

# The Home and School Food Environments of Senegalese Adolescent Girls

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**Abstract Background:** In West Africa, there is scarcity of data on the food environment of adolescent girls even though these factors impact their nutritional status. This study described the school and home food environment of Senegalese adolescent girls living in Dakar city. **Methods:** This cross-sectional study was conducted in Dakar city, Senegal over a two-month period among adolescent girls aged 13-18 years old (n = 136) years old attending two colleges. Dietary intake and food behaviours were assessed using three 24-hour recalls. The Household Food Insecurity Access Scale was used to assess accessibility to food in the adolescents' home environment. To assess the availability and access to food in their school environment, an inventory of all foods available and their prices was performed in all food outlets located near each college where adolescents purchased food. **Principal findings:** Two thirds of adolescent girls' households were food insecure. Overall, food outlets sold more unhealthy than healthy foods. The average price of meat, poultry and fish, as well as the average price of sweets were higher than that of other food groups. **Conclusions:** Results show that Senegalese adolescent girls' home and school food environments do not support healthy eating. Actions at multiple levels of the food system are needed to improve adolescents' availability and accessibility to healthy foods.

**Keywords:** school food environment, food insecurity, adolescent girls

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## 1. Introduction

Worldwide, malnutrition affects a third of adolescents [1]. Adolescents are vulnerable to malnutrition given their rapid growth, and girls are particularly at risk of iron deficiency due to menstruation. Poor dietary habits have been recognized as one of the leading risk factors for malnutrition [1]. Results from a systematic review show that adolescents' diet, particularly in Sub-Saharan Africa, is of poor quality [2]. Specifically, their consumption of fruits and vegetables is low, while the consumption of unhealthy foods such as fast food, salty snacks and sweets was elevated [3]. This dietary pattern is worrisome given the rise of global rates of obesity and its association with the development of non-communicable diseases [4].

In the past decades, urbanization in low- and middle-income countries (LMIC) such as Senegal has led to the emergence of multiple types of food outlets, including street vendors, convenience stores (also known as boutiques) and fast food restaurants which generally offer a wide variety of inexpensive and non-nutritious foods [5]. These changes have brought a transition from traditional foods and ways of eating to a mixed food system

influenced by other parts of the world [5]. In Senegal, this has had a profound effect on dietary patterns and behaviors of the country's population, particularly on those living in urban areas. In fact, a study has shown an increase in adolescent girls' consumption of processed and packaged foods in response to the growing number of street foods and fast food outlets in Dakar, the capital city of Senegal [5]. Therefore, access to nutritious foods poses a real challenge for adolescents living in LMIC who are exposed to this ever-growing selection of non-nutritious foods across their community, including near their home and school [1].

The home food environment remains an important setting for adolescents, despite being one where they may have less control, as parents are often still making decisions regarding what and how to provide food [6]. One study has estimated that in LMICs, a quarter of households' food budget is spent on street foods [7]. In Dakar, households rely primarily on cash to purchase food [5]. However, in 2015, approximately 40% of Dakar households experienced a shortage of food due to a lack of financial resources [8]. Therefore, the household's level of food security can affect the quantity and types of foods that can be purchased, which can impact adolescents' access to nutritious foods at home.

On the other hand, increased independence during adolescence means that they have more opportunities to purchase their own foods when they are out in their community [6]. Since adolescents spend a significant amount of time in school, the school food environment, including food outlets in and around schools, can have a significant impact on adolescents' food choices and behaviors. Therefore, the home and school food environment could both influence adolescents' diet.

While availability and accessibility are important elements of the school food environment that can influence dietary intake or food behaviors of adolescents, other components must be considered. The types of food outlets that are present, as well as the price and nutritional quality of foods to which adolescents have access are also key components of the food environment, as suggested by Turner et al. [9]. Therefore, this study aimed to describe 1) the types of food outlets present in Senegalese adolescent girls' school environment as well as the types of foods that are available, their prices and nutritional quality, and 2) the access to food in the home environment of adolescent girls as measured by the level of household food security.

## 2. Materials and Methods

### 2.1. Study Site, Design and Sample

This study was conducted in Dakar city, the capital and largest urban setting of Senegal. Senegal is considered a LMIC with 38 % its population earning less than 1.90 US \$ per day in 2010 [10,11].

This cross-sectional study was part of a larger one that investigated psychosocial and environmental factors associated with the consumption of iron-rich foods among adolescents attending two colleges in the Dakar district. Using the G\*power software [12], the sample size for this larger study was estimated, at 134. Two colleges were purposively selected in the Greater Dakar Area of the Dakar district. In both colleges, all adolescent girls aged 13-18 years old were invited to participate in the study. Written informed assent and consent were provided by each adolescent and her parents, respectively, prior to data collection. This study was approved by the *Comité National de la recherche en santé* of Senegal (# 0000106) as well as by the *Comité d'éthique de la recherche avec les êtres humains* of the Université de Moncton in New Brunswick, Canada (# 2018-214).

### 2.2. Data Collection & Analysis

#### 2.2.1. Home Food Environment

The Household Food Insecurity Access Scale (HFIAS) [13] was used to assess accessibility to food in the adolescents' home environment. Specifically, this tool has been used in previous studies conducted in Senegal to indicate the degree of household's food insecurity [8,14,15]. The HFIAS was administered to the adolescent's head of household and their spouse(s). The tool included nine occurrence questions (yes or no) and nine frequencies of occurrence questions (rarely, sometimes or often) that addressed uncertainty and

anxiety over food, insufficient quantity and quality of food, reductions of food intake due to lack of resources and the behavioral or psychological consequences of food insecurity [13]. Those who reported "no" at the occurrence question were given a score of zero (0), while a score of 1 (rarely), 2 (sometimes) or 3 (often) was given according to the answer to the frequency of occurrence questions. Therefore, each household obtained a score between 0 and 27 points. The level of food security (food secure, mildly food insecure, moderately food insecure or severely food insecure) was also determined, as per Coates et al.'s [13] methodology.

#### 2.2.2. School Food Environment

Based on Turner et al.'s [9] framework, the school food environment was defined as all spaces or infrastructures, either around the school or between the participants' home and their school, where food was obtained, purchased and / or consumed. During a group discussion in each college at the beginning of the study, all participants were asked to report each outlet where they typically purchased food during school days or on their way to or from school. Once these food outlets were identified, the main author of the study visited each of them to document the type of food outlet, the types of foods that were sold their forms and their formats, as well as their price.

First, each food outlet was classified as one of the following types [6]:

- **Street food vendor:** Vendor who prepares beverages or foods onsite, such as milk, curd milk, coffee, bread with butter or chocolate, sandwiches with meat, eggs, fish, pasta or French fries. Some also sell snacks such as chocolate bars, peanuts and fruit.
- **Boutique:** Convenience store which sells a limited variety of food products such as everyday staples (e.g. sugar, oil, rice), wheat bread, cookies, milk, fruit and vegetables, and sugary drinks.
- **Restaurant:** Business which typically offers meat, fish or egg-based dishes with / without rice or couscous.

Second, characteristics of all individual food items available for purchase in each food outlet were documented, including the type of food (e.g. mango, bread, rice, ice cream, candy), the food group [2-16] to which they belong (grains / roots / tubers / plantains, legumes, milk and dairy products, meat / poultry / fish, eggs, nuts and seeds, oils and fats, fruits, vegetables, fried and salty foods, fast food, sugary drinks, sweets, condiments and seasonings) (Supplementary material), their form (e.g. fresh, canned, frozen, packaged, whole, sliced, diced), their format, when applicable (e.g. 355 ml, 710 ml, 591 ml, 75 g, 150 g), and their price in the local currency (Franc of the Financial Community of Africa (FCFA)). A "combined dishes" food group was added to reflect dishes that are frequently served in restaurants, such as rice with fish / meat / chicken, couscous with meat, rice and fish / meat yassa, rice with meat in peanut sauce (also known as "mafé"), soup made with gombo ("kandja soup") and stew with meat served with rice ("domoda"). With regards to the forms and format of items, these were recorded to provide a better representation of food accessibility. For example, an adolescent may have

enough money to purchase a small bag of sliced mangoes but not a whole mango. All formats include different forms of each different food item. For ease of assessment and interpretation, all food prices were calculated for a 100g portion and beverages were weighed as to also obtain a price per 100g portion. Mean price was calculated using all formats of a given food or beverage available in each selling point.

Once all food items were documented, they were each categorized as either healthy or unhealthy using New Brunswick Department of Education and Early Childhood Development (NBDEECD) Policy 711's criteria [17], to better reflect the nutritional quality of the foods available for purchase in the food outlets. To measure accessibility to healthy food, mean price / 100 g per food group as well as the average price / 100 g of healthy and unhealthy foods sold in each type of food outlet were also calculated in the local currency.

### 2.3. Sociodemographic Data of the Adolescents' Household

Sociodemographic data were collected using a questionnaire administered to the head of household. This included questions on age, sex, and education level of household members, assets ownership, housing characteristics, and access to an improved water source and water sanitation. A factorial analysis was conducted to define and assign a score to categorize the socioeconomic status of the adolescent's household. Initially, 18 items on ownership of assets and housing conditions were used. The final score considered 11 items (radio, refrigerator, computer, internet, bicycle, motorcycle, having a car, agricultural field, farm animal or poultry, bank account or participating to a "tontine" or community fund) which explains 21.18 % of the total variance and composition of the first factor. The Kaiser-Meyer-Olkin Test, which assesses the suitability of the data for the factor analysis was 0.765 which is considered acceptable [18].

### 2.3. Statistical Analysis

Data were analyzed with SPSS (version 21, Statistical Package for the Social Sciences, Statistics for Windows, Version 21.0, IBM Corporation, Armonk, NY, USA). Means and standard deviations were used to describe the home and school food environment, as well as the households' sociodemographic characteristics. To assess differences between continuous variables (e.g. mean prices of food), t-tests, ANOVA and post-hoc multiple comparison tests were performed. For all tests, a *p* value < 0.05 was used to indicate significant differences.

## 3. Results

Household sociodemographic characteristics of girls attending each college are presented in Table 1. Most heads of households were male and approximately 40 % of them (as well as their spouses) had no formal education. Mean household socioeconomic score was  $0.00 \pm 0.82$  (range of -1.34 to 1.68) and over two thirds of households were food insecure.

**Table 1. Sociodemographic and food security characteristics of adolescent girls' households by college (N = 136)**

Sociodemographic characteristics	%	
	College #1 (n = 68)	College #2 (n = 68)
Gender of head of household		
Male	67.2	51.5
Female	32.8	48.5
Education level of head of household		
None	37.3	43.9
Primary (incomplete / complete)	20.9	27.3
Secondary (incomplete / complete)	28.4	22.7
Superior / University	10.4	6.1
Other	3.0	0.0
Age of head of household (years)		
< 40	9.0	12.1
40-49	26.9	30.3
50-59	40.3	27.3
≥ 60	23.9	30.3
Education level of spouse of head of household		
None	46.3	39.4
Primary incomplete / complete	26.9	16.7
Secondary incomplete / complete	22.4	37.9
Superior / University	3.0	6.1
Age of spouse of head of household (years)		
< 40	38.0	17.1
40-49	32.0	46.3
50-59	20.0	14.6
≥ 60	8.0	22.0
Household size		
1-3	2.9	1.5
4-6	42.6	30.9
7-9	33.8	22.1
≥ 10	20.6	45.6
Food security		
Food secure	38.8	34.8
Mildly food insecure	22.4	10.6
Moderately food insecure	11.9	22.7
Severely food insecure	26.9	31.8
	Mean ± SD	
Socioeconomic score (range of -1.34 to 1.68)	0.11 ± 0.92	-0.11 ± 0.69

Adolescents from both colleges reported purchasing food from a total of 31 different food outlets, either at lunch time or on their way to or from school (Table 2). In total, adolescents purchased food from 18 different street food vendors, 6 boutiques and 7 restaurants. For each food group, numbers of different types of foods sold by each type of food outlet are presented in Table 2. None of the food outlets sold vegetables, nuts, seeds, oils or fats, however all of them sold foods from the grains, tubers, roots and plantains group, fast foods, sugary drinks and sweets. Meat, poultry and fish dishes were only sold by restaurants while legumes (including all forms of peanuts) were only sold by street food vendors. Overall, the greatest variety of food items was noted for fast foods (n = 42), sweets (n = 24) and sugary drinks (n = 20), followed by fruit (n = 17). The number of types of foods sold among the food outlets were similar. However, street food vendors appear to sell foods in a greater number of formats (n = 115) than boutiques (n = 54) and restaurants (n = 63).

**Table 2. Food availability by food group and by type of food outlet where adolescent girls from each college reported purchasing food**

Food group	All forms & formats of different food items (n)	Type of food outlet			Overall (n = 31 food outlets)
		Street vendor (n = 18)	Boutique (n = 6)	Restaurant (n = 7)	
Grains, roots tubers & plantains	All forms	3	4	1	7
	All formats	3	8	1	12
Legumes	All forms	2	-	-	2
	All formats	9	-	-	9
Nuts and seeds	All forms	-	-	-	-
	All formats	-	-	-	-
Milk & dairy products	All forms	1	4	-	5
	All formats	1	8	-	9
Meat, poultry & fish	All forms	-	-	5	5
	All formats	-	-	5	5
Eggs	All forms	1	1	-	1
	All formats	1	1	-	2
Fruits	All forms	15	2	-	17
	All formats	38	5	-	43
Vegetables	All forms	-	-	-	-
	All formats	-	-	-	-
Fried and salty foods	All forms	-	1	2	3
	All formats	-	1	2	3
Fast food	All forms	24	4	18	42
	All formats	37	4	23	64
Sugary drinks	All forms	6	11	3	20
	All formats	7	12	9	28
Sweets	All forms	13	10	1	24
	All formats	16	14	1	31
Fats and oils	All forms	-	-	-	-
	All formats	-	-	-	-
Combined meals	All forms	1	-	12	12
	All formats	1	-	22	23
Water (mL)	All forms	1	1	-	1
	All formats	2	1	-	3
All	All forms	67	39	42	139
	All formats	115	54	63	232

When considering prices of the various food groups in each type of food outlet, the average price per 100 g of meat, poultry and fish was significantly higher ( $p = 0.000$ ) than that of grains, tubers, roots and plantains, legumes, fast food, sugary drinks and water (Table 3). The average price of sweets was also higher than that of grains, tubers, roots and plantain products, legumes, fast foods, sugary drinks and water. There were no significant differences

between average prices of foods from grains, tubers, roots and plantain products, legumes, milk products, eggs, fruits, fried and salted foods, fast foods, sugary drinks and water. There were also no significant differences in the average price of foods among street food vendors, boutiques and restaurants. Moreover, no significant differences were found between the average price of healthy and unhealthy foods between each type of food outlet (Table 4).

**Table 3. Mean food prices (FCFA\*  $\pm$  SD) / 100g by food group and by type of food outlet where adolescent girls from each college reported purchasing food\*\***

Food groups	Type of food outlet			Overall <sup>†</sup> (n = 31 food outlets)
	Street food vendor (n = 18)	Boutique (n = 6)	Restaurant (n = 7)	
Grains, roots tubers & plantains	242 $\pm$ 224	113 $\pm$ 27	120	146 $\pm$ 114 <sup>a</sup>
Legumes	120 $\pm$ 24	-	-	120 $\pm$ 25 <sup>a</sup>
Milk & dairy products	81	404 $\pm$ 298	-	368 $\pm$ 317 <sup>abc</sup>
Meat, poultry & fish	-	-	603 $\pm$ 121	603 $\pm$ 121 <sup>c</sup>
Eggs	200	189	-	194 $\pm$ 8 <sup>ab</sup>
Fruits	281 $\pm$ 458	106 $\pm$ 39	-	260 $\pm$ 434 <sup>ac</sup>
Fried & salty foods	-	300	364 $\pm$ 232	343 $\pm$ 168 <sup>ac</sup>
Fast food	111 $\pm$ 37	109 $\pm$ 16	301 $\pm$ 163	179 $\pm$ 137 <sup>a</sup>
Sugary drinks	58 $\pm$ 11	102 $\pm$ 73	169 $\pm$ 132	112 $\pm$ 96 <sup>a</sup>
Sweets	379 $\pm$ 392	283 $\pm$ 257	500	339 $\pm$ 330 <sup>bc</sup>
Combined meals	192	-	172 $\pm$ 112	173 $\pm$ 110 <sup>ab</sup>
Water	13	13	-	13 <sup>d</sup>

\* As of date 100 FCFA  $\approx$  0.17 US \$.

\*\* Mean price was estimated using all formats of all foods available in each selling point.

<sup>†</sup> Mean prices with the same letter are not significantly different ( $p < 0.05$ ).

**Table 4. Numbers of healthy and unhealthy foods available for purchase and their price (FCFA\*  $\pm$  SD) by type of food outlet**

Food availability and mean price	Type of food outlet			Overall (n = 31 food outlets)
	Street food vendors (n = 18)	Boutique (n = 6)	Restaurants (n = 7)	
Number of different types of healthy food available (all forms and formats combined)	26 (58)	17 (23)	22 (35)	56 (120)
Mean price in FCFA $\pm$ SD /100g of healthy food**	231 $\pm$ 380	211 $\pm$ 233	230 $\pm$ 183	212 $\pm$ 221
Number of different types of unhealthy food available (all forms and formats combined)	37 (57)	22 (31)	25 (28)	83 (116)
Mean price in FCFA* $\pm$ SD /100g of unhealthy food**	178 $\pm$ 242	191 $\pm$ 197	305 $\pm$ 179	227 $\pm$ 303

\*As of date 100 FCFA  $\approx$  0.17 US \$.

\*\* Healthy and unhealthy foods include beverages.

Food outlets sold a greater number of unhealthy (n = 83) than healthy foods (n = 56) (Table 4). When considering all forms and formats, street food vendors sold more healthy foods (n = 58) than boutiques (n = 23) and restaurants (n = 35). Unhealthy food items were sold in similar amounts amongst all food outlets.

## 4. Discussion

This study described the types of food outlets that were present in Senegalese adolescent girl's school environment, the types of foods that were available, their prices and their nutritional quality, as well as adolescents' access to food in their home environment.

Our results show that a majority of adolescent girls had poor access to food in their home environment, as approximately two thirds of them were living in a food insecure household. The limited access to food in the home environment highlights the importance that the school environment can represent in providing opportunities for these girls to access food. In fact, a large variety of foods were available to adolescents in their school environment, with most of them being sold by street food vendors. Street food vendors were the most commonly visited type of food outlet in our study, regardless of which college the participants attended. These findings are similar to those of Battersby and Crush [19] who reported that street vendors are important food retailers in LMIC. While many of the foods that the adolescents were exposed to were unhealthy, street food vendors did offer a greater number of healthy food items as compared to boutiques and restaurants. In fact, although they offered energy-dense foods such as fast foods, sugary drinks and sweets, they also sold fruits, legumes and grains, tubers, roots and plantain products. While it is worth noting that none of the food outlets identified by the participants sold vegetables, this finding was expected since vegetables are normally purchased in public markets in Dakar [5].

With regards to food prices, meat, poultry and fish were among the most expensive foods followed by sweets. Grains, tubers, roots and plantain products, as well as legumes, were the cheapest. These findings are identical to those of Marras et al. [5] who also noted large variations in prices among food groups, as was the case in our study.

In light of these results, the school food environment seems to promote unhealthy foods which may negatively impact adolescents' diet. In fact, fast foods cost less than fruits, eggs, meat / poultry / fish, milk and dairy products, which makes them more appealing options particularly to

adolescents who have limited access to cash. It is therefore not surprising that fast foods represent a significant part of adolescents' diet [3]. Furthermore, being exposed to unhealthy foods in the school food environment may influence adolescents' general food preferences and increase their demand for foods of poor nutritional quality [6], thus leading to an unhealthy diet. Improving the quality of adolescents' diet may be particularly challenging given the low cost of fast foods and the higher cost of purchasing healthier options. For example, considering the average price of fruit was 260 FCFA per 100 g in our study, it would cost 1 100 FCFA (or approximately 1,70 US\$) to purchase the recommended daily quantity of 400 g of fruit and vegetables recommended by the World Health Organization [20] for one person. These findings are in line with data from the latest report on food insecurity and nutrition which provided an estimate of 1,60 US\$ for the daily purchase of 354 g of fruits and vegetables in LMIC [21]. In the Senegalese context, it is unlikely that such amount of money (1,60-1,70 US\$) would be spent for the sole purpose of purchasing of fruits and vegetables given the limited daily income of about 7 US\$ / worker and the needs to cover other food and non-food expenses [22].

Overall, our findings show that neither the home nor the school food environment appear to promote healthy eating. Therefore, actions are needed to improve the availability and accessibility of healthy foods in adolescents' environments. As stated in a recent joint consultation between UNICEF and GAIN [23], adopting a food systems approach is essential to ensure that adolescents' diets are healthy, affordable and sustainable. Specifically, partnerships among actors at multiple levels of the food system are needed to improve adolescents' food environment in and outside the home [23]. Additionally, identifying context-specific interventions, policy and programs that may help improve adolescents' diet is required, as significant efforts have not been undertaken to adequately address the nutritional needs of this population.

This is the first study to have provided insights on both the school and home food environment of adolescent girls in an urban region of Senegal. Additionally, this is the first study to describe, in a comprehensive manner, the types of food outlets that are most commonly frequented by adolescent girls in Dakar, as well as the availability and accessibility of foods sold in these outlets. This said, our study has limitations that need to be acknowledged. First, our results cannot be generalized to a broader population given that only two colleges participated in this study and that the school food environment was specific to those colleges. Second, it was not possible to assess all aspects

of the food environment that could influence the adolescents' food behaviors and dietary intake, as only the food outlets where the participants reported purchasing food were assessed. Third, given the cross-sectional nature of our study, our findings may also not reflect the year-round availability and access to foods nor the quality of the adolescents' diet throughout the year given the seasonal availability of certain foods.

## 5. Conclusions

Results of this study show that Senegalese adolescent girls' food environment does not appear to support healthy eating, as many have limited access to food at home and ample access to unhealthy foods in their school environment. Actions at multiple levels of the food system are needed to improve adolescents' availability and accessibility to healthy foods, including developing context-specific interventions, policy and programs that promote healthy eating among adolescents.

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## Competing Interests

The authors declare that they have no competing interests.

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## Supplementary Material

List of single foods included within each food group identified in all types of food outlets.

Food groups	Foods recorded
Cereals / roots / tubers / plantains	Bread ("French baguette", milk bread), couscous, "thiakry" (millet couscous), popcorn, taro, "ndir" (type of root)
Legumes	Peanuts (all types but sugar coated)
Nuts and seeds	NA
Milk and dairy	Milk (liquid and powdered), curd milk, cheese
Meat / poultry / fish	Fish brochette, braised fish, « dibi » (braised seasoned beef / goat / mutton)
Eggs	Chicken eggs.
Fruits	mango, baobab fruit, orange, clementine, "sidème" (fruit from the jujube tree), « dankh » / tamarin (from from the tamarind tree), "mad" (fruit from the Saba senegalensis tree), green cherry, « soumpe » (fruit of the date tree), grapefruit, papaya, banana, apple, pear
Vegetables	NA
Fast foods	All types of sandwich (e.g. tuna, eggs, French fries, liver, corned beef, green peas, spaghetti, chocolate, "niébé" (type of bean), meat, liver, poultry and cheese, "fataya" (fried dough with meat), "nems" (spring rolls), hamburger, shawarma, pizza, tacos
Sugary drinks	All types of juices with added sugar, coffee and tea with sugar, sweetened condensed milk, milk shakes
Oils and fats	NA
Sweets	Ice cream, cookies (all types), candies, gum, chocolate, sugar coated peanuts, dates, toffee
Fried and salty foods	Chips (all types), French fries
Condiments and seasonings	NA
Combined meals	"Domoda" (meat stew), chicken curry and cheese / egg, "thieboudienne / thiebou yapp" (rice with fish / meat), "mafé" (meat in peanut sauce), rice with chicken, couscous with meat, "yassa" (fish / meat in onion sauce), okra soup, meat with eggs.



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