UPFs in modern retail outlets in Kenya calls for policies regulating unhealthy food advertisements in different settings in the country.

Keywords: Ultra-processed foods, unhealthy foods, retail food environments, marketing.

Introduction

Obesity is a major global health challenge, with more than one billion people estimated to live with obesity worldwide, and is a major driver of non-communicable diseases (NCDs) such as cardiovascular diseases and some cancers [1]. NCDs contribute to 14 million deaths (71% of all deaths) per year globally and 77% of these deaths occur in low- and middle-income countries (LMICs) [2]. Overweight and obesity in Kenya and other LMICs are on the rise, particularly among urban populations [3–6]. One-third of the adult population in Kenya is overweight or obese and the rates are particularly high among urban residents, women, and people with middle or higher wealth status [3].

Among the four main risk factors for NCDs, unhealthy diets have been identified as the major driver globally [7]. In 2019, 7.9 million deaths and 187.7 million disability-adjusted life-years were attributed only to unhealthy diets [8]. The global shift to increased consumption of ultra-processed foods high in sugar and sodium content, and low intake of vegetables and whole grains have largely contributed to the rising overweight and obesity epidemic [8],[9]. Urbanization has caused the transformation of food environments through increased availability of modern retail food outlets, which mainly sell ultra-processed foods (UPFs) [10], [11], most of which are unhealthy. In most LMICs, there is a rapid increase in retail food outlets, sales, and marketing strategies influencing dietary behaviors [12],[13]. The availability of modern retail food outlets has been positively associated with the purchase and consumption of unhealthy foods, and increased risk of overweight and obesity in Kenya and other LMICs [14–16]. A GeoPoll survey among consumers in Kenya showed that 56% of shoppers prefer shopping in supermarkets compared to traditional kiosks and informal vendors. Shopping in supermarkets has been associated with purchasing unhealthier food options [17]. Identification of strategies used for marketing unhealthy foods in supermarkets is vital in informing regulatory interventions and consumer education [18],[19].

A study conducted in formal and informal food outlets in Uganda and South Africa showed a high level of promotion of unhealthy foods [20]. Studies conducted in Kenya on the retail food environments mainly focused on store access, food purchases and consumption, and their implication on the transition of dietary behaviors to consumption of processed foods, high adult BMI, and prediabetes condition [13], [16], [21]. Most studies have not examined in detail the relative shelf-space allocation of healthy and unhealthy foods, the mapping of the food items available, and the marketing strategies used to promote various food categories within the food outlets. One study conducted in Ghana assessed the in-store availability of unhealthy and healthy foods and the relative shelf space coverage of the foods in Accra [22]. However, this study only included urban areas and did not investigate the marketing of unhealthy and healthy foods in those outlets.

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The main objective of this study was to assess the availability of various food types sold in food stores and the marketing of UPFs in modern retail food outlets in urban and rural Kenya. We further explored the factors associated with the availability and marketing of UPFs.

Methods

Study design and study site.

This study was a cross-sectional study assessing the retail food environment in Kenya conducted from August 2021 to October 2021. For this study, a three-stage sampling approach was used. In the first stage, three Kenyan counties were purposively selected including Nairobi county (population: 4.397 million) representing an urban metropolitan setting, Mombasa county (population: 1.208 million) an urban coastal tourist city and Baringo (population: 666,763) county representing a predominantly rural setting in Kenya [23]. The rationale for the selection of these counties was their diversity in socioeconomic status (SES) as well as the level of urbanization and geographical location. In stage two, sub-counties in each county were stratified into higher and lower socioeconomically deprived areas using poverty-level data from the 2019 Kenya National Bureau of Statistics (KNBS) estimates[23]. Areas with the highest number of people below the 10% poverty line were classified as lower SES while those with the lowest number of individuals living below the 10% poverty line were classified as higher SES). From each SES level, one or two sub-counties were selected depending on the population size. Figure 1 shows the location of the selected counties in Kenya.

Modern retail food outlet identification

Trained field interviewers walked through the selected sub-counties and manually mapped and geocoded all the outlets that met the eligibility criteria set for this study. A food retail outlet was regarded as eligible if: i) they were a self-service outlet, ii) had at least one checkout point, and iii) had at least two stocked aisles. The inclusion criteria were based on the modern retail outlets landscape in Kenya. In Kenya, all self-service outlets are referred to as supermarkets, henceforth we refer to them in this study as supermarkets or modern retail outlets. Food service restaurants such as fast-food joints and other non-self-service outlets such as shops, kiosks, and informal vendors were excluded.

Data collection and measurements in modern retail food outlets

The International Network for Food and Obesity, Non-communicable Diseases Monitoring and Action Support (INFORMAS) protocol and tool on in-store food availability and marketing was adopted for data collection in the three counties [24–26]. The INFORMAS protocol entails detailed

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research methodologies on monitoring, mapping, and assessing food environments with the aim of promoting healthier food environments to reduce the risks of obesity and NCDs[27]. The tool was piloted for 4 days prior to the actual data collection to adapt its use to the local context.

Food availability measurements (shelf space, floor space, and location within modern retail outlets)

We identified all the food groups and the corresponding individual food items in the store and measured the shelf-space for all the individual food items as follows: first, the food groups were identified and then the unique individual food and non-alcoholic beverages items were identified, and the allocated shelf-space measured for each item. We excluded alcohol, infant formula, and supplements from the measurements. The shelf space for each food item was determined by measuring the length (cm), width/breadth (cm), and height (cm), of the shelves and then multiplying these dimensions and the number of shelves occupied by the food items [24,25]. Since food items appeared in different locations in the supermarkets, we recorded the location along with measurement of the dimensions of the shelves and then aggregated the shelf area coverage by food groups [24].

The total supermarket floor space was determined by requesting the measurements for the large supermarkets from the owners, or by measuring floor space using the tape measures for the small supermarkets. For each supermarket, two research assistants were trained to take the measurements. A different pair of research assistants repeated these measurements to determine the inter-rater reliability score. The accepted inter-rater reliability was 90%, failure to get this level of agreement prompted the repetition of measurements [25].

The locations of all the food items based on their visibility were determined and recorded. The various locations include; The endcap A, which is the end-of-aisles directly facing the entrance, and the center of the supermarkets: endcap B represents the end-of-aisles facing the back of the store [25,28]. The island medium, is the temporary aisles on the floor facing the center, back, or front of the retail food store[28]. These locations were then categorized using the Gro-Promo tool [28] into various prominence levels pre-determined based on the individual level of placement and the visibility of the products[29]. Areas classified as high prominence included entrance, endcap A, check-out side, check-out edge, and aisles. The medium prominence included Endcap B, aisle medium, and, island medium, while low prominence included the edges of the store [25,28].

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Food marketing assessments

The food items advertised were recorded by observing the promotional flyers, posters, and banners with food items inside the supermarket [25]. All the supermarket locations of the flyers were recorded and all the food items advertised were recorded, as well as the promotional characters observed. The promotional characters observed on the promotional flyers in the supermarket include; cartoon or company-owned characters, historical events such as Ramadhan and Christmas, licensed characters e.g. Mickey Mouse, amateur sports person (a person playing sports), famous sports person e.g. Dennis Oliech, sport events, and celebrities.

Modern retail outlet size classification

The modern retail outlet size was subcategorized based on the number of checkout points [25] as small (one checkout), medium (two checkouts), and large (more than two checkouts).

Food classification

The foods were classified based on the INFORMAS food categories[30], and the NOVA classification [31]. The INFORMAS food categorization classifies foods into core and non-core food categories[30, 31, 32]. Examples of core food categories include healthier food options such as fruits and fruit products with no added sugars and salt, and vegetable and vegetable products with no added sugar and salts. Non-core food categories are unhealthy foods that include savory snacks with added salts, sugars, and fats, and sugar-sweetened drinks including soft drinks such as sodas. The NOVA system classifies foods into i) unprocessed/minimally processed which are foods in their raw state that have undergone no industrialization processes and have no added sugars and salts such as fruits, vegetables, rice, beans, and other unprocessed cereals, ii) processed culinary ingredients which are additives and condiments added to foods during preparation such as oils and fats iii) processed foods, which are foods that have undergone minimal industrialization process and have added salts, sugars, and preservatives including jams, and canned meat and fruits, and iv) UPFs [25], which are foods that have undergone numerous industrialization processes and have a high level of sugar, fats, with low fiber and high energy density such as sugar-sweetened beverages. The food categories were further subcategorized into a binary variable: UPFs and not UPFs.

Statistical analysis

The analysis was guided by the INFORMAS protocol [25]. Descriptive statistics were used to show the distribution of these foods by counties, SES areas, and prominence level/placement in the supermarkets. Ratios were used to compare the cumulative shelf length of UPFs to unprocessed/minimally processed foods based on various store characteristics in the three counties.

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The main outcome (dependent) variables were: UPFs availability for sale based on food counts and proportions, and shelf space of UPFs and advertisements of foods in the store based on food counts and proportions. The independent variables included, strategic placement/ prominence levels, SES levels, and supermarket size.

Bivariate comparison between counties, SES areas, prominence level/placement in the supermarket of the proportions of UPFs sold and advertised was conducted using Chi-square tests. Then univariate and multivariable Poisson regression models were used to determine the association between the count of foods available for sale and those advertised in the retail food outlets and the store characteristics. The store characteristics (independent variables) included the SES status, type of supermarket, levels of placement, and the specific locations of the food items (prominence). For the cumulative shelf space (m^2), which is a continuous outcome, we conducted bivariate and multivariable linear regression analysis to determine the predictors of the cumulative shelf space covered by different food groups. We adjusted for clustering within the individual modern retail outlets in all the regression models to account for the heterogeneity of the various settings. Post-estimations were conducted to assess the validity and fitness of the models.

Results

Store characteristics

In total, 252 modern retail food outlets met the inclusion criteria. Of these 137 were excluded due to delays in getting permission from the store owners (110) or refusal to participate (27). All the exclusions were from Nairobi and Mombasa only. Table 1 shows the main store characteristics, while supplementary Table 1 details the store characteristics stratified by counties. Up to 70% of the modern retail outlets were small-sized outlets, 22% were medium, and 8% were large outlets. The mean surface area (floor coverage) of the outlets was different based on their county location. Nairobi had the highest mean food outlet floor size of 243,131m^2 (range 15 m^2 -15000 m^2). Mombasa county had predominantly small-sized, outlets and a mean floor surface area of 68.21m^2 (range 10 m^2 -360 m^2).

In Baringo county, approximately 92% of the outlets were small-sized, with an overall mean surface area of 206.91m^2 (range 15 m^2 - 572 m^2). Most of the small-sized outlets were found in low SES areas.

Food items available for sale in the modern retail food outlets and percent shelf space coverage

Overall food available for sale and shelf space coverage

We observed a substantial availability of unhealthier food options such as sugar-sweetened beverages and savory snacks and a very low availability of healthier food categories such as fruits and vegetables. The oils high in mono or polyunsaturated fats, occupied the most shelf space within the supermarkets, namely 28.6% (Figure 2). The bread, rice, wheat, maize, and other refined and whole

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cereals with no added salt or sugars group, representing approximately a mean (SD) of 18.6(8.9) percent of the total shelf space across the modern retail outlets, followed this (Table 2). The sugar-sweetened beverages, including soft and sweet drinks, occupied approximately 13% of the total shelf space across the modern retail outlets. This was followed closely by sweet bread, cakes, and high-fat savory biscuits, which had 11% overall coverage (Figure 2). Vegetable and vegetable products, and fruits and fruit products with no added sugars and salts had the least shelf space of less than 2% (Figure 2 & Table 2).

Food availability by settings

A further categorization using NOVA classification showed that UPFs represented 40% of all the food items available for sale in modern retail outlets varying across Nairobi (38.9%), Mombasa (43.9%) and Baringo (31.9%) respectively (Figure 3). There was a significant difference in the availability of different food products for sale in the three counties *(p*=0.020, <0.05*)*, with the highest proportion of UPFs being available for sale in the urban counties (Mombasa and Nairobi).

Food availability by prominence levels, SES settings, and supermarket size.

The bivariate comparisons showed food availability in the modern retail outlets were all significantly different by counties (*p*=0.0020), prominence levels (*p*=0.000), SES setting of the outlets (*p*=0.000), and supermarket size (*p*=0.000) (Table 3). The majority of the UPFs were available in lower SES neighborhoods (40.9%) compared to higher SES neighborhoods (39.1%). The unprocessed/minimally processed foods were more available in higher SES neighborhoods (53.2%) compared to lower SES neighborhoods. There was high availability of UPFS in the high prominence areas of the stores (46.3%) and in small (40.0%) and medium supermarkets (40.6%).

Ratios of the total cumulative shelf length and food items availability in modern retail outlets within the three Counties

Table 4 shows the ratios corresponding to cumulative shelf-space coverage and the food items available for sale in modern retail outlets. The shelf space coverage of the unprocessed/minimally processed foods was equal to that of UPFs in all the counties, a ratio of 1:1. In small-sized modern retail outlets and low prominence areas, unprocessed/minimally processed foods had more space coverage compared to UPFs, a ratio of 2:1. We found equal shelf space coverage of the unprocessed/minimally processed foods to that of UPFs (ratio of 1:1) in both high and low SES neighborhoods. In low prominence areas of the outlets, unprocessed/minimally processed foods had more space coverage compared to UPFs, a ratio of 2:1.

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Food items advertised in retail food outlets

Among the 922 food items advertised in the outlets through banners, posters, and flyers, approximately 60% were in the UPF category (Figure 3). Of all the food items advertised in Nairobi, Mombasa, and Baringo counties, 59.2%, 90.5%, and 41.7% of them were in the UPFs, respectively. The majority of the foods advertised in the high-prominence areas of the supermarket were UPFs (n=244, 63.7%). Approximately 25% of the advertisements had promotional characters. The most commonly used promotional characters were the cartoons or company-owned characters, observed among 18% of the total advertisements. The bivariate comparisons of the food items advertised were all significantly different ($p<0.05$) by counties, prominence levels, SES setting of the outlets, and supermarket size (Table 3). There was a higher rate of advertisement of UPFS in urban Mombasa county (90.5%), higher SES area (65.0%), and larger modern retail outlets (88.1%). The medium and high prominence areas of the stores had a high proportion of advertisements of UPFs; 62.8% and 63.7%, respectively.

Factor associated with UPFs availability, advertisements, and cumulative shelf space coverage

Food availability and advertisements as count-outcome (Poisson regression)

There was a significantly higher rate of availability of UPFs in Mombasa county (Adjusted prevalence rate ratios (APRR): 1.13, 95% CI: 1.00-1.26) compared to the rural Baringo county. Conversely, there was no difference was observed in the availability of UPFS in Nairobi county compared to rural Baringo County (APRR: 1.01, 95% CI: 0.88-1.15). Further, there was a higher availability of UPFs in medium prominence areas of the outlets (APRR: 1.14, 95% CI: 1.05-1.25) and in high prominence areas of the outlets (APRR: 1.69, 95% CI: 1.53-1.86) (Table 4). There was a significantly increased rate of advertisement of UPFs in Mombasa county (APRR: 2.18, 95% CI: 1.26-3.79) compared to Baringo County, and in the large-sized retail food outlets (APRR: 1.68, 95% CI: 1.06-2.67) compared to small sized outlets.

Cumulative shelf coverage as a continuous outcome (linear regression)

Table 5 shows the simple and multivariable linear regression analysis of the factors associated with the cumulative shelf space coverage of UPFs in modern retail outlets. After adjusting for other predictors there was a unit increase in cumulative shelf space coverage covered by UPFs in Mombasa County by 96.9 units, in medium and large modern retail outlets by 231.6 and 220.4 units, respectively. There was a significant unit decrease in cumulative shelf-space coverage of UPFs in high-prominence areas by 173.2 units.

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Discussion

We found that 40% of all foods available for sale in modern food retail outlets were UPFs and 60% of the advertised foods were also in the UPF category. A higher level of advertisements and availability of UPFs for sale were observed in urban counties and high-prominence areas of supermarkets. The majority of the shelf space was occupied by foods in the oils high in mono or polyunsaturated fats category, followed by bread, rice, and other refined and whole cereals category. There was a substantial coverage of unhealthier food options including sugar-sweetened beverages and sweet breads, cakes, and high-fat savory biscuits. Healthier food options including fruits and vegetables had very low shelf-space coverage. There was a significant increase in cumulative shelf space coverage covered by UPFs in Mombasa County, in medium and large modern retail outlets, respectively.

In a study conducted in Accra, Ghana, there was a 75% availability of UPFs for sale and a significant proportion of shelf space covered by UPFs [22]. This was much higher compared to our study sites where our urban sites in Nairobi and Mombasa counties had 38.9% and 43.9% availability of UPFs for sale, respectively. The cumulative shelf space allocation for UPFs in the same Nairobi and Mombasa counties were 40% and 10% respectively. The differences observed in the two studies may be due to the different dynamics of the retail food environment in Ghana and Kenya. The majority of the modern retail stores mapped in Kenya were small-sized stores and we considered the inclusion of both rural and urban settings. Further, the differences in these settings could be attributed to the inclusion of two regions in the same counties representing both low SES and high SES settings. Previous studies have shown a link between consumption behaviors and geographic variability and quality and access to healthy foods with an increased accumulation of visceral and subcutaneous fats in people in urban areas [33]. Our study findings further evidence the geographic variability in access to quality and healthy foods.

Our findings are consistent with findings from other studies in Kenya, Uganda, and South Africa [20,34]. This is an implication that Kenya is facing a nutrition transition and accelerated industrialization, which is associated with the provision and consumption of UPFs. The significant availability and marketing of UPFs in medium and large-sized modern retail outlets was also identified in a study conducted in two urban counties in Kenya and Brazil [35], [36], [37]. This shows that the trends of the availability and marketing of unhealthier food options continue to grow with the evidence available in different countries. In this study, it was also evident that there was a relatively low shelf-space allocation of the most recommended healthier food options, such as fruits and vegetables as found elsewhere in both high-income countries and LMICs [22,34,37]. There are pronounced trends in the presence and preference for informal food vendors/wet markets for the purchase of fresh foods in Kenya, Ghana, and Zambia [38–40]. This has been attributed to the convenience, accessibility, and competitive pricing of wet markets and the prioritization of fruits,

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vegetables, and whole foods over processed foods in these settings [38]. Therefore, the low shelf space allocation of healthier food options in Kenyan supermarkets could be due to low demand since people can purchase these products at better prices in wet markets and other informal outlets. In Ghana, the ratio of healthy foods to unhealthy/ UPFs was higher (1:5) implying that for every $1m^2$ of shelf area for healthy foods, there was a $5m^2$ cumulative shelf-space area covered by unhealthy foods [22]. A study conducted in New Zealand supermarkets showed a close ratio of unhealthy to healthy foods as 1:0.42, with low prominence areas having a ratio of 1: 4 [26]. In Kenya, the cumulative shelf space and food items availability for the UPFs were not different from that of minimally processed foods. This means Kenya as compared to other countries, still has a substantial amount of healthy foods available in the retail food outlets but an increasing proportion of unhealthy foods.

In Mombasa county, we had a higher availability and advertisement rate of UPFs compared to other counties. This may be attributable to the urban-coastal setting in Mombasa harboring tourism activities among other economic activities as a port city, with fewer commercial and subsistence farming activities. Accelerating urbanization levels have been associated with nutrition transition and dietary shifts towards the provision, promotion, and consumption of UPFs [41–43]. Further, we observed that the cumulative shelf space coverage of the UPFs increased significantly with supermarket size, SES status, and prominence levels in the modern retail outlets in Kenya. The increasing availability of modern retail outlets, including supermarkets/minimarts and informal outlets, has been observed in other studies in Kenya and other low and middle-income settings and has been associated with the provision of unhealthy foods [11,20,22,35,44]. The availability of these outlets has been associated with the marketing of unhealthy foods in Uganda and South Africa [20]. This study evidences that exposure to unhealthy foods is linked with poor health outcomes among children and adults such as overweight/obesity and other nutrition-related non-communicable diseases in Kenya. In Kenya, there are no specific regulations on supermarket food placement, however, a few policies are in development using some of this data as a reference. In LMICs, the introduction of food policies, by introduction of taxes and tariff rates for unhealthy foods high in nutrients of concern such as sugars and salts consequently contributed to the reduction in overweight and obesity [45]. There is some progress regarding this policy in LMIC, and this evidence could serve as a benchmark to visualize the introduction of suggested policy guidelines to counter supermarket prominence of unhealthy foods in Kenya. In contrast, a study conducted in Australian supermarkets showed an increased availability of healthier food options such as fruits and vegetables, in supermarkets [46]. The policy proposals in Australia on the restriction of the placement of food and beverage products in supermarkets may have caused the increased availability of healthier food options in supermarkets [18]. These policy recommendations can be suggested in Kenya as regulatory measures, as observed in HICs including Scotland and the UK where there are potential bans on the strategic placements of unhealthy foods and beverages in prominent areas of the stores such as the entrance and checkout sides [46,47]. There

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needs to be proper contextualization of these policy recommendations which are needed in a Kenyan setting.

Implication of findings

This study describes in detail the retail food environment encompassing food availability, placement, and promotion in both rural and urban settings in Kenya. Although unprocessed/minimally processed healthier foods occupy substantial space in supermarkets, the higher level of promotion of UPFs may shift food purchase decisions and influence consumption of UPFs [42,43]. There is a need to regulate the promotion of UPFs in the food retail environment in Kenya. It is also important to take advantage of the availability of substantial amounts of healthier food options in Kenyan supermarkets by encouraging consumers to purchase them. Health education messages about healthier foods and appropriate labeling of foods as healthy or non-healthy can help inform consumers to make appropriate choices. While arguments surrounding personal responsibility persist, policymakers need to consider the critical role that food environments play in consumer habits. The development of policies around food marketing in retail environments may be a useful strategy to mitigate this issue. Such interventions could be developed against Kenya's nutrition profile model (NPM) and front-of-pack labels (FOPL) systems. The policymakers can benchmark and implement policy suggestions utilized in high-income countries such as Australia and the UK on the restriction of promotion and strategic placement of food and beverage food products in supermarkets [46,47]. These policies will be relevant, particularly in rapidly urbanizing urban areas as studies show a high prevalence of overweight and/or obesity in these areas due to the exposure of populations to obesogenic environments.

Study strengths and limitations

The strength of this study lies in selecting diverse settings including rural, and urban settings varying in SES for the assessment of in-store food availability, advertisements, and cumulative shelf-space coverage. We used standardized tools of INFORMAS methodology enabling us to compare our studies internationally. However, we had a few limitations in our study. There was only a 46% response rate from the modern retail outlets mapped in Mombasa and Nairobi counties and most of the supermarkets included were small-sized supermarkets, and only 8% were large supermarkets. The lack of access to large outlets, especially in the urban areas may have led to an underestimate of the level of advertising for UPFs. However, most outlets in Kenya fall in the category of small or medium size, especially in areas of low SES where the majority of the population in urban areas purchase food. The outlets that were accessed may therefore be more representative of the true distribution of outlets in Kenya.

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Conclusion and recommendations

This study shows a substantial availability of UPFs and a high level of advertisements of UPFs in modern retail outlets in Kenya. We observed a significant association between the availability and advertisement of UPFs in medium and high-prominence areas of the outlets, and increased shelf space coverage of UPFs in the modern retail outlets in Kenya. This study shows cause for concern for Kenya as it suggests that in the absence of policy interventions as the country continues to develop and increasingly becomes a target for the food industry; the trends of an increased prevalence of NCDs are likely to continue. The development of policies around food marketing and availability will address the high level of availability of unhealthier food options. Fiscal policies and marketing regulations on UPFs and incentives for the consumption of fruits and vegetables may encourage consumers to make healthier choices, particularly in urban areas as supermarkets continue to take root.

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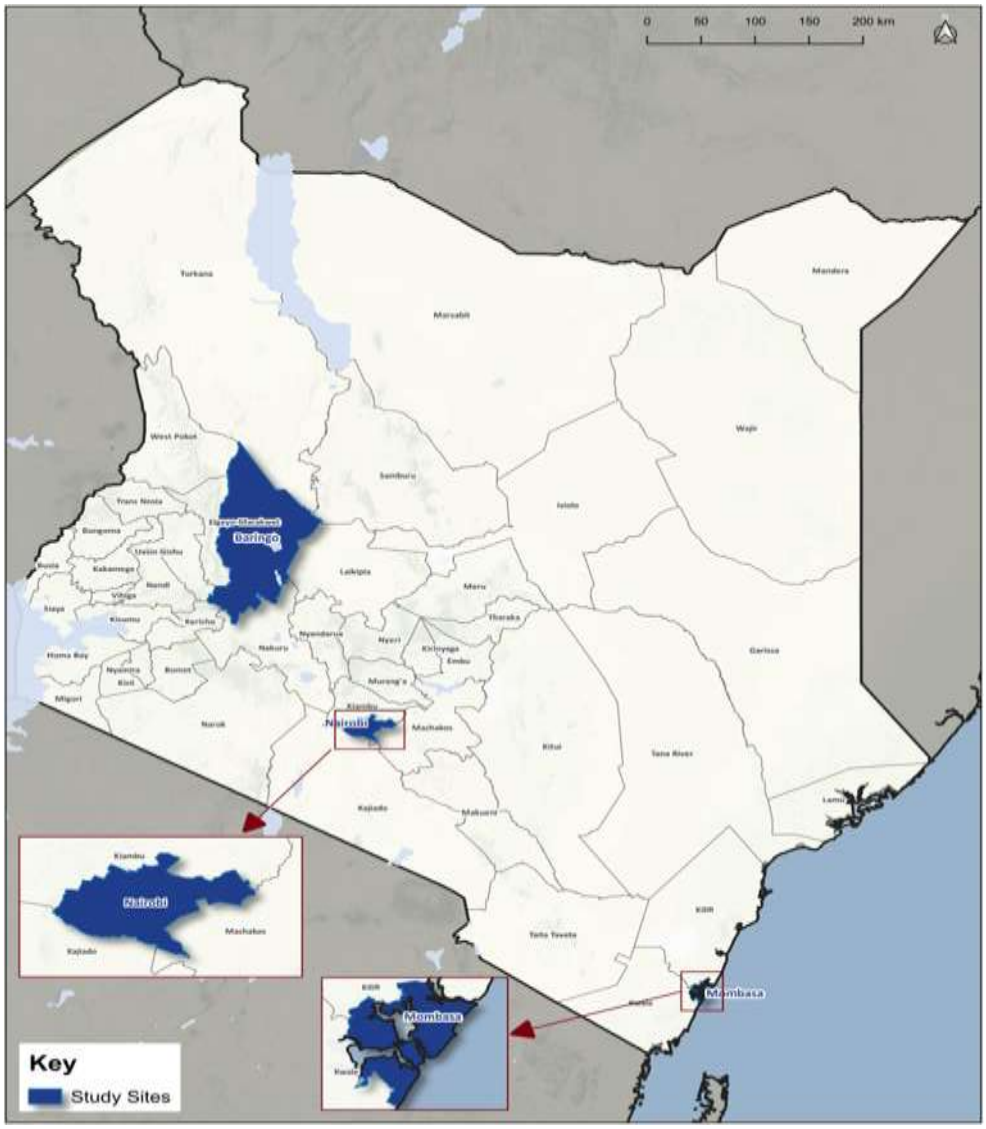

Figure 1: Map of Kenya showing the counties selected for assessing food availability and marketing at modern food retailers in 2021.

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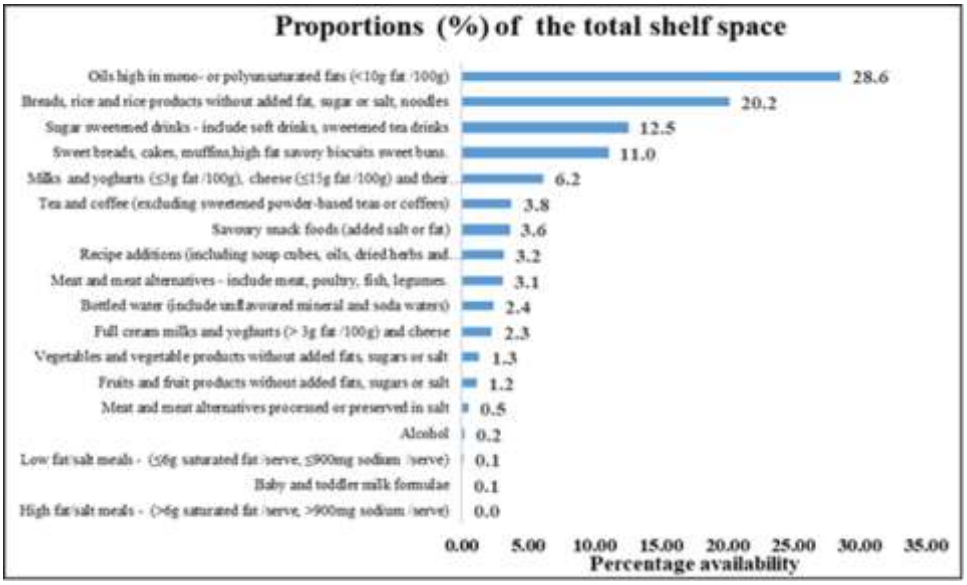

Figure 2: Availability (measured by the proportion of total shelf space (%)) of different types of food items in modern retail outlets in Kenya

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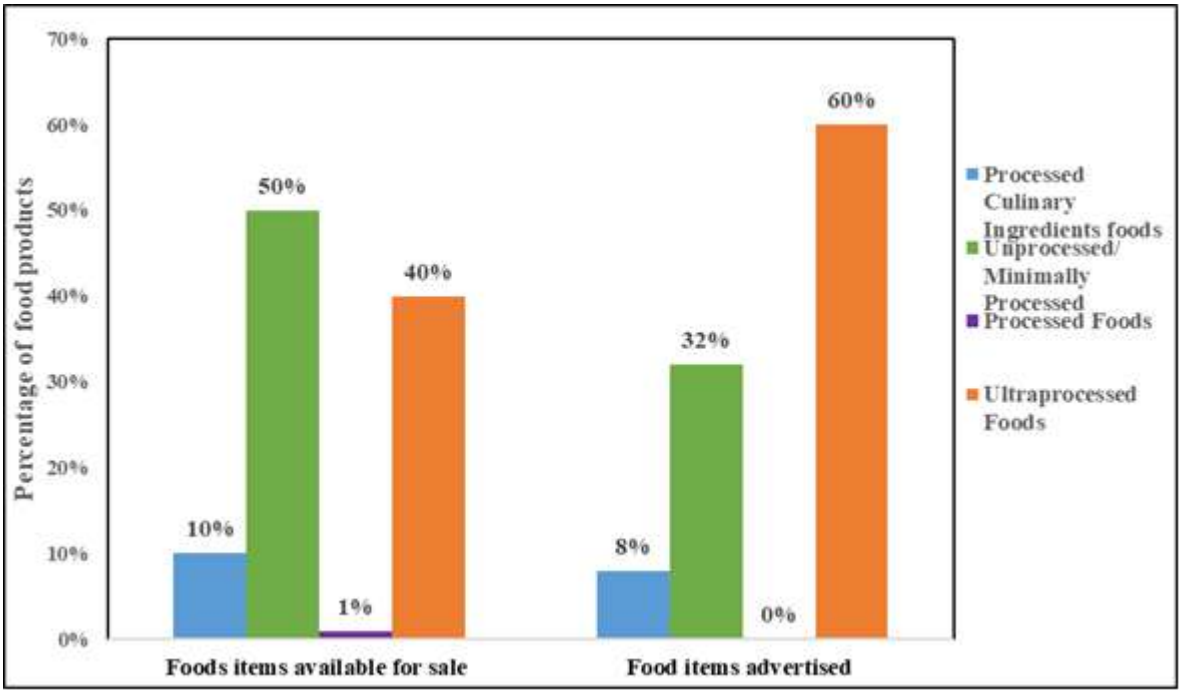

Figure 3: Unique food products displayed for sale and advertised in modern food outlets (Food items available for sale N= 3,669, food items advertised N=992

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Table 1: Characteristics of modern retail outlets in Nairobi, Baringo, and Mombasa counties

County	Sub county	Total outlets(N)	Outlets accessed n (%)		Mean (Stdev) floor space area (m^2)		SES Level	SES Proportion
Nairobi		177	65	(36.7%)	243131.2	(1947224.0)	High	21.8%
	Westlands	52	17	(32.7%)	1606.8	(2345.0)	High	25.5%
	Lang'ata	44	9	(20.5%)	3853	(2579.5)	High	17.0%
	Kibra	12	3	3 (25%)	149.57	(124.3)	Low	32.2%
	Mathare	16	11	(68.8%)	84.9	(64.8)	Low	36.5%
	Embakasi South	32	13	(40.6%)	3403.6	(5503.9)	Low	25.3%
	Embakasi North	21	12	(57.2%)	651.9	(1402.5)	Low	23.3%
Mombasa		51	26	(50.9%)	68.2	(85.5)	High	34.8%
	Mvita	22	6	(27.3%)	49.3	(40.1)	High	31.4%
	Kisauni	29	20	(68.9%)	131.2	(155.8)	Low	39.3%
Baringo		24	24	(100%)	206.9	(196.0)	Low	52.2%
	Baringo North	9	9	9(100%)	165.9	(149.7)	Higher	59.5%
	Mogotio	15	15	5(100%)	236.9	(224.3)	Low	43.7%

Notes: SES proportion: Percentage (%) of Individuals below poverty Line

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Table 2: Shelf-space coverage of food items in modern retail food outlets in the three counties

INFORMAS Food Category	Nairobi County				Mombasa County				Baringo County				All Counties % Coverage			
	Mean	SD	Sum	% Coverage	Mean	SD	Sum	% Coverage	Mean	SD	Sum	% Coverage	Total Sum	%Total SS Coverage	Average %Coverage	SD % Coverage
The bread, rice, wheat, maize and other refined and whole cereals with no added sugars or salt	408.2	1253.6	167362.0	25.3	202.9	334.9	15422.8	6.1	49.3	87.0	9324.9	24.5	192109.7	20.1	18.6	8.9
Fruits and fruit products without added fats, sugars or salt	93.6	168.0	8984.4	1.4	222.9	359.5	2006.3	0.8	5.9	5.0	17.6	0.0	11008.4	1.2	0.7	0.5
Vegetables and vegetable products without added fats, sugars or salt	101.5	220.9	12084.4	1.8	75.2	70.3	676.4	0.3	23.9	13.4	47.8	0.1	12808.6	1.3	0.7	0.8
Milks and yoghurts (≤3g fat /100g), cheese (≤15g fat /100g), and their alternatives	221.9	477.6	46602.5	7.1	226.2	1001.5	10403.1	4.1	32.1	42.6	1635.3	4.3	58640.9	6.2	5.1	1.3
Meat and meat alternatives - include meat, poultry, fish, legumes, tofu, eggs and raw unsalted nuts	118.8	245.7	24700.4	3.7	36.3	54.1	1052.6	0.4	80.0	439.1	3759.9	9.9	29512.9	3.1	4.7	3.9
Oils high in mono- or polyunsaturated fats, and low fat savoury sauces (<10g fat /100g)	326.5	462.8	72812.1	11.0	4272.6	27687.4	196541.8	77.2	37.1	77.6	3230.5	8.5	272584.4	28.6	32.2	31.8
Low fat/salt meals - include frozen or packaged meals (≤6g saturated fat /serve, ≤900mg sodium /serve)	95.3	89.5	1144.0	0.2	-	-	-	0.0	-	-	-	0.0	1144.0	0.1	0.1	0.1
Bottled water (include unflavoured mineral and soda waters)	165.4	332.6	19844.2	3.0	54.2	83.3	1246.5	0.5	33.0	27.9	1584.5	4.2	22675.2	2.4	2.6	1.5
Sweet breads, cakes, muffins, high-fat savory biscuits sweet buns, sweet biscuits,	279.6	696.4	91697.4	13.9	111.8	188.2	6710.3	2.6	58.3	209.2	6757.9	17.8	105165.6	11.0	11.4	6.4
Meat and meat alternatives processed or preserved in salt	238.1	353.2	4523.9	0.7	276.7	0.0	276.7	0.1				0.0	4800.6	0.5	0.3	0.3
Savoury snack foods (added salt or fat)	236.9	457.1	31266.8	4.7	103.0	124.5	2679.3	1.1	22.2	12.7	177.6	0.5	34123.6	3.6	2.1	1.9
Full cream milks and yogurts (> 3g fat /100g) and cheese	159.5	345.9	19932.6	3.0	26.8	15.2	214.1	0.1	37.5	37.0	1538.2	4.0	21684.9	2.3	2.4	1.7
High fat/salt meals - frozen or packaged meals (>6g saturated fat /serve, >900mg sodium /serve)	13.2	0.0	13.2	0.0	-	-	-	0.0	-	-	-	0.0	13.2	0.0	0.0	0.0
Sugar-sweetened drinks - including soft drinks, sweetened tea drinks	396.4	899.7	97912.7	14.8	207.0	287.1	14695.8	5.8	6.2	158.1	6550.1	17.2	119158.6	12.5	12.6	4.9
Alcohol	269.8	278.7	1618.9	0.2	-	-	-	0.0	-	-	-	0.0	1618.9	0.2	0.1	0.1
Recipe additions (including soup cubes, oils, dried herbs and seasonings)	259.9	361.7	26254.4	4.0	114.4	161.4	2517.6	1.0	24.5	68.0	1422.1	3.7	30194.0	3.2	2.9	1.4
Tea and coffee (excluding sweetened pow	407.4	768.8	33811.1	5.1	-	-	-	0.0	35.9	44.6	1974.2	5.2	35785.4	3.8	3.4	2.4
Baby and toddler milk formulae	58.3	76.8	408.2	0.1	-	-	-	0.0	6.5	1.5	32.5	0.1	440.7	0.1	0.0	0.0
Sum total by Counties			**660973.3**				**254443.2**				**38053.1**		**953469.7**			
Mean (SD)			**36720.7(43249.9)**				**27226.0(51348.3)**				**2718.1(2805.3)**					

Notes: SD: Standard deviation, Sum: Total shelf space surface area (m^2) by county, Total sum: Total shelf space Surface area (m^2) in all Counties, SS coverage: shelf space coverage.

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Table 3: Distribution of Food items available for sale and those advertised in the store.

		Food items available for sale				
Variable		**Processed culinary ingredients n(%)**	**Unprocessed foods n(%)**	**Processed foods n(%)**	**Ultra-processed foods n(%)**	**P-Value**
County						
	Nairobi County	223(9.1%)	1247(51.1%)	19(0.8%)	951(38.9)	0.020
	Mombasa County	46(10.8%)	192(45.1%)	1(0.2)	187(43.9%)	
	Baringo County	87(11.0%)	395(49.9%)	-	309(39.1%)	
Socioeconomic status (SES)						
	Low SES	209(11.4%)	861(47.1%)	10(0.6%)	747(40.9%)	0.000
	High SES	147(8.0%)	973(53.2%)	10(0.6%)	700(38.3%)	
Prominence level (Strategic placements)						
	Low prominence	162(11.8%)	737(53.5%)	11(0.8%)	468(22.9%)	0.000
	Medium prominence	40(6.22%)	378(58.8%)	3(0.5%)	222(34.5%)	
	High prominence	154(9.4%)	719(43.9%)	6(0.4%)	757(46.3%)	
Supermarket size						
	Small supermarket	208(10.9%)	935(49.0%)	1(0.1%)	763(40.0%)	0.000
	Medium supermarket	99(9.9%)	480(48.3%)	11(1.1%)	403(40.6%)	
	Large supermarket	49(6.5%)	419(55.4%)	8(1.1%)	281(37.1%)	
	Foods products advertised					
County						
	Nairobi County	2(0.3%)	264(40.3%)	1 (0.2%)	388(59.2%)	0.000
	Mombasa County	-	11(9.5%)	-	105(90.5%)	
	Baringo County	69(45.7%)	19(12.6%)	-	63(41.7%)	
Socioeconomic status (SES)						
	Low SES	31(7.4%)	158(37.7%)	1(0.2%)	229(54.7%)	0.000
	High SES	40(7.9%)	136(27.0%)	-	327(65.0%)	
Prominence level (Strategic placements)						
	Low prominence	51(12.2%)	130(31.1%)	1(0.2%)	236(56.5%)	0.000
	Medium prominence	-	45(37.2%)	-	76(62.8%)	
	High prominence	20(5.2%)	119(31.1%)	-	244(63.7%)	
Supermarket size						
	Small supermarket	69(17.6%)	87(22.1%)	-	237(60.3%)	0.000
	Medium supermarket	-	185(56.6%)	1(0.3%)	141(43.1%)	
	Large supermarket	2(0.9%)	22(10.9%)	-	178(88.1%)	

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Table 4: Ratio of the ultra-processed foods and unprocessed/minimally processed foods cumulative shelf space coverage, and food items available in the modern retail outlets.

		Cumulative shelf-Space Coverage (m^2)			Foods items available for sale (N=3716)		
Variable	**Categories**	**Ultra processed foods**	**Unprocessed/Minimally Processed Foods**	**Ratio[1]**	**Ultra processed foods count**	**Unprocessed/Minimally processed count**	**Ratio[2]**
County							
	Nairobi County	268696	313389.1	1	940	1,246	1
	Mombasa County	26817.0	30807.7	1	187	192	1
	Baringo County	16445.9	18344.2	1	309	395	1
	Overall(+-SD)	103986.3(116544.3)	120847.0(136242.9)				
Supermarket size							
	Small	69614.2	112858.1	2	763	935	1
	Medium	140386.9	125223.4	1	401	480	1
	Large	101957.8	124459.5	1	272	418	2
SES Level							
	Low	137187.4	171216.7	1	747	861	1
	High	174771.5	191324.3	1	689	972	1
Prominence levels							
	Low	95698.64	173999.7	2	466	737	2
	Medium	189389.4	168806.9	1	652	889	1
	High	26870.83	19734.41	1	318	207	1

Notes: **[1]Ratio of the total cumulative shelf space between ultra-processed foods and unprocessed/Minimally**

[2]Ratio of the total ultra-processed foods and unprocessed/Minimally processed food items available for sale

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Table 5: Poisson regression for factors associated with the UPF's availability for sale and marketing in modern retail outlets.

	Foods items available for sale						Foods items advertised					
	Unadjusted Poisson Model			Adjusted Poisson Model			Unadjusted Poisson Model			Adjusted Poisson regression model		
Variable	PRR	95% CI	P-Value	APRR	95% CI	P-Value	PRR	95% CI	P-Value	APRR	95% CI	P-Value
County												
Baringo	Ref											
Nairobi	0.99	(0.91-1.08)	0.81	1.01	(0.88-1.15)	0.93	1.42	(0.79-2.54)	0.24	1.30	(0.69-2.22)	0.42
Mombasa	1.13	(1.02-1.26)	0.02	1.13	(1.00-1.26)	0.05	2.17	(1.30-3.62)	<0.01	2.18	(1.26-3.79)	<0.01
SES Area												
Low	Ref											
High	0.92	(0.84-1.01)	0.07	0.96	(0.87-1.07)	0.47	1.19	(0.77-1.83)	0.43	0.89	(0.59-1.32)	0.55
Supermarket size												
Small	Ref											
Medium	1.01	(0.93-1.09)	0.90	0.98	(0.88-1.10)	0.76	0.72	(0.43-1.18)	0.19	0.73	(0.45-1.18)	0.20
Large	0.90	(0.79-1.02)	0.11	0.91	(0.76-1.09	0.30	1.46	(1.08- 1.97)	0.01	1.68	(1.06-2.67)	0.03
Prominence level												
Low	Ref											
Medium	1.12	(1.03-1.23)	0.01	1.14	(1.05-1.25)	<0.01	1.17	(0 .78-1.77)	0.45	1.02	(0.70-1.49)	0.91
High	1.67	(1.52-1.84)	<0.01	1.69	(1.53-1.86)	<0.01	1.00	(0.64-1.56)	1.00	1.02	(0.62-1.67)	0.95

**** PRR- Prevalence rate ratios CI-Confidence Interval, APRR- prevalence rate ratio; SES-Socioeconomic status***

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Table 6: Linear regression for factors associated with the cumulative shelf length coverage of different food groups in the three counties.

		Bivariate linear Regression			Multivariable Linear Regression		
Variable	**Category**	**Coefficient (β)**	**95% CI**	**P-Value**	**Coefficient (β)**	**95% CI**	**P-Value**
County							
	Baringo	Ref					
	Nairobi	232.62	(161.52-303.72)	0.000	96.85	(15.57-178.13)	0.020
	Mombasa	90.18	(-10.27-190.64)	0.078	73.25	(-26.44-172.95)	0.150
SES Area							
	Low	Ref					
	High	70.00	(11.98-128.04)	0.018	49.39	(-13.52-112.30)	0.124
Supermarket size							
	Small	Ref					
	Medium	258.85	(192.92-324.79)	0.000	231.63	(156.41-306.85)	0.000
	Large	283.61	(208.11-359.10)	0.000	220.40	(128.06-312.73)	0.000
Prominence level							
	Low	Ref					
	Medium	85.11	(19.00-151.23)	0.012	19.66	(-46.10-85.42)	0.558
	High	-120.86	(-200.14- -41.59)	0.003	-173.18	(-250.90- -95.46)	0.000

Notes: The response variable is the cumulative shelf-space (surface area coverage of the ultra-processed foods). CI-confidence interval, ref: reference category

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