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ORIGINAL RESEARCH

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Nutritional intake and food sources in an adult urban Kenyan population

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Abstract

Urbanisation is hastening the transition from traditional food habits to less healthy diets, which are becoming more common among Kenyans. No up-to-date studies on usual dietary intake and the main food sources of adult Kenyans are available. The aim of the present study was to identify the main food sources of nutrients in the diet of urban adult Kenyans and explore potential associations with demographic variables including age, sex, level of education, occupation and body mass index. The study adopted a cross-sectional design. The dietary intake of 486 adult Kenyans from Nairobi was assessed using a validated, culture-sensitive, semi-quantitative food frequency questionnaire. Binary logistic regression models were used to evaluate associations between food sources and demographic variables. Macronutrient intakes as a proportion of total energy intake (TEI) were within international dietary guidelines. Cereals and grain products (34.0%), sugar, syrups, sweets and snacks (9.8%), fruits (9.7%) and meat and eggs (8.8%) were the major contributors to TEI. Cereals and grain products contributed 42.5% to carbohydrates, followed by fruits (12.4%) and sugar, syrups, sweets and snacks (10.6%). The most important sources of protein and total fat were cereals and grain products (23.3% and 19.7%, respectively) and meat and eggs (22.0% and 18.7%, respectively). Sex, age and level of education were associated with the choice of food groups. Although macronutrient intakes were within guidelines, the Kenyan diet was revealed to be high in sugars, salt and fibre, with differences in food sources according to demographic variables. These results can act as an incentive to national authorities to implement nutritional strategies aiming to raise awareness of healthier dietary patterns among Kenyans.

KEYWORDS
Africa, developing countries, dietary intake, food sources, nutrients, urban adults

INTRODUCTION

Kenya is a country with traditional food habits, but increasingly, modern lifestyles with their associated less healthy diets, are becoming more common and both coexist (Mohajan, 2014). According to Kenya's Ministry of Health, unhealthy diets are common among Kenyans (Ministry of Health, 2017). Although there are no up-to-date total dietary intake data for Kenya, due to sociocultural/economic barriers, there are some published studies carried out on specific populations such as children, women (Gewa et al., 2012; Mwaniki & Makokha, 2013; Steyn et al., 2012) or focused on specific foods/nutrients (Beatrice, 2009; Steyn & Nel, 2006; Wanjihia et al., 2009) or on Kenyan rural areas (Dominguez-Salas et al., 2016; Jayne, 2011). These and other studies are compiled in the review of Vila-Real and collaborators (Vila-Real et al., 2016).

In Kenya, as in many other areas in the world, cereals are a very important source of energy, regardless of the urbanisation level. The most common dishes in Kenya include *Ugali* (thick porridge traditionally made of maize), *Githeri* (boiled maize and beans), *Mathoke* (mashed plantain), *Mukimo* (mashed potatoes with vegetables, maize and beans), *Pilau* (cooked chicken and rice prepared with a typical seasoning) and *Irio* (boiled maize, beans, vegetables and potatoes). Bread, milk and vegetables are also a crucial part of the diet (Mohajan, 2014).

Besides the burden of undernutrition, Kenya also faces overnutrition. According to the *Demographic and Health Survey* (*DHS*) 2014, the percentage of women with body mass index (BMI) below 18.5 kg/m^2 is 5.5% (2.8% in Nairobi) and with overweight and obesity is 43.3% (47.6% in Nairobi), of which 72% have obesity. In urban and rural men, the prevalence of overweight and obesity is 16.1% and 2.8%, respectively (Development Initiatives Poverty Research Ltd, 2018). Diabetes (prevalence female [7.9%], male [9.0%]) and high blood pressure (prevalence female [20.1%], male [26.4.1%]) are two comorbidities associated with overnutrition and are established among the adult population (Development Initiatives Poverty Research Ltd, 2018). Nevertheless, micronutrient deficiencies, such as iodine deficiency disorder, iron deficiency anaemia and vitamin A and zinc deficiencies, are also a health problem for Kenyans (Harambee Ministry of Health, 2011). Although advice on healthy dietary patterns has been published (Ministry of Health, 2017; Ministry of Medical Services, 2010), no national energy and nutrient guidelines exist in Kenya. Therefore in this study, the authors considered the energy and nutrient guidelines developed by the World Health Organization (WHO) in collaboration with the Food and Agriculture Organization of the United Nations (FAO) as the most suitable recommendations to study the nutrient adequacy of this population (FAO Expert Consultation, 2010; Joint FAO/WHO Expert Consultation on Human Vitamin and Mineral Requirements, 1998; Joint WHO/FAO Expert Consultation, 2003; Joint WHO/FAO/UNU Expert Consultation, 2001, 2002).

Food choice and consequently, dietary intake, are complex processes with many determinants, for instance, biological, social, economic and environmental (EUFIC, 2006). Food availability and accessibility are, unquestionably, two of the most influential drivers of food choice, but cultural aspects, socio-economic status, education and knowledge also play an important role in this process (Kearney, 2010; Okoro et al., 2015; Shepherd, 1999).

The objective of this research was to assess the food and nutrient intake of urban adult Kenyans, resident in Nairobi and to determine both the contributions of food groups to energy or nutrient intake and the nutritional adequacy of the diet, exploring possible associations with social or demographic characteristics.

METHODOLOGY

Study design and recruitment of participants

This cross-sectional study was carried out in April 2016 aiming to assess the dietary intake of urban adult Kenyans. Using a purposive sampling model, 524 respondents (≥18 and <60 years old) were recruited in shopping malls, open-air markets, churches and urban informal settlements, such as slums, located in different constituencies namely Westlands (wards: Kangemi, Karura, Kitisuru, Parklands), Dagoretti North (ward: Kilimani), Dagoretti South (ward: Uthiru), Langata (ward: Karen), Kibra (wards: Laini Saba and Lindi), Ruaraka (ward: Mathare North), Embakasi East (ward: Lower Savannah) and Starehe (wards: Nairobi Center; Kariokor). The variety of places aimed to comprise different social backgrounds, with diverse incomes and lifestyles. All the required authorisations to access the sampled institutions were provided by the local manager. Respondents were randomly selected within each population. The Institute for Bioethics, of the Catholic University of Portugal approved the study protocol (ESR 12/2014), all participants were informed about the objectives of the study, and those who agreed to participate in the study provided written informed consent according to the Declaration of Helsinki of the World Medical Association.

Eleven interviewers were recruited and given training by a nutritionist of the research team, along with all the necessary information to perform the interviews. In total, the team was composed of 12 trained interviewers. The training was focused on the dietary tool to be used during the interviews, particularly the recognition of the list of food and beverage items of the food frequency questionnaire (FFQ), the understanding of the standard

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portion sizes, the organisation of the food groups and the procedure to be followed for its application. Moreover, the plan and schedule of the interviews, and strategies for ensuring the quality of the data collected were discussed. All the interviewers were subject to face-to-face training sessions of the application of the FFQ until each of them was sufficiently prepared to begin the fieldwork.

The sample size for a prevalence survey calculation (Glaziou, 2005) was carried out, considering the urban population of Nairobi (13 876 112 people; The World Bank, 2019), a precision of 5%, and a nutritional inadequacy prevalence of 50%, to obtain the highest sample size possible, and the confidence interval (CI) level of 95%. The combination of these indicated a minimum sample of 385 respondents. Considering a misreporting of 25%, researchers set a sample size of 515 individuals.

From the 524 interviewed people, a total of 486 were included in the final sample. Exclusion criteria included age over 60 years old or people who did not know their age ($n = 22$) and potentially implausible energy intake (EI) reports ($n = 16$; the values 1.5 × IQR above the third quartile (Q3 + 1.5 × IQR; 5404 kcal) or 1.5 × IQR below the first quartile (Q1 + 1.5 × IQR; 531 kcal; 531 kcal; Kipnis et al., 2003) were considered as outliers).

Data collection and computation

A previously developed and validated semi-quantitative FFQ (Vila-Real et al., 2020), relative to the previous month's consumption, was used to study the dietary intake of the sample. The FFQ included 123 food items distributed over 11 food groups (Table 1). Respondents were interviewed in a single session, in which a general questionnaire was firstly applied, followed by the FFQ. The general questionnaire included questions about demographics, anthropometrics (weight and height), lifestyle and health status (presence of chronic diseases, specifically asked by the interviewer). All the information was self-reported.

In order to transform the food information into the nutrient intake, the Food Processor® software, version SQL 11.0.3 (ESHA Research) was used. Details about the methodology followed can be found in Vila-Real et al. (2020). Briefly, the information from the FFQ was introduced in a Microsoft Access® database, for further crossing with Food Processor®. Each food portion (weight in grams) was multiplied by the respective frequency of consumption and divided by the number of days corresponding to the frequency consumption, in order to estimate daily consumptions of each food item. The Food Processor® software includes the US Department of Agriculture's Food and Nutrient Database for Dietary Studies, the Canadian Nutrient File and the UK Foods Database along with manufacturer and restaurant data. Although Kenyan native food composition tables are not included in the software, food items were carefully selected by the comparison of their nutritional composition with local food composition tables. Whenever a matching food item was not found, the software was updated with nutritional information using the data from the Kenyan food composition tables.

Dietary data were analysed as energy, macronutrients and micronutrient intakes and the contributions of each macronutrient were calculated and expressed as percentages of the EI excluding energy from alcohol.

TABLE 1 Design characteristics of the developed semi-quantitative food-frequency questionnaire (FFQ)

Food groups (number of items)	Food items	Frequency options		Consumed amount	
Cereals and grain products (22)	Ugali, porridge, rice, maize, potatoes, pasta, bread, breakfast cereals, chapatti	Never		Smaller than Equal to Bigger than	Standard portion
Vegetables (21)	Carrots, light and dark green-leaf vegetables, onions, tomatoes, garlic	1–3	Per month		
Legumes, pulses, seeds and nuts (5)	Beans, lentils, peas, nuts and seeds	1			
Fruits (15)	Apple, pear, citrus, stone fruit, tropical fruits, berries, melons	2–4	Per week		
Meat, fish and eggs (18)	Red and white meat, offals, fish, eggs	5–6			
Dairy products (7)	Milk, cheese, yogurts	1	Per day		
Fats and oils (6)	Butter, margarine, oils	2–3 4–6			
Sauces, seasonings, flavourings (7)	Salty and sweet sauces, nut butters, spices	+ 6			
Sugar, syrups, sweets and snacks (9)	Cookies, cakes and other sweets, ice cream, sugar				
Beverages (10)	Soft drinks, fruit juices, coffee, tea, water, alcoholic beverages				
Composite dishes (3)	*Pilau*, *Githeri*, *Matoke*				

Food groups' contributions to energy and nutrient intake were also calculated and expressed as percentages of energy or nutrient intake. Energy and macronutrient adequacy was studied by the comparison of the actual intakes with the recommended specific nutrient requirements defined by the consortium WHO/FAO (FAO Expert Consultation, 2010; Joint FAO/WHO Expert Consultation on Human Vitamin and Mineral Requirements, 1998; Joint WHO/FAO Expert Consultation, 2003; Joint WHO/FAO/UNU Expert Consultation, 2001, 2002) and micronutrient adequacy was studied using the estimated average intake (EAR) fixed cut-point approach (IOM [Institute of Medicine], 2000a, 2000b, 2011).

Statistical analysis

Data were descriptively expressed as frequencies (absolute [n] and relative [%]) and as median and 25th (P25) and 75th (P75) quartiles for continuous and non-normally distributed variables. The Kolmogorov–Smirnoff test was used to study the variables' distribution normality. Associations between food sources (the contribution of each food group to energy or nutrient intake) and participants' demographic characteristics were studied by calculating the odds ratios (OR) and 95% CI, using logistic regression, the Enter method, with binary and continuous predictors, depending on the variable. Consequently, the contribution of each food group (dependent variables) was divided into two categories, using the median for each variable as the threshold. The models were adjusted for the following predictor variables: gender (0: female; 1: male), education level (0: none, primary and secondary; 1: tertiary), occupation (0: student, casual labourer and unemployed; 1: self or formally employed), marital status (0: single, widowed and divorced; 1: married), all binary; total EI, which was divided into quartiles (0: EI ≤ P25 [2352 kcal]; 1: P25 < EI ≤ P50 [2892 kcal]; 2: P50 < EI ≤ P75 [3509 kcal]; 3: EI > P75), and age and BMI were considered as continuous predictors. Models included 459 individuals (94.4%) because 27 respondents had missing information on at least one predictor.

Statistical analyses were conducted using Microsoft® Excel, version 16.41, and IBM® SPSS® Statistics, version 26 (SPSS Inc.).

RESULTS

Sample characterisation

More than half of the sample was aged below 30 years old (28 years old, 24–35 years old, P25–P75; ranging between 18 and 58 years old), had completed secondary or tertiary level of education and was self- or formally employed (Table 2). The sample was mostly single with no children or married with one or two children. In terms of meal patterns, half of the sample only consumed between one and three meals a day, and the other half more than three meals a day. Residents in lower-income settings, such as slums (n = 52, 10%), reported a higher average number of meals, when compared to the other groups (data not shown). Most of respondents did physical exercise, the most common activities being walking, running, dancing, playing football and skipping with a rope.

The respondents' clinical and anthropometric profiles are presented in Table 3. The more prevalent chronic diseases among the sample were hypertension and respiratory diseases, such as asthma. Some respondents were not sure about whether they had the chronic diseases listed in the general questionnaire.

Energy and nutrient intakes and recommendations

Carbohydrates (P50, 60.3%, P25–P75, 57.2%–63.8%) were the nutrient class that contributed most to TEI, including total sugars which contributed 19.8% TEI. Total fat intake provided almost 30% of TEI (P25–P75, 24.6%–30.4%), where monounsaturated fatty acids (MUFA) and saturated fatty acids (SFA) contributed the most. All the median macronutrient intakes were in accordance with WHO/FAO range recommendations apart from n-3 polyunsaturated fatty acids (PUFA), although a proportion of the sample were above or below the recommended ranges for some nutrients (Tables 4 and S1). Almost half the sample had protein intakes above the upper limit of the recommended range (15% of TEI) and 27.4% exceeded the upper limit of the recommended range for total fat. The carbohydrates lower limit of the recommended range of 55% of TEI was not reached by 15.2% of respondents. Half the sample had a salt intake over 10.1 g/day. Alcoholic beverages contributed only 0.5% of TEI and were excluded from the analysis.

Contribution of food groups to energy and nutrient intakes

Table 5 shows the percentage contribution of the food groups to energy and macronutrient intakes. The major contributors to TEI were cereals and grain products (34.0%), followed by sugar, syrups, sweets and snacks (9.8%), fruits (9.7%) and meat and eggs (8.8%). Cereals and grain products, fruits and vegetables were the groups that include the foods consumed most on a daily basis by Kenyans (Mohajan, 2014).

Cereals and grain products contributed 42.5% to carbohydrates intake, and fruits (12.4%) and sugars,

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TABLE 2 Socio-demographic and lifestyle characterisation of 486 adult urban Kenyans

	n (%)		*n* (%)
Age (years)		**Number of children living at home**	
≤25	173 (35.6)	0	211 (44.1)
26–29	108 (22.2)	1–2	209 (43.6)
30–34	80 (16.5)	3–4	51 (10.6)
35–39	56 (11.5)	5–7	8 (1.7)
≥40	69 (14.2)		
Sex		**Number of meals per day**	
Female	243 (50.0)	1–2	74 (15.8)
Male	243 (50.0)	3	242 (51.6)
		4–6	153 (32.6)
Education level		**Smoking habits**	
None/primary	54 (11.2)	Yes	18 (3.7)
Secondary	203 (41.9)	No	467 (96.3)
Tertiary	227 (46.9)		
Occupation		**Alcohol consumption**	
Unemployed	25 (5.2)	Yes	132 (27.3)
Student	36 (7.4)	No	351 (72.7)
Casual labourer	41 (8.5)		
Self-employed	199 (41.1)		
Formally employed	183 (37.8)		
Marital status		**Practice of physical exercise**	
Single	246 (51.0)	Yes	440 (90.5)
Married	227 (47.1)	No	46 (9.5)
Divorced/widowed	9 (1.9)		

syrups, sweets and snacks (10.6%) were also noteworthy. Among cereals and grain products, the most cited foods were maize ugali, maize porridge, rice, potatoes and bread. Fruits are very popular in Kenya and avocado, bananas, watermelon, oranges and mangoes were the most consumed in terms of the average daily amount. Cereals and grain products (26.7%) were the most important sources of dietary fibre, followed by similar contributions from vegetables and legumes, pulses, seeds and nuts, at 17.2% and 19.8%, respectively. Fruits and sugars, syrups, sweets and snacks counted for 23.2% and 20.8% of total sugars, respectively. Of sugary products, cookies, biscuits, cakes and ice-cream were the main providers, besides the table sugar itself that was used daily given the high consumption of tea (with or without milk).

The most important sources of protein were cereals and grain products (23.3%) and meat and eggs (22.0%), followed by dairy (11.7%) and legumes, pulses, seeds and nuts (10.7%). Half the sample consumed more protein from plant (46%) compared to animal sources (36%). Among cereals, white *chapati*, *ugali* and white bread were the most relevant protein contributors. The consumption of fish was uncommon in this sample; Tilapia was mainly consumed in the previous month, and other fish such as Omena (*Silver cyprinid*), Nile perch or canned fish were not consumed at all by more than 63% of the sample. Dairy products made an important contribution to protein, mainly due to the consumption of milk, which is commonly mixed with tea and consumed as a snack. However, other types of dairy products were not very popular. During the previous month, 95%, 59% and 38% of the sample did not consume any type of cheese, soured milk (known as *Mala*) or yogurt.

For total fats, cereals and grain products (19.7%) and meat and eggs (18.7%) were the main contributors, followed by dairy (13.6%). The same food groups were the main sources of SFA and MUFA, although the fruits group was the third most important source (11.2%) of MUFA. Only 28 respondents (5.8%) mentioned the consumption of skimmed milk. Legumes, pulses, seeds and nuts provided 10.3% of total PUFA, being surpassed only by cereals and grain products (38.8%). Among fats and oils food items, butter and margarine were the most cited products, while olive oil and other oils were not added to food after cooking (e.g. as a

TABLE 3 Body mass index (BMI) classification and prevalence of chronic diseases of the 486 adult urban Kenyans (243 females and 243 males)

	Total (n = 486)	Female (n = 243)	Male (n = 243)
	n (%)	n (%)	n (%)
BMI classification (kg/m^2)			
Under weight (<18.5)	23 (4.9)	13 (5.5)	10 (4.3)
Normal weight (≥18.5–24.9)	297 (63.7)	137 (58.3)	160 (69.2)
Pre-obesity (≥25.0–29.9)	108 (23.2)	61 (26.0)	47 (20.3)
Obesity (≥30.0)	28 (6.0)	24 (10.2)	14 (6.1)
Chronic disease			
Diabetes	3 (0.7)	1 (0.4)	2 (0.8)
Hypertension	21 (4.5)	16 (6.7)	5 (2.1)
Dyslipidaemia	6 (1.4)	4 (1.9)	2 (0.8)
Respiratory diseases	15 (3.1)	9 (3.8)	6 (2.5)
Cancer and others (such as arthritis)	5 (1.0)	4 (1.7)	1 (0.4)
Medical appointment (previous year)			
Yes	180 (37.0)	95 (39.1)	85 (35.0)
No	306 (63.0)	148 (60.9)	158 (65.0)

salad dressing) by 94% of the sample in the previous 4 weeks.

Cereals and grain products (32.7%), vegetables (14.9%) and legumes, pulses, seeds and nuts (13.2%) were the main sources of salt.

The last food group in this FFQ comprised the composite dishes, including *Pilau* (cooked rice with aromatic spices and meat), *Githeri* (boiled maize and beans) and *Matoke* (mashed plantain), which also contributed to energy and macronutrients, namely by 4%, 4%, 4% and 2% to total energy, protein, fats and carbohydrates intake, respectively.

Table 6 shows the percentage contribution of the food groups to micronutrient intakes. The main sources of folate were cereals and grain products, contributing almost a quarter of total intake, and legumes, pulses, seeds and nuts (16.4%), followed by fruits (12.1%) and vegetables (11.6%). The contributors to iron were the same groups except for fruits. The dairy food group included the most important providers of iodine (77.5%) and calcium (33.4%), with the vegetables group also contributing to calcium (28.5%). Within green-leafy vegetables, kale (*Sukuma wiki*), cabbage and spinach were the most consumed, either in frequency or quantity. More than half of zinc was supplied by cereals and grain products and meat and eggs.

Food sources of nutrients by demographic characteristics

Table 7 shows the association between food group consumption (only for those that provided at least 10% of the TEI of each nutrient) and demographic characteristics. While men are almost twice as likely to have higher consumption of cereals and grain products as women, women tend to have higher consumption of food items from vegetables and fruits, compared to men. Highly educated people are more likely to consume dairy products than less educated people, who tend to consume more cereals and grain products. In general people with higher dietary intakes are more likely to have higher daily consumption of all food groups, when compared to the reference category (DEI < P25). Regarding age, the only positive association that was found indicated that older people tend to consume more legumes, pulses, seeds and nuts, than younger people. As for marital status, cereals and grain products are consumed more by married people rather than single, widowed or divorced people.

Table S2 shows the association between the contribution of different food groups to daily energy and nutrient intakes and demographic characteristics. For men, cereals and grain products were a more important source of carbohydrates, total fibre, SFA, MUFA, sugars, salt, and magnesium, zinc and calcium than for women. For women, vegetables were a more important source of fibre, folate, iron, magnesium and salt. In addition, sugars, syrups, sweets and snacks contributed less to both carbohydrates and fat for men compared to women.

People with higher education levels were more likely to have higher contributions from meat and eggs to protein, MUFA, omega-6 PUFA and SFA and from dairy foods to protein and fat, compared to the reference group. For people with lower levels of education, cereals and grain products provided a significantly higher contribution to protein, and although not significant, pulses were also a greater source of protein. Vegetables were a more important source of dietary fibre among people with higher educational levels.

For those in the top quartile of EI, cereals and grain products were a less important source of the macronutrients, total fibre, total sugars and some micronutrients compared to those with EIs in the first quartile, with legumes, pulses, seeds and nuts being significantly more important sources of protein, PUFA and iron. For people with lower EIs (in the first quartile), vegetables were a more important source of fibre, calcium, magnesium and iron compared with those with higher EI and dairy, rather than sugars, syrups, sweets and snacks, was a more important source of fat, contrary to what was observed for people with higher EI.

TABLE 4 Energy and nutrient intake of 486 adult urban Kenyans (243 females and 243 males), and comparison with the World Health Organization/Food and Agriculture Organization (WHO/FAO) dietary recommendations for energy and macronutrients and with the Institute of Medicine Dietary Reference Intakes for micronutrients

		Total (*n* = 486)				Female (*n* = 243)			Male (*n* = 243)		
	Unit	Median	P25[b]	P75[b]	Guidelines[a]	Median	P25	P75	Median	P25	P75
Energy (E)	kcal	2892	2352	3512	F: 1800–2400; M: 2200-3200[c]	2647	2220	3347	3111	2532	3636
Protein	% E	14.8	13.6	16.0	10–15	14.6	13.4	16.0	15.0	13.8	16.0
Total Fat	% E	27.5	24.6	30.4	15–30	27.6	24.3	30.2	27.5	24.9	30.7
SFA	% E	8.4	7.4	9.6	< 10	8.5	7.3	9.7	8.3	7.4	9.6
MUFA	% E	8.7	7.4	10.2	By difference	8.6	7.2	10.2	8.8	7.6	10.2
PUFA	% E	5.9	5.2	6.7	6–10	5.8	5.3	6.6	6.1	5.2	6.7
n-3 PUFA	% E	0.45	0.40	0.52	1–2	0.46	0.40	0.53	0.45	0.39	0.52
n-6 PUFA	% E	5.1	4.4	5.8	5–8	5.0	4.4	5.8	5.2	4.4	5.9
TFA[j]	% E	0.20	0.16	0.26	<1	0.20	0.15	0.27	0.21	0.16	0.26
Cholesterol	mg	258	168	365	<300	252	157	360	266	177	371
Carbohydrates	% E	60.3	57.2	63.8	55–75	60.6	57.6	64.3	60.0	56.9	62.8
Total fibre	g	50	40	65	>25	48	38	61	51	41	68
Total sugars	% E	19.8	17.4	22.6	<10	20.2	18.2	22.9	19.3	16.6	22.2
Vitamin B_{12}	µg	5.9	3.1	10.8	2.0	5.8	2.9	10.7	5.9	3.1	10.8
Folate	µg	658	515	866	320	629	497	851	677	545	891
Vitamin C	mg	285	215	370	F: 60; M: 75	288	219	377	283	208	359
Vitamin D	µg	4.4	2.7	6.2	10	4.2	2.6	5.7	4.5	3.0	6.4
Calcium	mg	1406	1112	1729	F: 800 (19–50 y), 1000 (51–70 y); M: 800;	1387	1078	1748	1421	1126	1708
Iron	mg	30	24	40	F: 8.1 (19–50 y), 5 (51–70 y); M: 6.	28	23	38	31.6	24.0	41.0
Magnesium	mg	636	510	824	F: 255 (19–30 y), 265 (30–70 y); M: 350	599	478	799	650	541	847
Zinc	mg	13.3	10.2	16.6	F: 6.8; M: 9.4	11.9	9.4	15.8	14.5	11.5	17.3
Salt	g	10.1	7.9	12.7	<5	9.7	7.8	12.1	10.7	8.0	13.3

Abbreviations: F, female; M, male; MUFA, monounsaturated fatty acids; *n*-3, omega-3 fatty acids; *n*-6, omega-6 fatty acids; PUFA, polyunsaturated fatty acids; SFA, saturated fatty acids; TFA, trans fatty acids.

[a]Macronutrients: ranges of population nutrient goals; Micronutrients: estimated average intake (EAR).

[b]P25: 25th percentile and P75: 75th percentile.

[c]Estimated calorie needs per day, by sex, regardless of the physical activity level, for adults (18–59 years old), according to the Dietary Guidelines 2015–2020, defined by USDHHS and USDA (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015).

TABLE 5 Contribution (%) of food groups to energy and macronutrient intakes of 486 adult urban Kenyans

	Nutrients										
	Energy	Protein	Total fat	SFA	MUFA	PUFA	Cholesterol	Carbohydrates	Dietary fibre	Sugars	Salt
Food group	Median (P25–P75)[a]	Median (P25–P75)	Median (P25–P75)	Median (P25–P75)	Median (P25–P75)	Median (P25–P75)	Median (P25–P75)	Median (P25–P75)	Median (P25–P75)	Median (P25–P75)	Median (P25–P75)
Cereals and grain products	34.0 (27.6–40.8)	23.3 (18.4–29.8)	19.7 (14.3–26.3)	11.8 (8.3–16.7)	15.4 (10.6–21.1)	38.8 (28.9–49.7)	0.05 (0.00–0.16)	42.5 (35.1–49.2)	26.7 (19.8–33.7)	14.7 (10.4–20.4)	32.7 (26.0–41.2)
Vegetables	5.2 (4.0–6.6)	7.8 (6.0–9.8)	1.1(0.8–1.6)	0.32 (0.20–0.46)	0.18 (0.13–0.26)	1.1 (0.7–1.6)	0.0 (0.0–0.0)	7.3 (5.6–9.5)	17.2 (13.0–22.9)	8.0 (5.5–10.8)	14.9 (10.4–19.2)
Legumes, pulses, seeds and nuts	8.0 (4.7–12.1)	10.7 (6.2–17.2)	6.9 (3.0–11.5)	3.1 (1.4–5.6)	6.6 (3.0–12.3)	10.3 (5.2–17.6)	0.0 (0.0–0.0)	7.7 (4.1–11.7)	19.8 (11.2–28.4)	1.4 (0.8–2.3)	13.2 (7.4–21.2)
Fruits	9.7 (6.2–14.0)	4.0 (2.4–6.1)	7.2 (1.9–15-40)	4.4 (0.9–10.0)	11.2 (0.9–24.3)	6.1 (1.9–12.6)	0.0 (0.0–0.0)	12.4 (8.3–17.6)	21.7 (12.7–29.0)	23.2 (15.5–31.8)	0.04 (0.0–0.15)
Meat and eggs	8.8 (5.9–12.7)	22.0 (12.2–29.4)	18.2 (12.7–25.6)	20.4(13.8–27.7)	23.7 (15.8–32.1)	9.8 (6.5–13.8)	74.0 (61.6–82.0)	0.39 (0.17–0.85)	0.13 (0.0–0.33)	0.22 (0.11–0.34)	5.20 (2.9–8.4)
Fish	0.7 (0.2–1.7)	2.4 (0.8–5.4)	1.0 (0.1–2.4)	0.3 (0.0–0.6)	0.0 (0.0–0.0)	0.0 (0.0–0.0)	0.4 (0.0–1.0)	0.18 (0.0–0.43)	0.07 (0.0–0.1)	0.0 (0.0–0.0)	0.50 (0.0–1.0)
Dairy	8.3 (5.3–11.6)	11.7 (7.9–16.4)	13.6 (9.01–19.18)	10.4 (4.57–19.9)	10.8 (7.12–15.7)	3.05 (1.89–4.70)	16.2 (10.3–25.3)	1.79 (0.7–3.7)	0.0 (0.0–0.0)	13.3 (8.6–18.3)	4.2 (2.7–6.2)
Fats and oils	0.44 (0.0–0.99)	0.0 (0.0–0.0)	1.6 (0.0–3.6)	2.5 (0.0–5.7)	1.8 (0.0–4.3)	0.69 (0.0–1.8)	0.16 (0.0–0.41)	0.0 (0.0–0.0)	0.0 (0.0–0.0)	0.0 (0.0–0.0)	0.12 (0.0–0.30)
Sauces, seasonings, flavourings	0.36 (0.12–0.88)	0.07 (0.02–0.25)	0.04 (0.0–0.64)	0.002 (0.0–0.37)	0.015 (0.0–0.84)	0.003 (0.0–0.93)	0.0 (0.0–0.0)	0.45 (0.13–1.0)	0.034 (0.003–0.12)	0.43 (0.08–1.5)	0.8 (0.02–6.78)
Sugar, syrups, sweets and snacks	9.8 (6.0–13.7)	2.4 (1.3.4.2)	11.0 (5.6–16.7)	15.2 (8.6–23.7)	10.5 (5.1–16.1)	7.4 (3.6–11.6)	4.8 (1.8–10.0)	10.8 (6.9–14.8)	1.6 (0.8–3.0)	20.8 (13.6–29.3)	4.4 (2.3–6.9)
Soft and carbonated beverages	1.0 (0.4–2.5)	0.0 (0.0–0.09)	0.0 (0.0–0.0)	0.0 (0.0–0.0)	0.0 (0.0–0.0)	0.0 (0.0–0.0)	0.0 (0.0–0.0)	1.9 (0.7–4.4)	0.0 (0.0–0.36)	5.8 (2.3–13.0)	0.2 (0.08–0.54)

Abbreviations: MUFA, monounsaturated fatty acids; PUFA, polyunsaturated fatty acids; SFA, saturated fatty acids.
[a]P25–P75: 25th Percentile–75th Percentile.

For older people, cereals and grain products were a slightly less important source of most of the nutrients, except for carbohydrates and sugars, than for younger people while legumes, pulses, seeds and nuts were a more important source of fibre and PUFA and fruits, rather than sugars, syrups, sweets and snacks, were a more important source of sugars.

Having a stable job did not seem to influence food sources other than for the contribution of sugars, syrups, sweets and snacks to total fat, which was more important in students, the unemployed and casual employees. Higher contributions from dairy foods to total fat and cholesterol were associated with having higher BMI. No other associations between food sources and BMI or marital status were found.

DISCUSSION

This survey assessed the adequacy of the diets of a sample of adult Kenyans from Nairobi. The importance of various food groups as contributors to energy and nutrient intakes and how this varied according to several demographic characteristics was also examined. It is important therefore to consider how representative the survey sample was of the Nairobi population.

Sample characterisation

The sample was drawn from different clusters, based on local knowledge about the demographic profile of each specific area, to attempt to achieve a representative sample of the Nairobi adult population. Although no question about income level (apart from a question about education level) was included in the general questionnaire, a broad selection of wards was surveyed to achieve a balanced representation of the different socio-economic classes. Nevertheless, the authors recognise that lower socio-economic classes might be under-represented when compared to the population of Nairobi as a whole. Main differences include the proportion with primary education (49% in Nairobi County vs. 11% in the present study, for people with no or primary level education), of unemployed people (11% in Nairobi County vs. 5% in the present study) and of large families (31% in Nairobi County vs. 11% in the present study).

Regarding lifestyle habits, smoking was very infrequent, and exercising very common. Walking was included as physical exercise since it fits the concept determined by the WHO (World Health Organization, 2020) and it was done on a daily basis for more than 50 min on average. In Nairobi, many people walk to work. The low prevalence of smoking and the high level of activity of participants could be due to the young age of the sample. As stated in the *DHS 2014*, the practice of smoking increases with age and it is more common among men with no education (Kenya National Bureau of Statistics, 2015). Also in this report, it was demonstrated that people aged below 29 years old, specially between 15 and 24 years old, are more likely to have longer physical activities. The low reported prevalence of chronic diseases might be underestimated, due to the self-reported nature of these data. According to the *DHS*, the prevalence of overweight and obesity among Nairobian women is 47.8%, higher than that found in the present study (36.2%). Again, the self-reported nature of the body measurements or the younger age of the sample might explain the lower level found in this study.

In conclusion, although a comprehensive sampling procedure was carried out with the aim of gathering as representative a sample as possible in terms of socio-demographic indicators, those aged below 34 years-old and of higher socio-economic levels might be over-represented when compared to the population of Nairobi as a whole.

Comparison of energy and nutrient intakes and recommendations

The median EI was slightly above the recommendations for women, and within the guidelines for men and may reflect the tendency for overestimation when using the FFQ (Willet, 2013). Most of the sample had macronutrient intakes within recommended ranges, although nutrient intakes were above or below the recommended range for some of the sample. While the median protein intake was close to the upper limit of the recommended range, the major sources of protein were plant-based foods. However, median intakes of unsaturated fatty acids were below the lower limit of the recommended range, in particular for *n*-3 PUFA, which shows an opportunity for an increase in the consumption of unsaturated fat-rich foods. Although these results are not generally of concern, the dietary intake in this population should be monitored given the tendency for diets to increase in protein, sugar and fat with rapid urbanisation (Steyn et al., 2012). Even though the free sugars intake was not explored in this study and no global recommendation exists regarding total sugars intake, the percentage of total sugars (19.8% of TEI) was high although it is important to highlight that the main food source of total sugars are fruits. The only reference intake for total sugars was established in the United Kingdom and corresponds to 90 g/day, equivalent to 18% of TEI, considering a reference value of 2000 kcal per day (NHS, 2017). In the study of Mwenda et al. (2018), the reported total sugar intake corresponded to 13.7% (95% CI, 11.7%–15.8%), and came from carbonated drinks, biscuits, cakes, candy, chocolate, etc., all contributors to free

TABLE 6 Contribution (%) of food groups to micronutrient intakes of 486 adult urban Kenyans

Food group	Nutrients				
	Folate	Iron	Calcium	Iodine	Zinc
	Median (P25–P75)[a]	Median (P25–P75)	Median (P25–P75)	Median (P25–P75)	Median (P25–P75)
Cereals and grain products	23.0 (14.1–32.5)	27.5 (21.6–37.0)	12.1 (7.4–17.4)	2.2 (0.4–4.2)	26.1 (19.0–33.4)
Vegetables	11.6 (7.5–16.0)	19.6 (12.5–31.3)	28.5 (20.0–40.7)	0.02 (0.0–0.02)	4.8 (3.3–6.8)
Legumes, pulses, seeds and nuts	16.4 (8.7–27.2)	15.4 (8.13–23.9)	4.7 (2.5–8.8)	0.18 (0.48–1.3)	9.8 (5.6–15.4)
Fruits	12.1 (7.5–18.0)	3.6 (2.1–6.0)	3.7 (2.1–5.9)	1.8 (3.5–5.9)	4.4 (2.4–7.0)
Meat and eggs	4.4 (2.2–6.8)	8.0 (5.0–12.0)	2.2 (1.4–3.2)	12.1 (5.13–20.5)	26.1 (16.6–35.1)
Fish	0.0 (0.0–0.0)	0.0 (0.0–0.8)	0.0 (0.0–0.01)	0.0 (0.0–0.0)	0.0 (0.0–0.0)
Dairy	3.4 (2.1–5.2)	0.90 (0.58–1.41)	33.4 (22.2–43.7)	77.5 (66.3–85.8)	13.3 (8.5–18.2)
Fats and oils	0.0 (0.0–0.0)	0.0 (0.0–0.0)	0.0 (0.0–0.0)	0.0 (0.0–0.0)	0.0 (0.0–0.0)
Sauces, seasonings, flavourings	0.003 (0.030–0.13)	0.03 (0.004–0.11)	0.021 (0.001–0.070)	0.0 (0.0–0.0)	0.033 (0.003–0.17)
Sugar, syrups, sweets and snacks	5.5 (2.6–10.0)	3.7 (1.8–5.8)	3.4 (1.7–5.5)	0.0 (0.0–2.34)	1.9 (0.9–2.9)
Soft and carbonated beverages	0.0 (0.0–0.06)	0.0 (0.0–0.15)	0.0 (0.0–0.11)	0.0 (0.0–0.0)	0.0 (0.0–0.03)

[a]P25–P75: 25th Percentile - 75th Percentile.

sugars. Dietary fibre intakes are high and might be overestimated, since FFQs are prone to overestimate dietary intake (Willet, 2013), as mentioned above. Nevertheless, calculating the ratio of fibre per 1000 kcal, the median consumption is about 17 g of fibre/1000 kcal, which is closer to the American recommendations (14 g/1000 kcal; U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015). Still, this indicates that Kenyans have a reasonable fibre intake.

Iron and zinc intakes, micronutrients typically problematic in developing countries (Harambee Ministry of Health, 2011), appear to be adequate although there may be some overestimation of dietary intake. On the other hand, there was a high prevalence of inadequate vitamin D and vitamin B_{12} intakes in this study. Vitamin D intake can be a concern among Kenyans, since food sources rich in vitamin D, such as salmon, mushrooms or fortified foods, are not common in the Kenyan diet. Also, the most common sources of vitamin B_{12} are animal-based, which are less frequently consumed among the studied sample, and consequently may explain those results.

There are few studies carried out in Nairobi evaluating the dietary intake of the urban adult population, including both women and men with which to compare these findings. It is more common to analyse the nutritional intake of low-income or rural areas (Beatrice, 2009; Dominguez-Salas et al., 2016; Hansen et al., 2011; Jayne, 2011; Long et al., 2011; Van't Riet et al., 2002; Wanjihia et al., 2009) and in population groups such as children and women (Gegios et al., 2010; Gewa et al., 2007, 2009, 2012; Kamau-Mbuthia & Elmadfa, 2007; Long et al., 2011; Mala et al., 2012; Mwaniki & Makokha, 2013; Stephenson et al., 2010; Steyn et al., 2011, 2012; Steyn & Nel, 2006; Walingo & Musamali, 2008; Walton et al., 2012; Waudo et al., 2005), normally targeted because they might be disadvantaged in household food distribution.

Contribution of food groups to energy and nutrient intakes

The results from this study are in general agreement with the Kenyan food balance sheet, which shows that plant-based products contribute between 86% and 88% of total energy, being the most important daily per capita supply of calories (Kenya National Bureau of Statistics, 2019). The food group meat, fish and eggs was separated for this analysis (fish was considered an individual group), since it was observed that the consumption of fish was low. Interestingly, other researchers have found that a specific rural ethnic group had a higher contribution from fish to TEI (7%), showing that dietary intake and habits vary according to region and population type (Hansen et al., 2011). The sugars,

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syrups, sweets and snacks group make a high contribution to total EIs, of around 10%.

The contribution to carbohydrates from the cereals and grains group was mainly from maize products, namely ugali and porridge, as well as rice, potatoes and wheat products, such as chapati and bread, as also found by other researchers (Steyn et al., 2012; Waudo et al., 2005). Ugali and chapati are very popular in the Kenyan diet, being eaten as a main course, while bread is mostly consumed at breakfast time. The high consumption of fruits and their contribution to energy and carbohydrates intakes might be due to their availability in street markets, where they are usually sold in individual portions (even watermelon and pineapple) making their consumption easier, even at the point of buying.

The most important food sources of protein were cereals and grains, meat and eggs and dairy. In Nairobi city centre, the availability of fish is not great, and it is more expensive than meat, which might be one reason for its low consumption and reduced contribution to protein intake. Dairy products, other than milk, were poorly consumed, and consequently the contribution to protein from dairy foods was mainly from milk. Even though the recruited sample lives in an urban setting, products such as yogurts and cheese are not very popular due to their higher price, compared with staple foods.

At first glance it might be unexpected that cereals and grain products are one of the main contributors to total fat, however, this group includes cooked food, and so added fats are included. The contribution of meat and eggs to the three types of fats (more to SFA and MUFA and less to PUFA) might suggest that the sample had a higher consumption of red meats rather than white meats. Higher fish consumption would be desirable given the well-recognised benefits from fish fats, specifically the omega-3 PUFA (Shahidi & Ambigaipalan, 2018). The contribution from dairy foods to fats would be reduced if the consumption of low-fat dairy options were more common among Kenyans.

Respondents had a high contribution from sugars to TEI of almost 20%. Besides fruits, the sugars, syrups, sweets and snacks group was the other main food group contributor to sugars intake. This indicates that this sample had a high consumption of sugary products, and consequently, that the intake of free sugars (World Health Organization, 2015) might have been high. Regarding salt consumption, besides the salt used for cooking, nuts and groundnuts might have been one of the main contributors to salt intake, since they are sold as a salty snack in Nairobi, a trend which was also found by other researchers (Steyn et al., 2012). Mwenda et al. (2018) concluded that despite possessing a general awareness (more than 88% of the sample) about the health risks derived from the consumption of dietary sugar and salt, almost 50% of the respondents were not implementing any strategies to reduce their intake of both sugar and salt. The current results could act as an incentive to national authorities to implement nutritional strategies aimed at the reduction of sugar and salt, and their main sources. For example, this could include the creation of legislation identifying maximum levels of sugar/salt in specific foods towards the development of healthier products, as well as the promotion of awareness concerning the health risks associated with the consumption of such food products. In this sense, and according to the national Nutrition Action Plan 2018–2022, efforts are being taken by the Ministry of Public Health and Sanitation (Ministry of Public Health and Sanitation, 2018).

The important contribution of vegetables to calcium intake was also demonstrated by other authors (Jayne, 2011; Steyn et al., 2012; Waudo et al., 2005). Specifically, kales and spinach are a good source of calcium, while more traditional vegetables such as spider weed (*Sargiet*) and cowpeas leaves (*Kunde*), are excellent sources of iron and calcium although their bioavailability is lower from these foods. Since sugars, syrups, sweets and snacks group makes a high contribution to total energy but provide negligible amounts of vitamins or minerals, efforts to reduce the consumption of these high-energy-dense and nutritionally poor foods should be made.

Food sources of nutrients and demographic characteristics

An in-depth analysis of food sources and their association with demographic characteristics was carried out. To the best of the authors' knowledge, this is the first study that explores these associations in adults living in an urban setting of Nairobi.

Diets of less educated people were nutritionally poorer and less diverse compared with those of more educated people and going to university is associated with having healthier food habits. Higher levels of education might be indicative, not only of belonging to a higher social class, and consequently having an increased purchasing capacity, but also of possessing a greater knowledge and awareness about the food–health relationship.

The results might suggest that younger people have less healthy options for food sources of carbohydrates, sugar and fat, since they were more likely to consume sugars, syrups, sweets and snacks than older people. *Mandazi*, a traditional deep-fried bread very typical in Nairobi, was frequently consumed among the respondents (75% of this sample [n = 382] mentioned its consumption during the previous month). This snack, which is normally consumed together with tea, is sold in canteens and in the streets at a low price, and for that reason, it is more available to students and people with less purchasing capacity.

TABLE 7 Adjusted odds ratio (OR) of having higher or lower consumption of specific food groups, according to the adult urban Kenyans' characteristics (n = 459)

Predictor	Sex[a] (male)		Education level[b] (tertiary)		Occupation[c] (self/formally employed)		Marital status[d] (married)		Daily energy intake (DEI)[e] (P25<DEI<P50)		Daily energy intake[e] (P50<DEI<P75)		Daily energy intake[e] (DEI>P75)		Age		BMI	
Food group	Adjusted OR[f]	95% CI	Adjusted OR	95% CI	Adjusted OR	95% CI	Adjusted OR	95% CI	Adjusted OR	95% CI	Adjusted OR	95% CI	Adjusted OR	95% CI	Adjusted OR	95% CI	Adjusted OR	95% CI
Cereals and grain products	1.95*	1.26–3.02	0.51*	0.33–0.80	0.96	0.55–1.68	1.87*	1.14–3.06	3.85**	2.04–7.26	6.55**	3.41–12.55	22.92**	11.30–46.48	0.98	0.95–1.01	0.98	0.92–1.03
Vegetables	0.57*	0.38–0.85	1.35	0.92–2.00	0.70	0.43–1.16	0.92	0.60–1.41	0.93	0.55–1.60	2.47**	1.41–4.31	2.79**	1.61–4.86	1.02	0.99–1.05	1.02	0.97–1.07
Legumes, pulses, and nuts	0.93	0.61–1.40	0.95	0.63–1.42	0.76	0.45–1.29	1.00	0.64–1.58	2.55**	1.44–4.53	4.54**	2.51–8.22	9.41**	5.08–17.46	1.05**	1.02–1.08	0.98	0.93–1.03
Fruits	0.63*	0.41–0.96	1.27	0.84–1.90	1.42	0.84–2.40	1.18	0.75–1.85	1.49	0.86–2.60	2.83**	1.59–2.03	9.46**	5.07–17.64	1.02	0.99–1.05	1.03	0.98–1.08
Meat and eggs	1.14	0.74–1.74	1.37	0.90–2.08	1.68	0.98–2.88	0.72	0.45–1.14	3.37**	1.85–6.14	7.00**	3.76–13.06	14.45**	7.53–27.73	0.99	0.97–1.02	1.03	0.98–1.09
Dairy	0.84	0.56–1.25	2.24**	1.50–3.33	0.92	0.55–1.52	1.01	0.65–1.57	1.60	0.92–2.79	3.71**	2.08–6.60	4.65**	2.62–8.26	1.00	0.98–1.03	1.02	0.98–1.03
Sugar, syrups, sweets and snacks	0.78	0.50–1.21	1.21	0.79–1.86	0.59	0.34–1.03	0.87	0.54–1.38	3.64**	1.97–6.72	7.61**	3.97–14.57	13.94**	7.18–27.09	0.94**	0.91–0.97	1.02	0.97–1.08

*OR and 95% confidence interval are statistically significant (p < 0.05).; **OR and 95% confidence interval are statistically significant (p < 0.001).

[a]Reference category: female.

[b]Reference category: none, primary and secondary grouped.

[c]Reference category: Unemployed, student and casual labourer grouped.

[d]Reference category: single, widow, divorced grouped.

[e]Reference category: DEI < P25.

[f]Odds Ratio (OR) adjusted for sex, education level, occupation, marital status, total energy intake, age and BMI.

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Strengths and limitations of the study

This study carried out a dietary assessment never previously conducted in Kenya and will be useful for future dietary interventions in this population. The results obtained not only provide an improved understanding of the potential impact of food product reformulation, an important current recommendation, but also enable the targeting of nutritional education interventions at different population groups. Nevertheless, this study had some limitations. Lower socio-economic classes are likely to have been under-represented in the sample compared to medium and high socio-economic classes, and so particular food groups, foods or even nutrients, which are more characteristic of this population segment, might be under-represented. In what concerns alcoholic beverages consumption, it might be underestimated, given its low contribution to TEI (0.5%). This can be related with embarrassment of the respondents in assuming to drink alcohol, especially women. It would have been desirable to have obtained the anthropometric profile with actual measurements, instead of the self-reported values, because Kenyans do not monitor their bodyweight, which renders the values less reliable. Moreover, more reliable and detailed information regarding physical activity would have been useful to explore associations between diet and physical exercise levels. The use of a FFQ to assess diet usually tends to overestimate nutrient intake, which should be taken into consideration when analysing the present results. Additionally, it would have been desirable to have used a national food nutritional software database containing foods normally eaten in Kenya, such as Nutrisurvey, but this was not up to date which could have impaired the quality of data. Also, the large amount of statistical testing to study the associations between food sources and participants' characteristics might increase the likelihood of false positive findings, especially since the adjustment for multiple testing was not carried out. As previously discussed (Vila-Real et al., 2020), some difficulties were found in the estimation of the amounts consumed of certain types of foods. Vegetables was the most critical food group, mainly because Kenyan people do not eat a single vegetable at a time, but a mix of several types. Moreover, the estimation of meat portions (mainly beef and pork) was challenging in some cases, mostly because meat such as beef is not commonly eaten in large pieces, but in small pieces in mixed dishes. In consequence, portion size estimation was hampered. Another particularity of the Kenyan population that might have influenced portion size estimation is the fact that in some places, even in urban areas, people share a big plate, or a bowl, instead of having their own serving plate.

CONCLUSIONS

This study has shown that the dietary intake of urban adult Kenyans is in accordance with WHO/FAO macronutrient guidelines. Nevertheless, it revealed that the Kenyan diet is high in sugar and that sugars, syrups, sweets and snacks were one of the major contributors to total EI, carbohydrates, sugars and fats, in women, students and unemployed people. Cereals and grain products were the main contributor to energy and all macronutrients, especially in men, younger people and people with lower EIs. The contribution of meat and eggs to protein and total fat was much higher than for fish, and people with higher levels of education had higher contributions from this food group and from dairy for both nutrients. Nevertheless, a considerable proportion of protein intakes came from plant sources. Dietary fibre intakes were high and came from different food groups, with a major contribution from cereals and grain products for men, people with lower EIs and older people, from vegetables for women, people with a higher education level, and with lower EIs and from fruits for women and people with higher EI.

The information generated in the present study can act as an incentive to the formulation and implementation of nutritional interventional strategies, by national authorities, aiming the improvement of the dietary habits and, consequently, the nutritional profile of Kenyan adults, towards the reduction of non-communicable disease prevalence.

AUTHOR CONTRIBUTIONS

The authors' contributions are as follows: C. Vila-Real, A. Pimenta-Martins, E. Pinto, A. Gomes, N. H. Maina and K. Katina contributed to the study design. C. Vila-Real carried out the data collection and conducted the fieldwork, computed and analysed data, and wrote the manuscript. E. Pinto and A. Gomes also contributed to the decision-making process during data collection, interpretation of the findings, data analyses and writing of the manuscript. C. Kunyanga and S. Mbugua facilitated the selection of interviewers and fieldwork logistics. All authors read and approved the final version of the manuscript.

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CONFLICT OF INTEREST

No conflicts of interest to report.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICAL APPROVAL

The Institute for Bioethics, of the Universidade Católica Portuguesa (Catholic University of Portugal) approved the study protocol (Ethics Screening Report [ESR] 12/2014), all participants were informed about the objectives of the study, and those who agreed to participate in the study, provided written informed consent according to the Declaration of Helsinki of the World Medical Association.

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SUPPORTING INFORMATION

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

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