

Towards adequate food environment in Benin public primary schools, the challenge of food supply and hygiene practices: a case study of three municipalities

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Abstract. *Background and aim:* School food environment is a component of food system which provides the opportunity to implement interventions that lead to better nutrition. This study aimed to describe two of the five components of food environment notably food supply and food safety through hygiene practices in schools inside Cotonou, Abomey-Calavi and Sèmè-Kpodji, in Benin country. *Methods:* Twelve schools were randomly selected from a sampling frame of all public primary schools with canteens and that have space for school gardens and closer to the market garden sites. In the selected schools, we assessed the diversity of the Food Supply using Food Group Score (FGS) and Hygiene practices using the Summary Hygiene Index (SHI). Data were mainly collected using semi-structured questionnaire administered to foods cookers/vendors and by observation within schools. Fifteen food groups were considered to determine the FGS and 15 for SHI. Wilcoxon test was used to compare scores among urban and peri-urban areas. *Results:* Food supply appeared to be limited in 9 schools (FGS < 8) over the 12 with no significant difference between peri-urban and urban zone (p-value = 0.72). The most represented food group which was available in all schools are cereals, legumes, nuts, seeds, followed by sweet foods and drink while others groups (source of vitamin A and micronutrients) are poorly represented. It appears in all schools a low variability of food within each group. Basically, 8 schools out of 12 have a SHI lower than the median score (08) and the urban zone has a SHI (SHI = 9.5 ± 1.29) higher than peri-urban (SHI = 6.5 ± 1.18) with p-value = 0.015. *Conclusions:* The food supply is not very diversified in public primary schools and hygiene practices need to be improved for a healthy food environment around schools.

Key words: primary school, food supply, food group score, summary hygiene index, Benin

Introduction

African countries are facing multiple burdens of malnutrition and Benin is not on the sidelines of this situation. Nearly 10% of adolescents were stunted, whereas anemia affected one-third of the school population (1). However, most studies focus on children

under 5 or pregnant women while malnutrition affects young children and adolescents with serious consequences. These consequences can include a lack of productivity and academic performance, a weakened immune system with an increase in infectious diseases (2). They can also be associated with delayed maturation, poor muscle strength leading to constraints

in capacity for physical work, and reduced bone density later in life (3). One way to address this problem is to act on school food environment (4). Schoolchildren spend nearly 8 hours at school; and improving the school food environment could be an approach contributing to improve the diet (5). Food environment appears to be a component of food systems and has been defined in several ways. According to Swimburn et al (6), food environment is considered as “the collective physical, economic, policy and socio-cultural surroundings, opportunities and conditions that influence people’s food and beverage choices, consumption patterns and nutritional health”. Food environment concept was seen from two angles. The personal environment includes food accessibility, promotion and quality, food affordability, convenience and sustainability, while the external environment is relevant to encompassing food availability, prices, vendor, product properties, marketing and regulation (7). These concepts show the scope and the importance of food environment in the diets of the population and call for actions focused on their pillars to improve diet quality. One of the frameworks identified by several countries in Africa to act on the food environment is the school. In our knowledge to date in Benin, few studies targeted schoolchildren diet and revealed a bad food practices and food insecurity among them (8,9). This situation highlights the important role of eating outside home for school children who spend 8 hours per day at school. Schools are a key setting to improve dietary behaviors. Moreover, a healthy school food environment is associated with lower rates of obesity (10). Among other factors, food supply influences school children’s dietary status and hence their learning abilities (11). Moreover, food patterns analysis of school children in low-and-middle-income countries (LMICs) showed low intake of flesh foods, fruits and vegetables and high consumption of energy-dense processed foods (12). The cognitive performance of school children and their academic achievement depend closely on the quality of their school diets (13).

The key role that school feeding plays in the eating behaviors of school children from LMICs (11,13–15) and how school food environment represents an effective setting to influence children’s food choices, shapes their eating behavior patterns, prevent multiple burdens including obesity and undernutrition have been reported (16).

In fact, all the components of the food environment are necessary to improve the diet of schoolchildren. However, given the context where schoolchildren are assisted by a school feeding program operating in the most disadvantaged schools, this study focused on the assessment of the diversity of food supply in schools as well as the hygiene practices around public primary schools with canteens, two aspects that will also contribute significantly to improve the school food environment in order to better address schoolchildren’s food and nutrition problems.

Method

Study area

The present study is the diagnostic phase through which data were collected to assess the baseline situation. This study is conducted in three municipalities: Cotonou, Abomey-Calavi and Sèmè-Kpodji (CAS). Cotonou is an urban area while Abomey-Calavi and Sèmè-Kpodji are periurban area. The choice of these municipalities was, first, based on the fact that market gardening is mainly practiced in urban and peri-urban areas, but also on the willingness to characterize the market gardening practices.

Sampling

The design of the study is a cluster randomized controlled trial implemented in Public Primary Schools (PPS) with canteen (Table 1). The following formula was used to calculate the sample size at 5% level of significance, 80% power. $n = 2(Z\alpha/2 + Z\beta)/\delta^2$

The design effect was determined by the formula $DE = 1 + (K - 1) * ICC$ where K represents the number (75) of schoolchildren per cluster and ICC the Inter-Cluster Correlation fixed at 0.05. A sample size of 861 schoolchildren was calculated.

The number of schools was then obtained by dividing the number of schoolchildren to be surveyed by the number of schoolchildren per cluster, i.e. 11.48 schools, hence the choice of 12 PPS. The PPS were randomly selected based on the sampling frame from the list of all PPS benefiting from the National

Table 1. Public primary schools per municipalities.

Municipalities	Cotonou	Abomey-Calavi	Sèmè-Kpodji
Public primary schools	Toyoymé, Yagbé A, Yagbé B, Lomnava	Dassekommey, Ouega-Tokpa, Ahossou-Gbèta Ahouato	Yagbé, Djèffa Plage, Kpakpakame Gbakpodji

Integrated School Feeding Program implemented by the World Food Program and Benin Government in the three municipalities. Between the 58 PPS benefiting from canteens in CAS we proceeded to a simple random selection without discount of 4 schools per municipality.

Ethical considerations

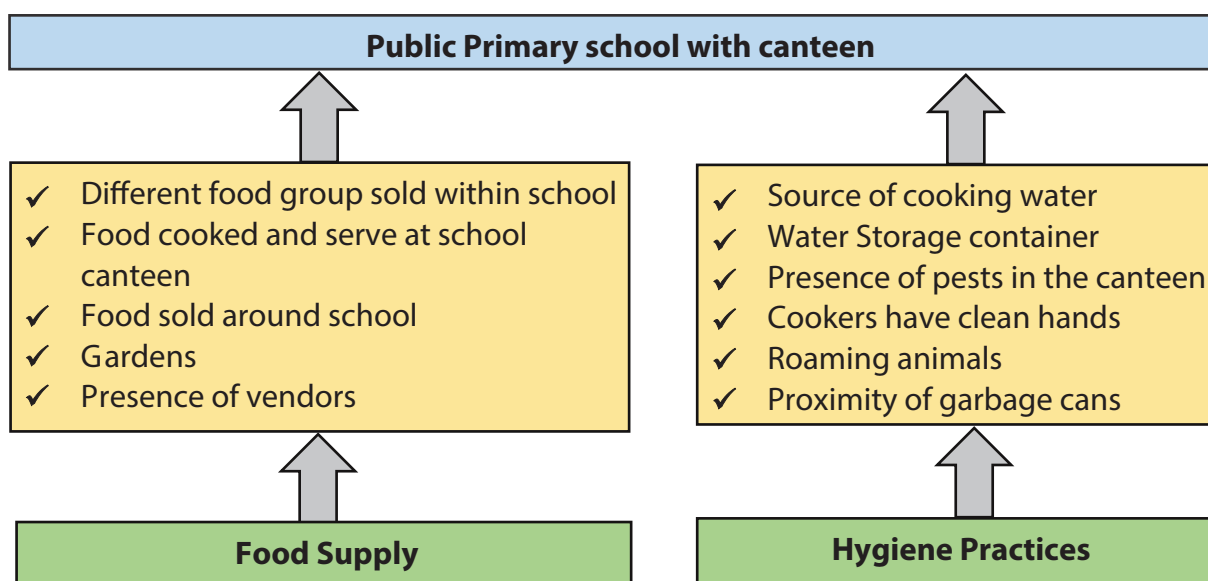
The present study was approved by the National Ethics and Health Research Committee (Authorization n° 53/MS/SGM/CNERS/SA) and the Ministry of Nursery (Pre-school) and Primary Education (Authorization n° 0031/MEMP/DC/DEP/SAS/SP). Moreover, informed consent was obtained from directors of school and cooks.

Data collection

Data related to the diversity of the food supply and hygiene practices were mainly collected. Data among the diversity of the food supply were obtained from a

collection sheet that was used to inventory all the foods available within and around each school. The list of all foods available in the school environment was compiled. Data related to hygiene around the preparation, hygiene of the handlers or cooks, presence of pests, cleanliness of the environment, presence and proximity of waste bins, hygiene of the container used for the storage of the water is kept, etc., were collected to assess the sanitary quality of foods cooked and served in canteens, through a semi-structured questionnaire administered to the cooks as well as by non-participant observation. This approach used to assess the hygiene was based on the guidelines on HACCP (18). Figure 1 shows the overview of the different aspects that need to be addressed in schools.

During the preparation, the interviewer observed and identified the critical points of contamination such as wearing of headgear, cleanliness of clothing, trimmed fingernails, use of apron, use of bib, coughing, nasal discharge, and wounds on the body. Observations allowed to assess the presence of animals roaming in the preparation site, the proximity of bins to

**Figure 1.** Overview of the assessment of food supply and hygiene practices.

the preparation site, the presence of the foodstuffs in the preparation site, the existence of the food storage site and the presence of pests (rats, mice, cockroaches, lizards, etc.) in the storage site. The quality of drinking water was assessed and this included source of water, cleaning of storage containers, covering of drinking and cooking water, etc. To minimize the influence of enumerator's presence on practices, they stayed at least three days in each school collecting other type of data (food consumption, anthropometry, etc.) and data related to hygiene were collected on the third day. Data were collected with tablets using Survey Solutions application.

Data management

After collection, data generated with the Survey Solutions server was corrected and combined to determine two indicators:

The first indicator concerns the Food group scores (FGS) which was calculated to assess the diversity of the food supply in each school using the food list. The foods available in the school environment were categorized into different food groups. The food groups considered here were adapted from those proposed by Adeleye et al (19); including cereals, vitamin A rich vegetables and tubers, white tubers, dark green leafy vegetables, other vegetables, vitamin A fruits, other fruits, organ meat, flesh meat, egg and egg products, fish, legumes/nuts/seeds, milk/milk products, oils/fats. To conform to the field realities, the group of sweet foods and drinks was added. A food group was assigned a score of '1' if it is available in the school and

'0' in the opposite case. The maximum score would be 15 for the school where all the food groups were available. The score median equal to 8 was determined to appreciate the FGS.

The second indicator is related to the Summary Hygiene Index (SHI): To assess food safety, the SHI reported by Webb et al (20) has been used. This overall index is calculated from four other indexes based on the simple weighting of hygiene practices. Each of these indexes represents the different pathways food contamination may occur (Table 2), as followed:

- Water: Source of water and contamination of stored water (Drinking Water Index, DWI);
- Food: Food storage conditions (Food Index, FI);
- Food: Hygiene practices related to cookers (Personal Hygiene Index, PHI) and
- Environment: Presence of animals, pests and garbage (Canteen Hygiene Index, CHI).

Each index item is appreciated by "Yes" or "No", according to the assessment criteria (Table 2).

Each item was scored as 0 or 1, with 1 representing positive behavior and 0, the negative one. The indexes were calculated as the sum of the hygiene practice. A summary hygiene index (SHI) was generated from the sum of the four (04) specific indices and had ranged from 0 to 15 (20). The score median equal to 8 was used to appreciate the SHI. SHI equal or greater than the median was considered as good hygiene and less than the median as lower hygiene practices.

Table 2. Indicators of hygiene used to develop summary hygiene index.

(DWI)1(Score: 0-3)	(FI) 2 (Score: 0-3)	(PHI) 3 (Score: 0-6)	(CHI) 4 (Score: 0-3)
Source of cooking water	Existence of food storage sites	Cookers have clean hands	Proximity of garbage cans
Water storage container	Presence of pests in the food storage site	Finger nails trimmed	Presence of pests
Covered water storage container	Clean dishes covered	Wearing of headgear	Roaming animals
		Wearing aprons	
		Clean outfits	
		Wearing of bibs	

Yes is coded 1 and No is coded 0; 1: Drinking water index; 2: Food index; 3: Personal hygiene index; 4: Canteen hygiene index.

Statistical analysis

Descriptive statistics were mainly used to assess the different parameters involved in this study. Wilcoxon rank sum test was implemented to compare food group score as well as the summary hygiene index among urban and peri-urban areas. Statistical analysis was performed in Stata software (version 16) and the significance level was set at 5%.

Results

Diversity of the food supply

Food groups score were relatively low and varied with schools (Figure 2). Only 3 schools out of the 12 achieved an FGS equal or greater than to the median score of 8, indicating a low diversity of food supply in the schools. PPS of Kpakpakame had the highest FGS (FGS=9), followed by PPSs of Lom-Nava and Dassekommey (FGS=8). The PPS

of Ahossou-Gbèta has the lowest food group score (FGS=4).

Food diversity within groups and schools

On the one hand, the most represented food groups available in almost all schools were cereals, legumes, nuts, seeds followed by sweet foods and drink, fish and egg and egg product. On the other hand, vitamin A rich vegetables and tubers, other vegetables, dark green leafy vegetables, vitamin A fruits, other fruits, organ meat, flesh meat, fish, milk/milk products, oils/fats, which are good sources of micronutrients, were poorly represented or not (Table 3 and Figure 3).

In all schools, cereals (rice, wheat, maize and sorghum based foods) and sweetened foods and drinks (pineapple juice, biscuits, bissap, candies) were at the top of the classification with four 4 food items. White tubers (cassava and yam based foods), legumes/nuts/seeds (cowpea and yellow cowpea), vitamin A fruit (*Carica papaya*) and others fruits (*Musa troglodytarum*

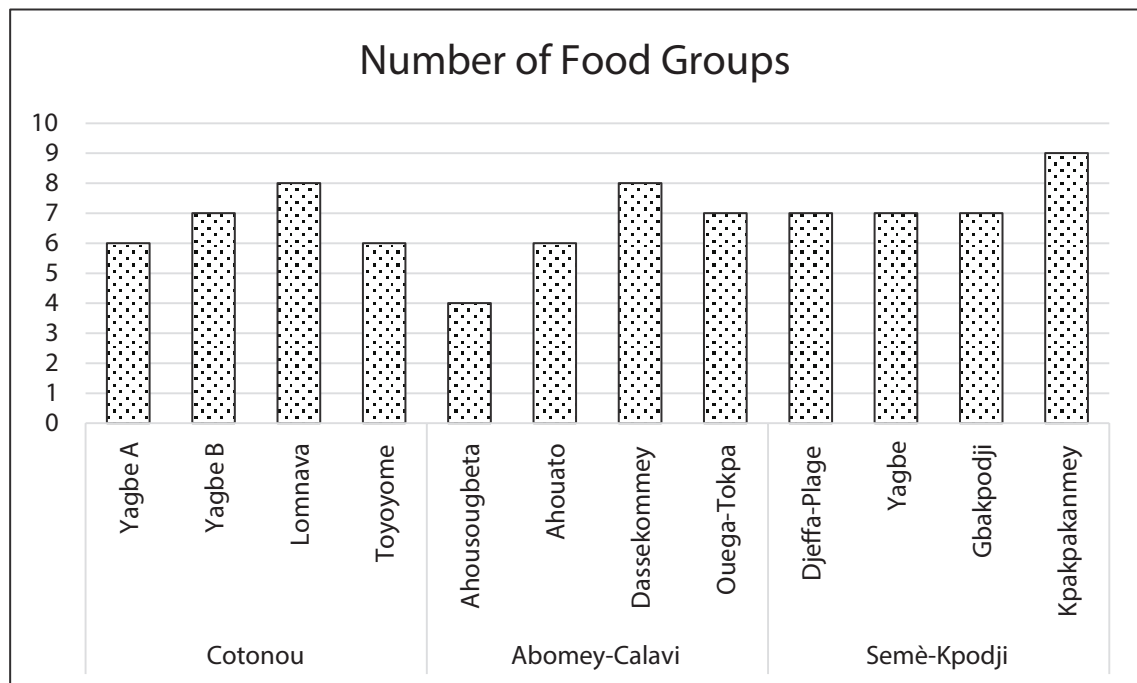


Figure 2. Food group score by schools.

Table 3. Foods groups available in the schools.

Municipalities	Cotonou				Abomey-Calavi				Semè-Kpodji			
	Yagbe A	Yagbe B	Lomnava	Toyoyome	Ahousoughbeta	Ahouato	Dassekomme	Ouega-Tokpa	Djeffia-Plage	Yagbe	Gbakpodji	Kpakpakannmey
Cereal	Wheat bread, rice, wheat fritter "doco"	Wheat bread, rice, macaroni, granulated fermented maize and sorghum porridge, wheat fritter "doco"	Rice, maize dough, wheat bread, wheat fritter "doco"	Wheat bread, macaroni, rice, granulated fermented maize and sorghum porridge, wheat fritter "doco"	rice, maize dough, wheat bread, wheat fritter "doco"	Rice, maize dough, wheat bread, wheat fritter "doco"	rice, maize dough, wheat bread, wheat fritter "doco"	Maize dough, rice, wheat bread, wheat fritter "doco"	Rice, maize dough, wheat bread, wheat fritter "doco"	wheat bread, macaroni, rice, vegetable yoghurt made from maize	Wheat bread, macaroni, rice, vegetable yoghurt made from maize dough, granulated fermented maize and sorghum porridge, wheat fritter "doco"	wheat bread, macaroni, rice, vegetable yoghurt made from maize dough
Legume/nuts/seeds	cowpeas, yellow peas	cowpeas, yellow peas	cowpeas, yellow peas	cowpeas, yellow peas	yellow peas	yellow peas	cowpeas, yellow peas	cowpeas, yellow peas	Yellow peas	cowpeas, yellow peas	cowpeas, yellow peas	cowpeas, yellow peas
vitamin A vegetables and tubers	-	-	-	-	-	-	-	-	-	-	-	-
white tubers	-	-	tapioca	-	Granulated fermented cassava, tapioca	Granulated fermented cassava, tapioca	tapioca	Granulated fermented cassava, tapioca	Granulated fermented cassava, tapioca	Yam, tapioca, granulated fermented cassava	Yam, tapioca, granulated fermented cassava	Yam, tapioca, granulated fermented cassava

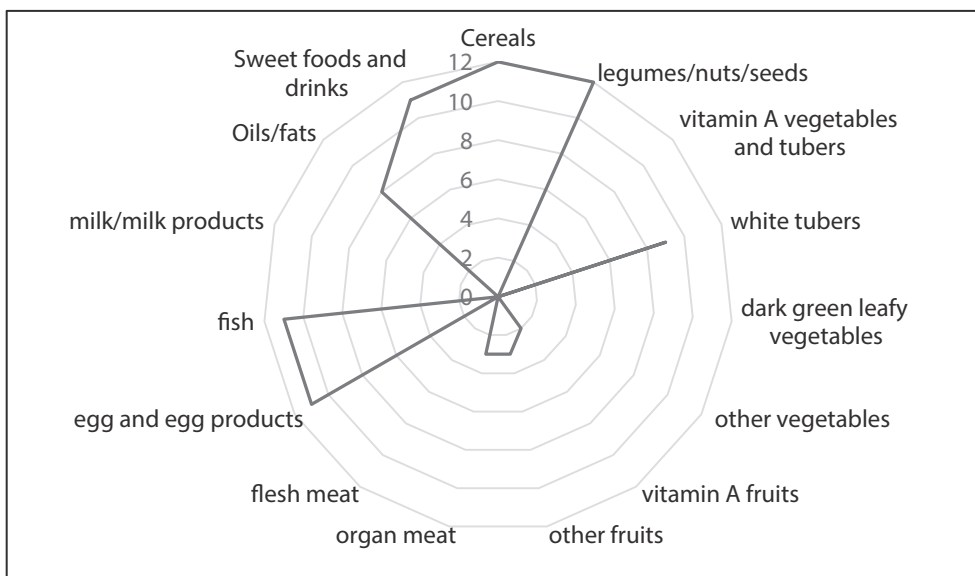


Figure 3. Number of schools where food group is available (offered).

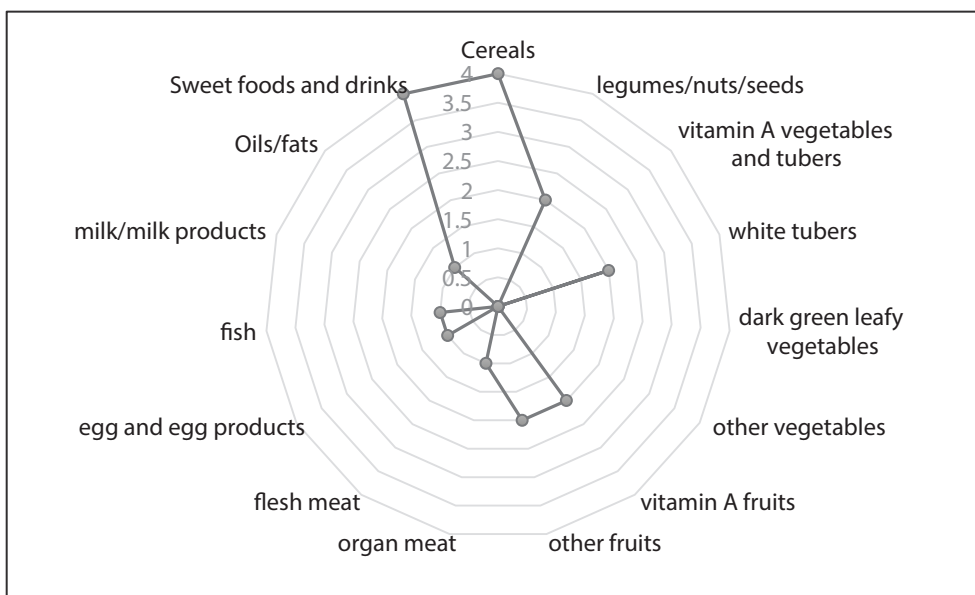


Figure 4. Variability of food within food group.

and *Citrus Sinensis*) were found in second position with 2 different items each. The groups of eggs and eggs product (boiled egg), fish, organ meat (sausage) and oil and fatty (fried tomato) had only one food item. No food item from milk and milk products, dark green leafy vegetables, other vegetables, vitamin A vegetable and tubers and flesh meat were available (Figure 4).

Hygiene practices

Overall, only four (4) schools had a hygiene score higher than the median score of 8. Among these schools, PPS of Yagbé A had the highest score (SHI= 11) followed by PPS of Yagbé B (SHI= 10). PPS of Lom-Nava and Ouéga-Tokpa followed by an

SHI = 9. Moreover, 8 schools had an SHI below the median. In addition, all the schools in Cotonou had a score above or equal to the median, while in Sèmè-Kpodji and Abomey-Calavi, the majority of schools were below the median (Figure 5).

Food group score and summary hygiene index within zone

The median FGS was 6.5 in schools in urban areas and 7 in schools in peri-urban areas ($p= 0.722$). SHI was higher in urban (9.5) than peri-urban area (6.5) ($p=0.015$) (Figure 6).

Discussion

Results showed that food supply in both urban and peri-urban schools was still limited in terms of availability of food groups and types of foods within each group. Dark leafy vegetables, milk and milk products, other vegetables, vitamin A rich vegetables and tubers and flesh meat were poorly represented as founded in a study relative to the food supply and dietary behavior of adolescents conducted in three colleges in Cotonou (21). The limited food supply trends

were also observed a study conducted in 20 schools in Bamako/Mali (22) one capital of West Africa. Authors found that the school food environment were not suitable for healthy foods. This situation could be explained by many ways: the low availability of foods rich in vitamins or micronutrients in the school environments could probably be explained by the perishability of these products due to the lack of foods storage methods in the schools (22). The lack of knowledge of cookers and food sellers about the nutritional and health benefits if eating healthy foods or different types of foods could also explain the non-diversity of food groups sold in school (23). Moreover, the cost of foods and the schoolchildren eating behaviors can affect the quality of the diet and the fact that certain type of food group is not proposed (24). Foods products like milk and fruits are relatively expensive and then less accessible to schoolchildren. The lack of policy or regulation regarding food sold in or around schools may also explain the situation observe in the 12 schools (25).

The diversity of the food supply determines food choice because, most of time, what is available is what is consumed and the availability in many food groups within school can influenced dietary habits (26). Lack of availability of a given food product affects food choices and the link between food availability

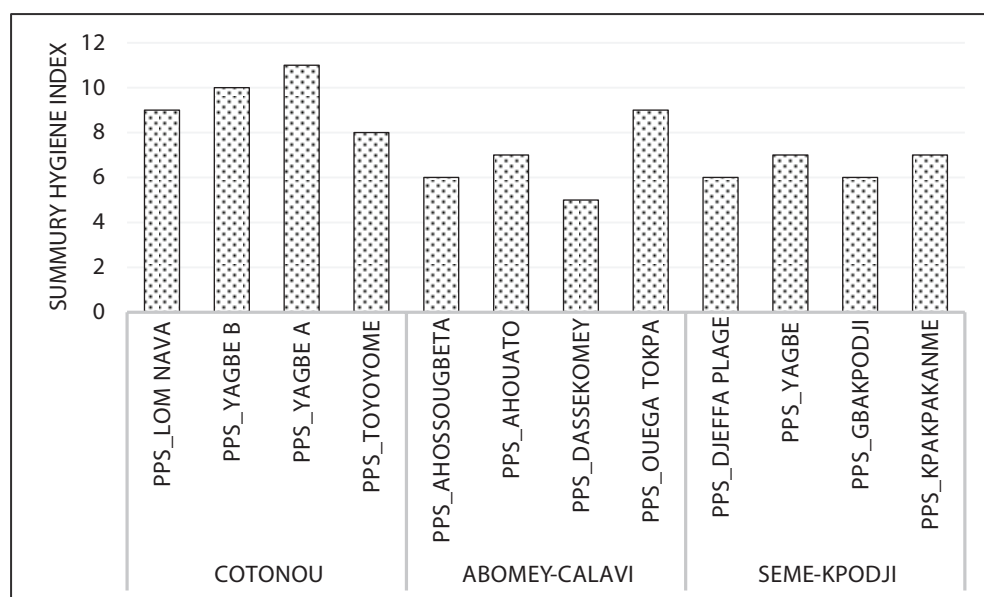


Figure 5. Summary hygiene index by schools. PPS: Public Primary School

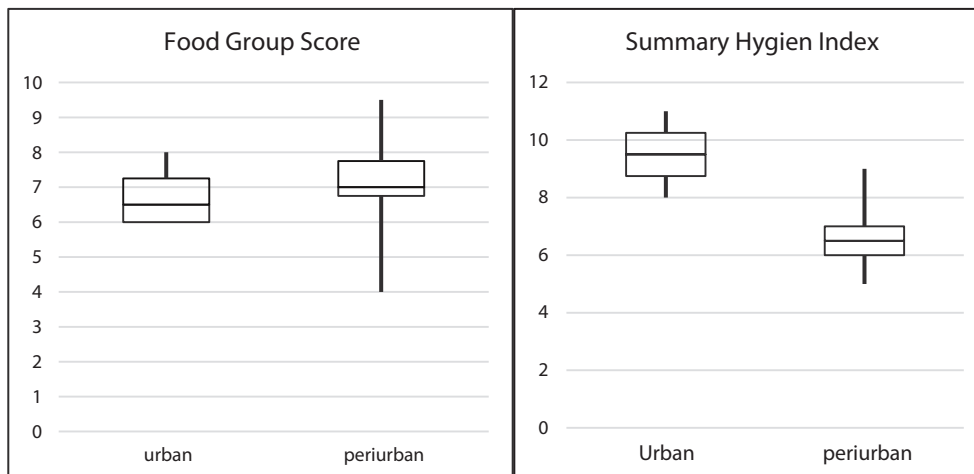


Figure 6. Plots of FGS and SHI within urban and peri-urban zone.

and consumption is two-ways, with one influencing the other (17). At a very basic level, food availability must precede consumption and a food cannot be consumed if it is not available. Study that have investigated the role of food availability in determining dietary intake have concluded that there is a positive relationship between food availability and food consumption (27) therefore the lack of a number of food groups within schools limit their consumption by school children. Diets rich in fruits and vegetables are generally linked with an improvement in general health (28, 29) due to the high amounts of fiber and phytonutrients present in fiber and vegetables (30, 31). The importance of adopting healthy eating behaviors such as consuming different food groups from childhood and healthy food choices in adulthood has been reported (32). Cognitive performance, academic achievement, low prevalence of obesity, good nutritional status can be a consequences of adopting healthy eating behaviors.

From these results, inadequate sanitary quality of foods prepared in all the schools was observed (Median of SHI \leq 8) The inadequate hygiene conditions observed could be explained by many factors such as: lack of hygiene policies and sanctions against canteen cookers for non-compliance with good hygiene practices of foods, lack of knowledge about the recommended hygiene practices and low accessibility to hygiene and sanitation facilities (22).

Similar results have been reported in southern Togo (33) and Cameroun (34) where some primary schools did not have adequate hygiene conditions and safety practices and facilities leading them to a high risk of contamination during foods preparation.

We had also observed that, in the urban area, the SHI seems significantly better than in the periurban area. The lack of water supply, more observed in periurban area could explain the disparities between urban and periurban area (35). Cost of acquiring water or difficulties encounter to have drinking water is higher in periurban area than urban due to the poor water infrastructures observed in periurban area.

Inadequate hygiene and sanitation practices could lead to health issues. It has been reported that poor hygiene practices in primary schools and a low level of sanitation in the school environment led to a high incidence and prevalence of childhood illnesses (36).

Poor hygiene practices in food preparation specifically can cause diarrhea and many other digestive infections (37, 38). Thus, the improvement of these practices could lead to better behaviors in terms of hygiene throughout their life and minimize the risks of occurrence of diseases (39, 40).

The results of the present study have made it possible to assess the diversity of the food supply in the schools surveyed as well as the hygiene practices, and to highlight the challenges to be met in terms of school feeding. From improving the range of foods

availability in term of diversity in schools to the quality of the meals served, this study was entirely justified. The presence of school canteens reinforced by the establishment of fruit and vegetable gardens and nutritional education program could improve both the diversity of the food supply and hygiene practices. Indeed, fruit and Vegetable gardens in schools accompanied by nutritional education program for school-age children are interventions that work nowadays according to United Nations System Standing Committee on Nutrition (4).

Limitation

This study ambition is to describe in depth food supply and hygiene practices. However, we faced two majors' limitations during our investigations. Firstly, the fact that the study was focused only on public primary schools and did not consider private schools which also could have its own reality and characteristics. Secondly, it was not also practically possible for us to assess all the components of food environment such as food accessibility, commodity and sustainability.

Conclusion

The food supply in school environment among the targeted public primary schools in Cotonou, Abomey-Calavi and Sèmè-Kpodji is not very diversified. This school food environment is dominated by the cereals, roots and tubers, and legumes-based food groups which are available as staple foods (source of energy). The study reveals that this environment is poor in fruits, leafy vegetables and dairy products, which are sources of essential micronutrients. In addition, inadequate hygiene practices noticed, compromised the sanitary quality of the food cooked and served to school children. These findings suggest taking additional actions like, school gardens and nutritional education program to make school environment suitable for adequate and healthy diet. Further studies will be therefore needed to assess the effect of setting up school gardens combined with a nutrition education program. This approach will make it possible to make progress on the link between improving the school food environment

and the quality of diets. That will help for taking corrective measures relating to the adequate management of the school canteens.

Conflict of Interest: Authors declare no conflict of interest.

Acknowledgments: The authors sincerely thank students, school children and teachers who were involved in the study. They gratefully thank the project HFA for financial support.

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Received: 28 November 2022

Accepted: 22 June 2023

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