Eating Habits of High School Students in the District of Bamako in the Context of Nutritional Transition

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Abstract

Introduction: Eating habits are consolidated in early childhood and continue throughout life. Adolescence is a stage of rapid growth linked to puberty affected by the nutritional transition. This study aimed to evaluate the eating habits of high school students in the district of Bamako. **Methodology:** The cross-sectional, descriptive study was conducted from June 15 to July 4, 2023. The sample size was calculated with the StatCalc program of the Epi 7.2 software. Data was collected using a questionnaire on KoboCollect. Analyses were performed using SPSS 26 software. **Results:** A total of 2400 high school students were surveyed. The average age of high school students was 16.9 years ± 1.4. The median age was 17, with extremes of 14 and 19. Of the high school students, 53.3% were boys. The sex ratio (M/F) was 1.14. About 89.4% of high school students had a Smartphone. Among high school students, 51.1% did not engage in physical activity outside of high school. Rice was the cereal most consumed by high school students (99.2%). Consumption of fish and seafood was very low (25.5%). Soft drinks were consumed on average 4.2 days/week. In addition, 60.8% of high school students consumed energy drinks. Certain eating behaviors were found in this study, such as nibbling (38.5%), eating in front of screens (79.0%), and skipping meals (46.1%). **Conclusion:** The most consumed cereal by high school students was rice. The consumption of ultra-processed products and sedentary leisure are habits to be monitored in the context of the prevention of food-related non-communicable diseases among high school students in the district of Bamako.

Keywords

Eating Habits, Behaviors, Nutrition, High School Students, Bamako

1. Introduction

The nutritional transition is a global phenomenon that combines profound changes in eating habits (excess sugar, salt, and saturated fats). It is accompanied by a decrease in daily physical activity, thus leading to a rapid increase in non-communicable diseases (diabetes, cardiovascular diseases, and cancers) [1]. These changes are occurring at a particularly rapid pace in low- and middle-income countries [2]. Adolescence is the age group of 10 - 19 years, located between childhood and adulthood [3]. It is a stage of rapid growth linked to puberty affected by the nutritional transition [4].

Eating habits are consolidated in early childhood and continue throughout life [5]. These eating habits have evolved considerably on a global scale, notably due to the entry of multinational agri-food companies into local markets [6]. This development has led to an increase in the presence of ultra-processed foods in food circuits and fast food chains [7]. These dietary habits can be influenced by both exogenous and endogenous factors. The most important exogenous factors are family, peer groups and the media [8]. Advertisements and marketing strategies play a major role in guiding adolescents' food choices, often pushing them toward consumption of ultra-processed foods. Unhealthy eating habits adopted during adolescence have long-term health implications, highlighting the need to promote healthy eating habits among adolescents to foster healthy behaviors in adulthood [9]. In high-income countries, regulatory mechanisms are in place to monitor the consumption of unhealthy foods among children and adolescents. However, in low- and middle-income countries, these mechanisms and the means of application are limited [10].

Along with this phenomenon of nutritional transition, non-communicable diseases have become a global public health problem. They are responsible for approximately 63% of deaths [11]. The prevalence of these diseases also remains a concern in sub-Saharan Africa. South Africa has the highest prevalence of diabetes in the region, reaching 11.3% [12]. In 2019, 82% of people with high blood pressure lived in low- or middle-income countries, particularly in Africa [13].

In Mali, the prevalence of diabetes was 2.1% in 2021. If no action is taken, this prevalence could reach 2.2% by 2030 [12]. Furthermore, the eating habits of high school students in the Bamako district are poorly documented. It is therefore important to have up-to-date data on eating habits to better guide decision-making in school food and nutrition policies and programs. Thus, this study aimed to evaluate the eating habits of high school students in the Bamako district.

2. Methodology

2.1. Study Framework

Bamako is the capital of Mali, a Sahelian country in West Africa, with an area of 1,241,238 km². The district of Bamako is located in the southwest part; it is di-

vided into two banks (right bank and left bank) by the Niger River. It has a population of 3,007,122 inhabitants according to figures from the central town hall, and was erected on February 2, 1982 into six (06) communes including four (04) communes on the left bank and the other two (02) on the left bank right (Figure 1) [14]. The Bamako district has 352 classical and technical high schools; with a population of 136,838 students, including 54% boys and 46% girls. The Malian education system is made up of four levels of education: preschool, basic (primary cycle and middle cycle), secondary (high school cycle and vocational training cycle) and higher. The country's economy is based on agriculture, livestock breeding, and fishing, hence its vulnerability, because it depends on seasonal climate variability and means of resilience. The Sudano-Sahelian type climate is characterized by very high average temperatures and by the alternation of a rainy wet season (June to September) and a dry season lasting between five and nine months (from October-November to May-June). Since 2012, Mali has faced a security, sociopolitical and humanitarian crisis [15]. This situation has a negative impact on economic and social life, as well as the food and nutritional security of populations.
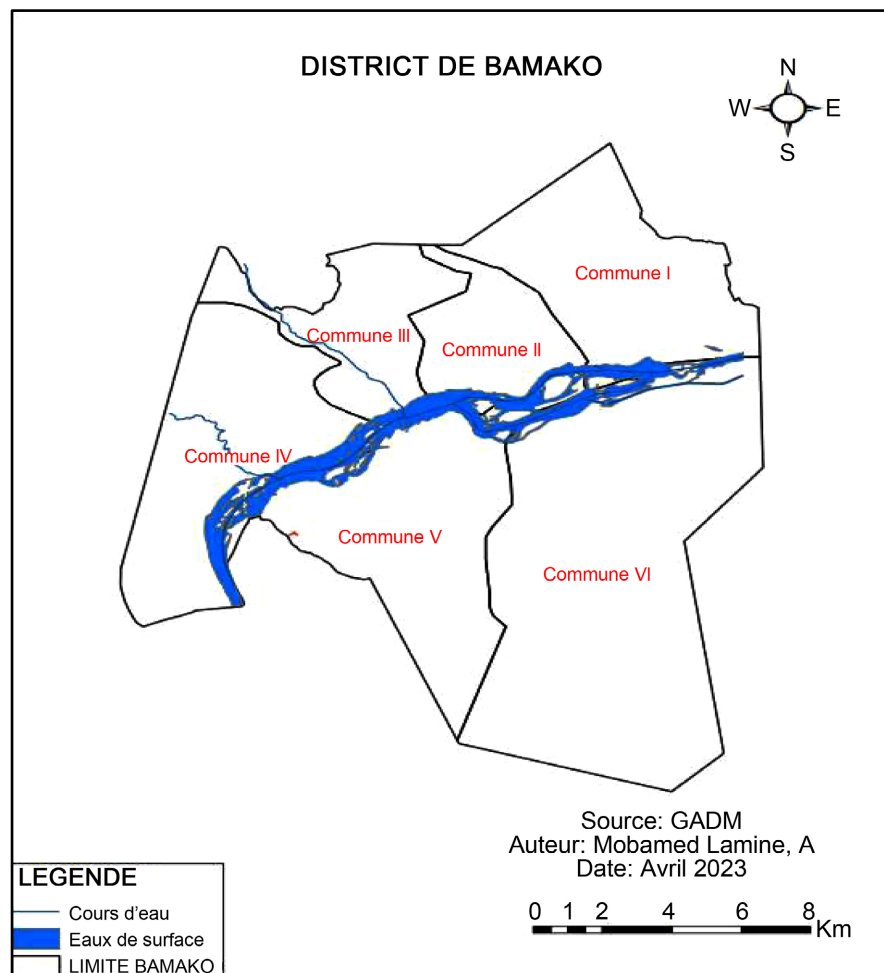

Figure 1. Schematic representation of the six communes of the Bamako district.

2.2. Study Type and Population

This is a cross-sectional study of high school students in public and private schools in the District of Bamako. It was carried out in the period from June 15 to July 4, 2022.

2.3. Sample Size and Sampling Procedure

The sampling was carried out based on the statistical reports (2021-2022) provided by the two teaching academies of the District of Bamako (right bank and left bank). The sample size was calculated with the StatCalc program of the Epi 7.2 software with the five parameters: size of the target population, margin of error of 2%, expected prevalence of 50% and confidence at 95%, which makes a total of 2360 ≈ 2400 students. The three-stage probing technique was used in this study. The first degree consisted of the selection of high schools from among high schools on both shores from the lists of each academy. A total of 80 high schools with 30 students were selected, including 40 high schools in each academy at random. The second degree consisted in selecting three classes in each high school by a simple random draw. The third degree allowed students to be selected, with an allocation of 10 students per class. In each class, a random draw stratified according to sex (54% boys and 46% girls) was carried out to choose the participants.

The inclusion criteria for this study were as follows: students had to be between the ages of 10 and 19, enrolled in one of the selected high schools, had agreed to participate in the survey and obtained the consent of their parents or legal guardians (for minors). People absent on the day of the survey were not included in this study.

2.4. Data Collection Tools and Procedure

The KoboCollect app was used to collect information from participants. The questionnaire was developed in XLSForm and hosted on the KoboToolbox server to facilitate the monitoring of submissions and also to be able to control the reliability of the data collected in real-time.

A questionnaire created by the objectives of the study included several dimensions such as the identification of schools (academy and status of the high school) and students (age, sex, level of study…), socioeconomic and demographic characteristics, and eating habits. Regarding dietary habits, the evaluation of the frequency of consumption of food groups over 7 days was carried out using the food rating questionnaire of the World Food Program (WFP). This methodological choice proved to be appropriate for this study to carry out a detailed and precise analysis of the eating habits of high school students. Before data collection, 10 interviewers (5 women and 5 men) were selected and trained on the various tools. The investigators were general practitioners and nutrition students with experience in nutritional surveys, as well as a good geographical knowledge of the neighborhoods of Bamako. The 2-day training focused on the

objectives of the study, the administration of the questionnaire and the ethical aspects. After the training, a pre-test phase was carried out in the field.

2.5. Data Analytics

At the end of the collection, the data were imported into Xlsx then and formats. SPSS v26 software was used for data cleaning and analysis. For the descriptive part, the quantitative variables were presented in the form of mean ± standard deviation, median and extremes. Qualitative variables were expressed in absolute and relative frequencies.

2.6. Ethical Considerations

The research protocol was validated by the ethics committee of the University of Sciences, Techniques, and Technologies of Bamako (USTTB). Letters of authorization were provided by the education academies of Bamako to allow the investigators access to the selected establishments. The consent of adult students has been obtained. The consent of minor students and the consent of their parents or legal guardians were also obtained. The participants were informed of the objectives and purpose of the research before their selection. To guarantee confidentiality, no personal data has been collected.

3. Results

3.1. Socio-Economic Characteristics

A total of 2400 high school students took part in this survey, with a participation rate of 100%. The mean age was 16.9 ± 1.4 years. The median age was 17 years with extremes of 14 and 19 years. High school students aged 16 - 17 years represented 46.7%. Boys numbered 1280 (53.3%). The sex ratio (M/F) was 1.14. High school students lived in households with an average size of 7.9 ± 2.4 persons with a median of 8 persons. Charcoal was the main source of energy for cooking in the households of high school students (80.7%). About 89.4% of high school students had a Smartphone. Among high school students, 51.1% did not engage in any physical activity outside of high school. Regarding the educational level of the high school students' parents, 37.1% of the fathers had attained a university level, while 14.5% of the mothers had no formal education (Table 1).

3.2. Eating Habits of High School Students

3.2.1. Consumption of Starches (Cereals, Legumes and Nuts)
Rice was consumed on average 5.6 days/week ± 1.2, with a median of 5 days/week. Among high school students, 99.2% consumed rice 3 or more times per week. Millet, sorghum, and corn were consumed on average 2.9 days/week ± 1.8, with a median of 3 days/week. The frequency of consumption of bread and pasta was ≥ 3 times/week among 96.9% of high school students. For the frequency of consumption of legumes and nuts (beans, peanuts, lentils), the average was 1.5 days/week ± 1.4, with a median of 1 day/week (Table 2).

Table 1. Characteristics of participants (n = 2400).

Variables	Terms	Frequencies	
		n	**(%)**
High School Students' School Status			
	Public	1200	(50.0)
	Private	1200	(50.0)
Sex			
	Boys	1280	(53.3)
	Girls	1120	(46.7)
Age (years)			
	14 - 15	398	(16.6)
	16 - 17	1121	(46.7)
	18 - 19	881	(36.7)
Father's education level			
	None	78	(3.3)
	Literate	532	(22.2)
	Primary/Secondary	434	(18.1)
	High school	465	(19.4)
	University	891	(37.1)
Mother's education level			
	None	347	(14.5)
	Literate	592	(24.7)
	Primary/Secondary	507	(21.1)
	High school	478	(19.9)
	University	476	(19.8)
Father's professional status			
	Employee	2015	(84.0)
	Not employed	385	(16.0)
Mother's professional status			
	Employee	1701	(70.9)
	Not employed	699	(29.1)
Number of Individuals per Household			
	<5	152	(6.3)
	≥5	2248	(93.7)
Source of energy for the kitchen			
	Charcoal	1936	(80.7)
	Butane gas	241	(10.0)
	Firewood	194	(8.1)
	Electricity	29	(1.2)
Smartphone ownership			
	Yes	2145	(89.4)
	No	255	(10.6)

Table 2. Eating habits of high school students (n = 2400).

Variables	Consumption frequency			
	<3 times/week		≥3 times/week	
	n	(%)	n	(%)
Rice	19	(0.8)	2381	(99.2)
Pasta, bread, pancakes	74	(3.1)	2326	(96.9)
Potato, yam, cassava	1268	(52.8)	1132	(47.2)
Sorghum, millet, corn	1106	(46.1)	1294	(53.9)
Legumes/Nuts: Beans, peanuts, lentils	1892	(78.8)	508	(21.2)
Vegetables rich in vitamin A	662	(27.6)	1738	(72.4)
Green leafy vegetables	1810	(75.4)	590	(24.6)
Fruits rich in vitamin A	968	(40.3)	1432	(59.7)
Other fruits: Banana, Apple, Mandarin	1416	(59.0)	984	(41.0)
Meat/poultry	37	(1.5)	2363	(98.5)
Liver, kidney, heart and other offal	2226	(92.8)	174	(7.2)
Fish and seafood	1789	(74.5)	611	(25.5)
Eggs	1639	(68.3)	761	(31.7)
Milk and dairy products	1712	(71.3)	688	(28.7)
Oils and fats	8	(0.3)	2392	(99.7)
Sweets, cakes, pastries	6	(0.2)	2394	(99.8)
Soda	542	(22.6)	1858	(77.4)

3.2.2. Consumption of Fruits and Vegetables

Fruits rich in vitamin A were consumed on average 3.2 days/week ± 1.9, with a median of 3 days/week. The frequency of consumption of fruits rich in vitamin A (mango, papaya, melon) was ≥ 3 times/week among 59.7% of high school students. Green leafy vegetables were consumed on average 1.7 days/week ± 1.2, with a median of 2 days/week (Table 2).

3.2.3. Consumption of Meat/Poultry, Fish and Seafood

Meat/poultry was consumed on average 6.6 days/week ± 1.1, with a median of 7 days/week. Among high school students, 98.5% consumed meat at least 3 times/week. For the frequency of fish and seafood consumption, the average was 1.9 days/week ± 1.7, with a median of 1 day/week. The frequency of consumption of fish and seafood ≥ 3 times/week was found in 25.5% of high school students (Table 2).

3.2.4. Consumption of Sweet Products

Soda was consumed on average 4.2 days/week ± 1.9, with a median of 4 days/week. All the high school students drank soda. The frequency of consumption of sweets, sweets or pastries ≥ 3 times/week was found among 99.8% of high school students in the Bamako district (Table 2).

3.2.5. Eating Behaviors

In this study, 79.0% of high school students had the habit of eating in front of television screens. About 60.8% of high school students consumed energy drinks. Skipping meals, snacking and sweetening foods were found in 46.1%, 38.5%, and 32.7% of high school students respectively. Around 88.1% of high school students frequented fast-food restaurants. Among high school students, only 5.6% of them had the habit of taking their meals at regular times (Table 3).

4. Discussion

The objective of this study was to evaluate the eating habits of high school students in the District of Bamako in the context of nutritional transition. The

Table 3. Eating behavior of high school students (n = 2400).

Variables	Terms	Frequencies	
		n	(%)
Energy drink consumption			
	Yes	1460	(60.8)
	No	940	(39.2)
Fast food attendance			
	Yes	2115	(88.1)
	No	285	(11.9)
Adding sugar			
	Yes	784	(32.7)
	No	1616	(67.3)
Resalting food			
	Yes	807	(33.6)
	No	1593	(66.4)
Snacking			
	Yes	924	(38.5)
	No	1476	(61.5)
Skipping meals			
	Yes	1106	(46.1)
	No	1294	(53.9)
Eat in front of the TV			
	Yes	1896	(79.0)
	No	504	(21.0)
Eating meals at regular times			
	Always	135	(5.6)
	Sometimes	2172	(90.5)
	Never	93	(3.9)

participation rate was 100%.

4.1. Consumption of Starchy Foods (Cereals, Legumes and Nuts)

Starchy foods are an integral part of the daily diet of adolescents. Cereals are widespread in sub-Saharan Africa and serve as a staple food [16]. Among them, rice was the most consumed cereal, with 99.9% of respondents reporting eating it more than three times a week. According to *Chege et al.* [17], in Kenya, rice is the most frequently consumed food by high school students. In Mali, rice is the main component of the daily dish for lunch. Unlike millet, sorghum, and corn, rice is a cereal that is easily accessible physically and economically. This accessibility of rice could be explained by the combination of local production and imports. The "Riz Initiative" program set up by the Malian government in 2008 played a significant role in increasing national rice production, particularly in the Office du Niger area. In addition, local production of cereals such as millet, sorghum and corn has experienced a significant decrease due to the effects of climate change, notably drought, as well as the security crisis affecting the Ségou and Mopti regions. These two regions are essentially recognized as the main cereal-producing regions in Mali.

4.2. Consumption of Fruits and Vegetables

Fruits and vegetables are an important source of vitamins and minerals that contribute to the maintenance of good health and the prevention of non-communicable diseases, such as cardiovascular diseases, metabolic diseases and cancers [18]. In this study, the frequency of consumption of fruits rich in vitamin A, such as mango, papaya and melon, was higher (59.7%) than that of other fruits such as banana, apple, and melon. tangerine (41.0%). This disparity could be explained by the availability of certain fruits such as mangoes, papayas, and melons in high school outlets. Additionally, the study period coincided with the fruit season in Mali, which likely contributed to the more frequent consumption of these fruits among high school students. High school students consumed vegetables rich in vitamin A such as carrots and orange sweet potatoes (72.4%), as well as green leafy vegetables (24.6%). In Mali, sweet potatoes are often eaten in the form of fried foods as a snack at high school sales outlets and near homes. The consumption of green leafy vegetables could be attributed to the use of sweet potato, cassava, cauliflower or baobab leaves in the preparation of sauces for lunch or dinner, which are usually served with rice or millet or sorghum paste. In the study of *Isabirye et al.* [19], the frequency of consumption of vitamin A-rich fruits and green leafy vegetables among Ugandan high school students was 33.4% and 42.3%, respectively. Compared to this study, consumption of green leafy vegetables was higher among Ugandan high school students. This could be explained by the fact that these vegetables are an important component of traditional dishes in Uganda [19]. Furthermore, fruit and vegetable consumption among adolescents is insufficient globally [20]. The integration of the nutri-

tional education component in the school curriculum could contribute to increasing the consumption of fruit and vegetables among students. Nutrition education has an impact on the food choices of children and adolescents, including their consumption of fruits and vegetables [18].

4.3. Consumption of Fish and Seafood

Animal proteins such as meat, fish, and eggs provide an important source of nutrients including essential amino acids for adolescent growth and development. These proteins are also an important source of B vitamins, iron, calcium, and zinc. Iron is especially important for adolescent girls because they have higher iron needs during menstruation. Meat consumption is higher for adolescents living in high-income countries than those in low- and middle-income countries [21]. The frequency of fish and seafood consumption was extremely low, with only 7.2% of high school students consuming fish 3 or more times per week. The study by *Daboné et al.* [22] found similar results (8.6%) in Burkina Faso. This low consumption could be explained by economic factors (high cost). In the district of Bamako, the price of fish varies between 1500 and 4000 CFA francs/kg. Drought and insecurity in the central Niger River delta have contributed to this drop in production, as 80% of national fishing is provided by this part of the river. Population pressure, due to rapid urbanization in the Bamako district, particularly along the banks of the Niger River, could also be responsible for this decrease in supply. Mali is also a continental country, which does not have a maritime coastline.

4.4. Consumption of Sugary Products and Energy Drinks

The consumption of sugary products is very common among adolescents, which raises concerns about the increasing prevalence of non-communicable diseases in this age group [23]. The sweet taste has a great psychological impact, according to *Brundell et al.* [24], the sweet flavor is associated with a feeling of intense pleasure. It has been established that sweet taste triggers reward and motivational brain responses, similar to those caused by drugs. In this study, the consumption of sugary products such as sodas was observed among all high school students. This high consumption could be explained by the availability of these products at an affordable cost (200 FCFA) in high school sales points. A survey in Ethiopia revealed that 92.9% of high school students had a preference for sweet foods [25]. Consumption of energy drinks was high (60.8%) among high school students. A study conducted by *Oladoyinbo et al.* [26], in Nigeria reported even higher results among high school students (72.8%). This trend could be explained by advertisements broadcast on social networks by influencers and by the sponsorship of school events by certain brands. In Saudi Arabia, consumption of energy drinks by adolescents was low (25.7%) compared to this study and that of Nigeria [27]. This trend could be attributed to the restriction of the sale of certain beverages in Saudi territory, as well as the influence of the so-

cio-cultural environment. Energy drinks are also sold in stores near high schools. The price of these drinks varies between 400 and 700 FCFA depending on the brand and the quantity. The composition may also vary depending on the energy drink brand; however, there are generally very high doses of sugars, caffeine, and taurine. Consumption of energy drinks poses a health risk, especially among adolescents [27]. According to a meta-analysis by *Nadeem et al.* [28], the most frequently reported adverse effects among energy drink consumers were insomnia, stress, and depressed mood. To reduce the consumption of sugary drinks, several countries have banned vending machines in schools and convenience stores [29].

4.5. Eating Behaviors

Among eating behaviors, snacking was found among 38.5% of high school students. Snacking is a behavior that involves eating small amounts of food between meals, without feeling hungry. The person tends to consume sugary foods such as sugary drinks, cakes, and chocolate. This behavior could be explained by the proximity of fast-food outlets around high schools, as well as the fact that most high school students spend part of their day away from home. In the study by *Tunkara-Bah et al.* [30], in The Gambia, snacking was associated with overweight and obesity among adolescents. In adolescents, lifestyle habits and social environment can have an influence on snacking [31]. Among high school students, 79.0% had the habit of eating in front of screens. Eating in front of screens could be explained by the fact that many households have digital television, offering a diversity of programs that particularly attract adolescents. A study conducted by *Falbe et al.* [32], among adolescents revealed that the more time they spend in front of screens, the higher their consumption of ultra-processed products (candy, cake, soda, chips, etc.). It could also lead to a reduction in the consumption of foods of high nutritional quality, such as fruits and vegetables. According to the study conducted by *Pearson et al.* [33], watching television on school days as well as on weekends was correlated with snacking on foods of low nutritional quality among adolescents. Eating in front of screens is also considered a factor associated with being overweight, as it changes eating habits in terms of quality and quantity, while also exposing individuals to advertising of ultra-processed foods [34]. A survey conducted in Brazil revealed that 78.3% of adolescents believe that food advertising encourages the consumption of foods high in sugar and fat [7].

Skipping meals (46.1%) could be explained by the fact that most high school students spend the entire day at school. This frequently leads high school students living in remote neighborhoods to skip breakfast or lunch. Similar results (48.1%) of meal skipping were found in Nigeria by *Onyiriuka et al.*, [35]. This behavior could encourage snacking and lead to an increase in the amount of food consumed during subsequent meals [36].

In this study, 88.1% of high school students frequented fast-food restaurants.

Fast food is growing in popularity among teenagers and is easily accessible at an affordable cost. Fast food is present both in high school canteens and in local stores, offering consumers a diverse range of ultra-processed foods. The presence of fast food in the school environment could also encourage snacking among high school students. Psychosocial factors may interact with environmental factors to influence adolescents' food choices. According to *Ioannou* [37], eating fast food is seen by adolescents as a way to express self-image and modernity. Fast food is now a complex phenomenon, as it has entered homes with the transition from traditional cooking practices to convenience foods. These types of foods generally adapt to city lifestyle habits, responding to the constraints of long working hours. However, these ultra-processed foods are risk factors for non-communicable diseases [1]. Citizen initiatives such as the slow food movement in the USA could help reduce the consumption of ultra-processed foods by implementing nutritional education actions and promoting restaurants that respect health standards for healthy eating [29]. These actions could also be aligned with national policies regarding school canteens to provide a legal and institutional framework for the promotion of healthy diets.

4.6. Limitations of the Study

Due to the limitations of this study, a quantitative assessment (portion size) of food intake was not carried out. However, this does not influence the quality of the results obtained.

5. Conclusion

Rice was the cereal most consumed by high school students in the Bamako District. Consumption of fast food and snacking were among the eating behaviors found among high school students. In addition, energy drinks occupy a significant place in their eating habits. Advertising of ultra-processed foods through television and the Internet is also a factor that influences food choices. It is essential to consider these dietary behaviors and influencing factors in school nutrition programs, as this will help prevent non-communicable diseases in the short and long term.

Conflicts of Interest

The authors declare no conflicts of interest with regard to this paper.

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