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Secondary School Food Environment and Purchase Choices of Adolescents in Mbeya City

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Abstract

Background: Increasing levels of overweight and obesity among adolescents are quite alarming worldwide. Among the depicted causes is poor diet, in which the food environment plays a major role in contributing. Still, little is known about adolescents and the school food environment they are exposed to in Tanzania.

Objective: This study aimed to explore the secondary school food environment and document food and drink mostly purchased by secondary school adolescents

Methodology: This cross-sectional study involved 8 secondary schools in Mbeya City, 384 secondary school adolescents and 35 food outlets. Aspects of the food environment studied were under the external domain, food availability, price and promotion and policy and guideline. Personal domain: accessibility, affordability and desirability. Direct observation was used in food outlets with the help of an observation tool adopted from the Nutrition Environment Measure Survey. Structured interviews were done with the school administrators or teachers responsible for nutrition issues in school with the help of a questionnaire designed based on WHO Nutrition Friendly Schools Initiative**.** Also, a student purchased a recall questionnaire designed based on the Nutrition Environment Measure Survey, which also helped identify the adolescents' demographic characteristics. Descriptive statistics and ordinal logistic regression were used to establish prevalences and associations between variables.

Results: Most available food outlets outside the school were retail shops and canteens inside the schools. The foods most purchased by adolescents are sweets, fried snacks, and sugar-sweetened beverages. Most adolescents purchase their food and drinks in school shops and canteens. Cereal-based foods are most available, while fruit and vegetables are least available inside and outside school. Adolescents care most about taste and least about nutrition and weight control while purchasing food and drinks. Demographic characteristics like age, level of education, and the type of school adolescents attend are associated with purchasing certain foods.

Conclusion: Secondary schools have weak policies and guidelines on the food environment, and they are filled with ultra-processed foods, fried snacks, and sugar-sweetened beverages. Adolescents respond to their environment by purchasing what is most available. Adolescents' responses depend on their age and the school type, either public or private. This situation calls for effective planning and interventions from the national to the institutional/school levels to ensure a nutrition-enabling environment is created in secondary schools.

Introduction

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Increasing levels of overweight and obesity among adolescents are quite alarming worldwide, where one in five adolescents is either obese or overweight (WHO, 2020). The scenario is similar

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in Sub-Saharan countries, except that this area also struggles with undernutrition, making it double the burden of malnutrition among children and adolescents (Berhane *et al.,* 2022).
A major contributing factor causing the rise, especially among adolescents, is the shift from consuming fresh and minimal processed foods to ultra-processed foods (Venurs *et al.,* 2021). Among the factors that have been recognized to influence the consumption of these foods is the food environment, which affects societal and individual food choices (FAO, 2022). This, in turn, affects adolescents' dietary behaviours and diets (Beck *et al.,* 2019).

The food environment is built on the understanding and acknowledgement that people are exposed to various choices in obtaining and consuming food. (Pacific *et al.,* 2020)It has been defined as the interface that mediates people's food acquisition and consumption within the wider food system. This system encompasses external dimensions such as availability, prices, vendor and product properties, and promotional information, as well as personal dimensions such as the accessibility, affordability, convenience, and desirability of food sources and products (Turner *et al.*, 2017).

It has been reported that a significant part of the diet of millions of adolescents is consumed at schools during school hours. (FAO, 2022). At the same time, adolescents in different countries have been reported to be exposed to high-fat, high-sugar, high-salt, energy-dense, and micronutrient-poor foods, which has contributed to the rise of obesity (WHO, 2021). This can be explained as a response to the two-way relationship between food environment and dietary behaviour(Pacific *et al.,* 2020)In different countries, some secondary school adolescents eat lunch prepared and sold within schools (Stevens et al., 2013). Other adolescents bring food and drink from home to consume at school, whereas some purchase and consume food or drink from local retailers around school. Some go home to eat lunch, while others do not eat or drink during school hours (Tugault-Lafleur & Black, 2020).

School food environment is the spaces, infrastructure and conditions within and beyond school premises where food is available, obtained, purchased and consumed (FAO, 2019). School Food environment consists of several types of retail food establishments present within and around schools. Characteristics of the school food environment include targeted marketing, availability and access to unhealthy food, which contribute to the school environment being unhealthy. This, consequently, influences the nutritional status of adolescents. (da Costa Peres *et al*., 2020; Gewa *et al.*, 2021).

For adolescents, these elements of the food environment led to a greater preference for foods with low nutritive value and ultra-processed foods (Popkin & Reardon, 2018). At the same time, these dietary patterns are believed to underlie the nutrition transition and double the burden of malnutrition in many Low-middle-income countries (International Food Policy Research Institute, 2017). That is why, in different countries, it has been suggested that comprehensive interventions should be conducted to improve the school food environment to prevent the double burden of malnutrition (Mukanu *et al.,* 2022; High-Level Panel of Experts, 2017; WHO, 2016).

However, the degree of choices adolescents experience means that policymakers and program planners must understand the food purchased and consumed inside and outside schools and the factors relating to these practices. This will develop effective intervention strategies and improve the nutritional status of the adolescents (Wills *et al.,* 2019). Therefore, this area of research has established a gap in many countries (Franca *et al.,* 2022). Research topics concerning adolescents are still evolving in Tanzania because little is known about them. Although there is information on food consumption and nutrition status (John *et al.,* 2021), information on the food environment is scarce, especially about the secondary school food

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environment. Therefore, this study aimed to explore the school food environment and document foods and drinks mostly purchased by secondary school adolescents.

Methodology

Study design, area and participants

A cross-sectional study was conducted in Mbeya City. Mbeya City covers a total area of 222 sq. Km, 46.4% of this area is under agriculture, and 53.6% is used for other uses, which include settlements, forestry, valleys, and mountain ranges. Mbeya City Council has a total population of 385,279 inhabitants, of which 182,620 (47%) are male and 202,659 (53%) are female. The city is considered a highland characterized by a mode climate and sufficient rainfall, with major economic activities such as commerce and trade, agriculture and livestock keeping, small-scale and large-scale production, and service provision (MCC, 2018). It has 36 wards and 51 secondary schools (23 private schools). It is in the region with high levels of stunting and among leading regions with high levels of overweight and obesity among adolescents (John *et al.,* 2021).

The study involved male and female adolescent students, ages 14 to 19 years (WHO, 2016), who attended ordinary-level (From 1 to 4) secondary schools in private and public schools. Multistage sampling was conducted, and four wards in Mbeya city were purposively selected to have both private and public schools on both days. Schools in each selected ward were clustered into private and public schools. One private and public day school was randomly selected in each ward, which resulted in 8 schools being recruited in the study. 48 students were stratified and randomly selected from form one to form four in selected schools by considering forms/grades and sex. Kothar's formula (kothar, 2004) was used to calculate the sample size. A total of 384 students participated in the study. Participating schools and subjects were given codes to maintain anonymity and confidentiality.

Data collection

Socio-demographic and food environment characteristics were assessed using structured interviews and direct observation.

Food environment

Two domains of the food environment, external and personal domains, were explored in this study.

External domains of the food environment

The availability of foods, prices, marketing, and regulations were explored in this domain, including the availability of different food groups and varieties of food items under each food group sold in food outlets. Another aspect is the price of food items under the food groups. Also, promotional activities and advertisements to promote food purchasing. This was observed inside and outside schools and food outlets. Google Earth was used to find approximate coverage of 800m from the selected schools (Figure 1), and the physical survey was done to recruit the food outlets around the school by considering that they are visited frequently by students of the neighbouring participating schools. A total of 35 food outlets located inside and outside 8 participating schools were studied. Food ‘outlets’ were defined as any shop/place selling foodstuff, including grocery stores, food vendors of take-out foods, minimarkets, supermarkets,

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bakeries, milk kiosks or restaurants. Then, structured observation was done with the help of the store observation tool adapted from the Nutrition Environment Measures Survey (NEMS, 2010). This was used to assess availability, prices and promotion.

The last aspect under external domains was policy and guidelines governing the food environment inside and around schools. Three aspects were considered. First was the recommended package of school-based nutrition services. In this aspect, food vendor guidelines/regulations, physical activities packages, WASH infrastructure/ practice packages, School feeding program packages and dietary guidelines availability were considered. The second aspect was whether nutrition is taught in school or not. Then, Nutrition and WASH Services, whereby this study focused on school feeding services, clean water availability, toilet cleanliness and repair services. Also, are the services offered daily, per term, when needed, or never? Data were collected with the help of structured interviews with the school's nutrition teacher or a teacher who is an expert or responsible for nutrition issues. The questionnaire was designed based on the WHO Nutrition Friendly Schools Initiative (WHO, 2020).

Personal domains of the food environment

The domains in focus were accessibility, affordability and desirability. The aspects studied were as follows: a place where food outlets are located either inside or outside the school and purchasing power, assessed using student allowances. Lastly, attitude on taste, nutrition, cost, convenience and weight control when purchasing food. This was done with the help of structured interviews guided by purchasing a recall questionnaire designed based on the Nutrition Environment Measures Survey (NEMS, 2010). Also, participants were given a list of 54 foods normally sold in food outlets to assess food items most purchased among students. Whereby during interviews, Nutrition was defined as the study of nutrients in food, how the body uses nutrients, and the relationship between diet, health and disease (Beauman *et al.*, 2005). Convenience was defined as a quality of food that makes it easy to be consumed by reducing amount of time and work required to consume or prepare it.

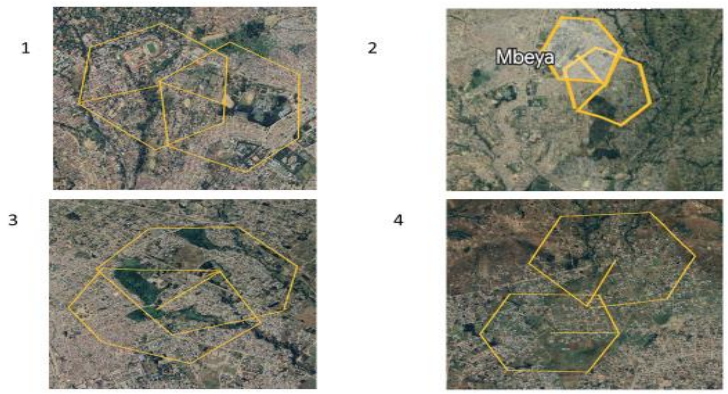

Figure 1: Approximate Coverage Area (800m) Around school obtained from Google Earth

Data analysis

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A statistical package for social sciences (SPSS version 21) was used for the data analysis. Data were presented as numbers, frequencies and percentages. Descriptive statistics were used to analyse the food environment's demographic characteristics and external and personal domains. Ordinal logistic regression was used to test the association between socio-demographic characteristics (independent variable) and most food and drink purchases (dependent variable) among adolescents. All p-values were significant at $p<0.05$

Ethical clearance

Ethical clearance was sought from the National Health Research Ethics Sub-Committee (NatHREC) of the National Institute for Medical Research (NIMR), Tanzania, with the reference number NIMR/HQ/R.8a/Vol.IX/4315. Permission to conduct this study was also sought from relevant authorities, including the Regional Administrative Secretary to District Executive Directors and respective school authorities. The purpose of the study was well explained to the school administrators, students, and caregivers (staff or teachers responsible for meals) before commencement. Assent was sought from students, and their caregivers signed the consent form. The school administrators signed consent forms for their schools and caregivers' consent for the students under 18 years, while students aged 18 years and above signed their consent forms after they all agreed to participate in the study. Consent was sought from food vendors, and they signed consent forms after the study was explained to them well. Confidentiality of the information obtained was assured, and participation was voluntary.

Results

384 students from eight secondary schools (four private and four public schools) participated in this study. Of these, 195 (50.8%) were female and 189(49.2%) were male. The age of respondents at recruitment ranged between 14 and 19 years, with a mean (±SD) of 15.5(±1.2). Half (50%) of the participants were from private schools and the other half (50%) from public schools. On the level of education, 101 (26.3%) students were in form one, 88(22.9%) were in form two, 98(25.5%) were in form three and 97(25.3%) were in form four. Food purchasing among adolescents was characterised by deep-fried buns being the most (100%) bought food among adolescents, being in the top ten list of most bought foods, and potato chips being last in the list (51.4%) **(Table 1).**

Personal domains of the food environment

Three aspects were studied. First, affordability, where most adolescents (70.8%) had school allowances ranging from 500-1500TZS. Another aspect was desirability; it was observed that among adolescents' taste was the most somewhat or very important considered (84.9%) factor while purchasing food items, and the least considered factors were nutrition (48.4%) and weight control (40.0%) **(Table 2)**. In the case of accessibility whereby, there was a difference in the availability of food outlets inside and outside schools. Canteens are the most available food outlets (42.1%) inside schools, and retail shops are the most available food outlets (38.9%) outside schools **(Table 3)**. Most students accessed food from the school canteen and shops **(Figure 2**).

External Domains of Food Environment

Under the availability domain, results showed that cereal-based foods were the most available food items (74.2%) in food outlets, and vegetables and fruits were the least since 80.0% and 82.9% of food outlets were not selling vegetables and fruits, respectively. Another aspect was price, where the food group with the highest price was drinks (3500TZS), and the lowest was

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snacks and fruits, with a price of 50TZS. Regarding Advertisement and promotion, the only promotion activities done among food outlets was to provide an option to ask for ½ portion or reduced portions for reduced value **(Table 4).**

The last aspect of external domains studied was policy and guidelines. We focused on three aspects studied: firstly, a recommended package of school-based nutrition services, and in this aspect, all schools had food vendor guidelines/regulations, physical activities packages, WASH infrastructure/ practice packages, and school feeding program packages. However, none had a dietary guideline. The second aspect is that all schools taught nutrition, and the topics covered were physical activities, hygiene, and healthy eating practices. However, no topics related to unhealthy foods and beverages were covered. Third, in all schools' clean water was available daily, and toilets were cleaned daily and repaired when needed; however, none provided school feeding services **(Table 5).**

Association between demographic characteristics and most purchases among adolescents
The relationship between demographic characteristics and most food and drink purchases among adolescents was explored by testing the association between personal domains of food environment, demographic characteristics and food purchasing. Where age had a positive association with purchasing of bags (β=0.518, p=0.002), Chapati (β=0.625, p≤0.001), fried cassava (β=0.540, p=0.002), potato chips (β=0.615, p≤0.001) and Sweets (β=0.369, p=0.020). Level of education had a positive association with purchasing foods like chapati (β=1.607, p=0.004), fried cassava (β=1.913, p=0.002), potato chips (β=1.381, p=0.011) and sweets (β=1.210, p=0.019). At the same time, public schools had a negative association with purchasing of some foods like bagia (β=-0.872, p=0.001), kachori (β=-0.994, p≤0.001), potato chips (β=-0.899, p≤0.001) and processed juice (β=0.65, p=0.005) (**Table 6).**

Table 1: Socio-demographic information of the adolescents

Characteristics	N	%
Mean age (standard deviation)	15.5(±1.2)	
Type of the school of the respondent		
Public	192	50
Private	192	50
Age of the respondent		
14	109	28.4
15	96	25.0
16	95	24.5
17	61	15.9
18	22	5.7
19	2	0.5
Level of Education		
Form one	101	26.3
Form two	88	22.9
Form three	98	25.5
Form four	97	25.3

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Gender of the respondent		
Male	189	49.2
Female	195	50.8
Most bought foods and drinks among adolescents		
Deep fried buns		
Bought	358	100
Not bought	0	0
Chapati		
Bought	241	67.3
Not bought	117	32.7
Bagia		
Bought	240	67.0
Not bought	118	33.0
Kachori		
Bought	213	59.5
Not bought	145	40.5
Deep fried Cassava		
Bought	279	77.9
Not bought	79	22.1
Potato chips		
Bought	184	51.4
Not bought	174	48.6
Sweets		
Bought	294	82.1
Not bought	64	17.9
Carbonated drinks		
Bought	220	61.5
Not bought	138	38.5
Energy drinks		
Bought	191	53.4
Not bought	167	46.6
Processed juices		
Bought	217	60.6
Not bought	141	39.4

Table 2: Personal domains of food environment

Food environment aspect	n	%
AFFORDABILITY		
Purchasing power		
None	26	6.8
500-1500TZS	272	70.8
1600-2500TZS	60	15.6
>2500TZS	23	6.0
DESIRABILITY		
Attitude when purchasing food		
Taste importance	34	8.9
Not at all important	138	35.9
Somewhat important	188	49.0

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Very important		
Nutrition importance	174	45.3
Not at all important	124	32.3
Somewhat important	62	16.1
Very important		
Cost importance	79	20.6
Not at all important	174	45.3
Somewhat important	107	27.9
Very important		
Convenience importance	84	21.9
Not at all important	163	42.4
Somewhat important	113	29.4
Very important		
Weight control	203	52.9
Not at all important	94	24.5
Somewhat important	63	16.4
Very important		

Table 3: Food outlets inside and outside schools

	Type of food outlet available	(n)	(%)
	School canteen/ cafeteria	7	41.2
inside	Retail shop	2	11.8
school	School shop	4	23.5
	Food vendors (mixed foods)	1	5.9
	Food vendors (deep fried snacks)	3	17.6
	Milk kiosk	1	5.6
	Retail shop	7	38.9
outside	Food vendors (mixed foods)	2	11.1
school	Food vendors (deep fried snacks)	6	33.3
	Food vendors (fruits)	2	11.1

Table 4: external food environment in school

FOOD ENVIRONMENT ASPECTS	Number of outlets(n)	%
FOOD AVAILABILITY IN STORES		
Cereal based foods		
1-5 varieties	26	74.2
5-10 varieties	1	2.9
0	8	22.9
Starchy roots and tubers		
1-5 varieties	17	48.6
0	18	51.4
Fruits		
1-5 varieties	3	8.6
5-10 varieties	3	8.6
0	29	82.9
Vegetables		
1-5 varieties	6	17.1

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0	29	80.0
Snacks		
1-5 varieties	5	14.3
5-10 varieties	6	17.1
10-15 varieties	6	17.1
>20 varieties	1	2.9
0 varieties	17	48.9
Prepared dishes		
1-5 varieties	11	31.4
5-10 varieties	1	2.9
0	23	65.7
Beverages		
1-5 varieties	1	2.9
5-10 varieties	6	17.1
10-15 varieties	8	22.9
0 varieties	20	57.1
FOOD PRICE IN FOOD OUTLET(TZS)		
Cereal based foods		
Highest prices	3000	-
Lowest prices	100	-
Starchy roots and tubers		
Highest prices	2000	-
Lowest prices		-
Fruits		
Highest prices	1000	-
Lowest prices	50	-
Vegetables		
Highest prices	500	-
Lowest prices	200	-
Snacks		
Highest prices	3000	-
Lowest prices	50	-
Prepared dishes		
Highest prices	2500	-
Lowest prices	200	-
Beverages		
Highest price	3500	-
Lowest price	100	-
ADVERTISEMENT AND PROMOTION		
Visual advertising encouraging the purchase of sugar-added drinks or soft drinks	0	0
Yes	35	100
No		
Visual advertising encouraging the purchase of fruits, legumes and vegetables	0	0
Yes	35	100
No		
Visual advertising encouraging the	0	0

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purchase of biscuits, balls and snacks	35	100
Yes		
No	0	0
Other advertisement within and outside the store	35	100
yes		
No	0	0
Nutritional information about the products offered on the wall/or in folders available to customers	35	100
Yes	0	37.1
No	35	62.9
Option to ask for ½ portion or reduced portions for reduced value		
Yes		
No		

Table 5: Policy and Guideline Environment

	Yes (n (%))	No (n (%))
Recommended package of school based nutrition services		
Food vendor guidelines/regulation	8(100)	0(0)
Physical activities	8(100)	0(0)
School feeding program	3(37.5)	5(62.5)
WASH infrastructure/ practice	8(100)	0 (0)
Dietary guideline	0(0)	8(100)
Mandated guidelines for nutrition studies	8(100)	0(0)
Do you teach nutrition or nutrition related topics in this school?	8(100)	0 (0)
Topic covered		
Health eating practices	8(100)	0 (0)
Physical activity	8 (100)	0 (0)
Unhealthy foods and beverages	0 (0)	8(100)
Hygiene	8(100)	0 (0)
Nutrition and WASH Services		
School feeding services		
Daily	-	-
Per term	-	-
When needed	-	-
Never	8 (100)	0(0)
Clean water		
Daily	8(100)	0(0)
Per term	-	-
When needed	-	-
Never	-	-
Toilet cleaned		
Daily	8(100)	0(0)
Per term	-	-
When needed	-	-

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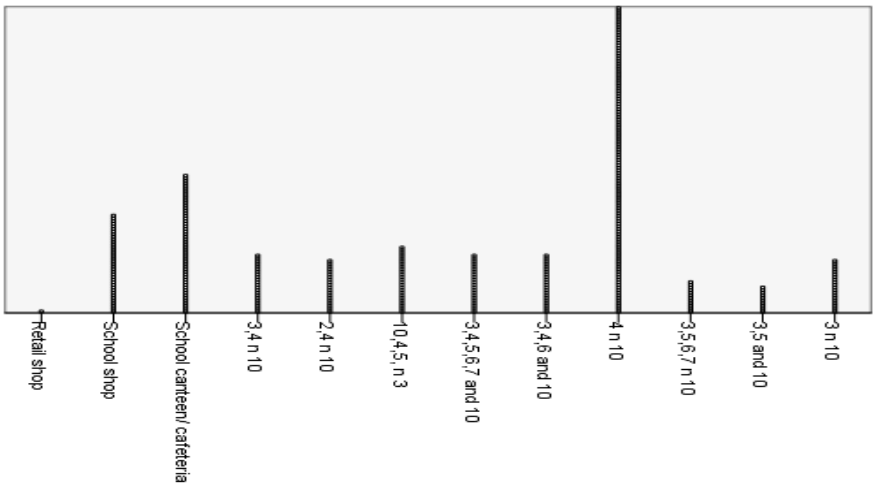
Never	-	-
Toilet repaired		
Daily	-	-
Per term	-	-
When needed	8(100)	0(0)
Never	-	-

Figure 2: Source of food among secondary school adolescents



*1-supermarket, 2-minisupermarket, 3-retail store, 4- school shop, 5- food vendors (mixed foods), 6- food vendors selling deep fried (snacks), 7- food vendors selling fruit, 8- ice cream vendors, 9-milk kiosk and 10- school canteen/cafeteria

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Table 6: Association between most bought food items and demographic characteristics and personal domain of food environment

Characteristics	Bagia	Chapati	Fried cassava	Kachori	Potato chips	Sweets	Carbonated drink	energy drink	Processed juice
Demographic Characteristics	β (CI)	β (CI)	β (CI)	β (CI)	β (CI)	β (CI)	β (CI)	β (CI)	β (CI)
Type of school									
public school	**-0.872* (-1.396-0.375)**	-0.180 (0.666-0.307)	-0.193 (-0.737-0.351)	**-0.994* (-1.455-0.533)**	**-0.899* (-1.364-0.434)**	-0.380 (-0.824-0.064)	-0.358 (-0.811-0.095)	-0.419 (-0.865-0.027)	**-0.651* (-1.109-0.193)**
private school	ref	ref	ref	ref	ref	ref	ref	ref	ref
level of education									
form 1	0.736 (-0.336-1.808)	**1.607* (0.509-2.706)**	**1.913* (0.686-3.139)**	0.321 (-0.972-1.313)	**1.381* (0.319-2.443)**	**1.210* (0.201-2.219)**	-0.413 (-1.398-0.572)	0.688 (-0.289-1.665)	-0.102 (-1.099-0.895)
form 2	**1.257* (0.348-2.166)**	**1.165* (0.233-2.097)**	**1.167* (0.119-2.214)**	0.187 (-0668-1.042)	**1.332* (0.420-2.243)**	**0.932* (0.065-1.799)**	-0.396 (-1.244-0.452)	0.467 (-0.373-1.307)	0.040 (-0.820-0.899)
form 3	-0.221 (-0.963-0521)	0.547 (-0.187-1.280)	0.787 (-0.053-1.628)	-0.041 (-0.724-0.642)	0.579 (-0.120-1.278)	0.370 (-0.295-1.035)	-0.269 (-0.937-399)	0.082 (-0.582-0.746)	0.130 (-0.554-0.814)
form 4	ref	ref	ref	ref	ref		ref	ref	ref
Age	**0.518* (0.194-0.843)**	**0.625* (0.299-0.951)**	**0.540* (0.191-0.888)**	0.080 (-0.219-0.378)	**0.615* (0.284-0.946)**	**0.369* (0.059-0.680)**	-0.101 (-0.042-0.199)	0.065 (-0.232-0.361)	-0.174 (-0.478-0.130)
Gender									
male	ref	ref	ref	ref	ref	ref	ref	ref	ref
female	0.259 (-0.0936-0.079)	-0.353 (-0.846-0.141)	-0.055 (-0.601-0.492)	-0.182 (-0.646-0.281)	-0.164 (-0.633-0.306)	0.256 (-0.194-0.707)	-0.049 (-0.508-0.411)	0.163 (-0.290-0.616)	0.276 (-0.189-0.741)

Ordinal logistic regression, p<0.05, B-Coefficient, CI-Confidence interval. Deep fried buns could not be involved since it cannot provide any results statistically since it was consumed by all adolescents.

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Discussion

The study focused on exploring the secondary school food environment in Mbeya city, where external and personal domains of the food environment were studied, including accessibility, availability, prices, marketing and regulation, affordability and desirability. Retail shops mainly surrounded schools, but adolescents' leading food sources were canteen and school shops, consistent with what has been reported in other places (Pauuvale *et al.,* 2022; Londoño-Cañola *et al.,* 2023). In terms of food purchasing, the study found that adolescents purchase mostly fried snacks, sweets and sugar-sweetened beverages like what has been reported in other studies exploring food purchasing among adolescents (da Costa Peres *et al*., 2020; Leite *et al.,* 2022; Mukanu *et al.,* 2022).

This study's external domains of the food environment have shown how much students are exposed to cereal-based food and less fruits and vegetables, as other studies have reported (França *et al.,* 2022; Mukanu *et al.,* 2022). Most of these foods were ultra-processed foods and fried foods, and they are found within school premises, which is different to what has been reported in other places where foods like these were found outside school (Wills *et al.,* 2019; França *et al.,* 2022), which shows weak policies and dietary guideline in secondary schools. That has been evident in this study since all the participating schools had food vendor guidelines; they were not specifically tailored to support a nutritious environment in schools, like what has been reported in other places (Bassi *et al.,* 2021). Also, although the schools taught nutrition-related topics, they were only in biology studies and never included healthy and unhealthy food and drinks (Reeve *et al.,* 2021).

This is because schools have guidelines for nutrition studies at the regional level but no actual mandated curriculum for nutrition studies in the country. This showed immediate effects on the adolescents by showing pictures of the top ten list of food items purchased among students, which was made of snacks, oily foods and sugar-sweetened beverages, which have also been reported by other studies (Bassi *et al.,* 2021). Results showed advertisement and promotion inside and outside the school, and food outlets was almost not existing, which shows that promotion activities in the school environment may not affect the purchasing of food around the school environment; this report different from what other studies have reported (Bassi *et al.,* 2021; Reeve *et al.,* 2021). However, it could be explained by the fact that this study did not involve promotion activities and advertisements, such as social media and Television advertisements, that happen away from the school environment but only focused on the promotion activities done inside and outside schools and food outlets.

Results also showed adolescents cared less about nutrition and weight control but taste while purchasing foods, which was also reported in other studies (Wills *et al.,* 2019; Leite *et al.,* 2022). Also, cost and convenience were some factors that were somewhat considered necessary by many adolescents, as other literature has reported (Wills *et al.,* 2019). Demographic characteristics showed an important role in food purchasing, where purchasing of some foods like bags, fried cassava, chapati, potato chips, and sweets increased with age. Bags, kachori, potato chips and processed juice were not likely to be purchased in public schools, which is unlike what has been reported that public school adolescents are exposed to more fast foods and, therefore, tend to purchase and consume unhealthy foods more than private school adolescents (França *et al.,* 2022).

This study could be explained by the variations in purchasing power among private and public-school adolescents. This is similar to what has been reported in other studies (Carmo *et al.,* 2018). Also, purchasing of chapati, fried cassava, potato chips and sweets was higher among

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lower grades/ forms compared to those in upper grade/forms, which shows their preference for some foods compared to their fellow older adolescents, which is like what has been reported (Will *et al.,* 2021).

Limitations of the study

As much as this study's novelty is relevant in the country, it has covered most aspects of the food environment and can provide a representative picture of the secondary school food environment. However, some aspects could have been captured better by incorporating more qualitative methods in data collection, especially in finding factors influencing students' food purchasing. This would enhance the view of what happens as adolescents access and consume food inside and around schools.

Conclusion and recommendation

Ultra-processed foods, fried snacks, and sugar-sweetened beverages characterise the secondary school food environment. Adolescents respond depending on their age and the type of school they attend, either public or private; they respond to their environment by purchasing what is most available. Also, schools have a weak policy environment to support an excellent nutrition-enabling environment.

Limited information about the school environment is still a hindrance in planning and executing interventions and policies that could help solve the problem of malnutrition among adolescents in Tanzania. Therefore, more research is needed to explore this area in the country. Not only that, but also, at the organisation/school level, teachers should be capacitated to deliver nutrition education and communication messages to students so they may be aware of unhealthy and healthy foods and the consequences to their nutrition and health status. This could begin with creating a mandated curriculum for nutrition studies for secondary schools and other education levels. Promotion/modification of school food policy/environment at national and school levels are obliged to set policies and laws that will guide types of foods that should be available in schools and hence promote the creation of an excellent nutrition-enabling food environment.

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