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Nutritional and hygienic quality of meals served in school canteens in Togo: A cross-sectional study.

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ABSTRACT

School feeding is important in terms of nutrition, as it contributes to the prevention of malnutrition, especially in low-income countries. However, the nutritional and hygienic quality of meals served at schools in several countries is rarely examined. We aimed to assess the quality of meals served in school canteens in Togo. We designed a descriptive cross-sectional study and collected data from eight school canteens located in Southern Togo. Hygiene compliance and potential sources of food contamination in the canteens were assessed using the 5 M approach, which evaluates the performance of hygiene parameters at each "M" i.e., medium (cooking environment), raw material (staples), cooking material (kitchenware), method (cooking) and manipulator (cooks) in the food preparation environment. Foods were sampled in each school and analysed for microbiological (presence of *Salmonella*, total coliforms, and staphylococci) and nutritional (nutrient content) quality. The 5 M analysis revealed significant hygienic violations by the food preparators, as well as poor preparation conditions and utilization of low-quality raw materials in all the school canteens. Out of the 30 meal samples collected, 10 were of poor microbiological quality with the presence of total coliforms and staphylococci exceeding established limits of 10 and 100 cfu/g in 30 and 6.6% of the meals, respectively. However, none of the meals was contaminated by *Salmonella* spp. Nutritional analysis revealed that none of the meals served respected the nutritional balance, especially for contents in calcium, and vitamins A and C. Nonetheless, the iron content complied with the recommendations for children aged 9–13 years. Our analyses showed that several routes of contamination exist for the meals consumed in school canteens in Togo. Also, the nutritional quality of the ready-to-eat foods served at school canteens needs to be improved, particularly with the inclusion in the diet of fruits and vegetables to cover the micronutrient requirements.

1. 1- Introduction

The quality of school children's diets influences their cognitive performance and academic achievement (O'Halloran et al., 2020). The school food environment represents an effective setting to influence children's food choices and shapes their eating behaviour patterns even later at adulthood. Several studies have shown that school feeding plays

a key role in developing children's eating behaviours (Bardin et al., 2020; Micha et al., 2018; O'Halloran et al., 2020; Story et al., 2009). Therefore, the school food environment is considered a critical framework for influencing children's eating behaviours to prevent both undernutrition and childhood obesity (World Health Organization. Regional Office for the WHO, 2010). In fact, the majority of children eat on average two meals at school, which could correspond to

Abbreviations: CDP, Community Development Project; GNI, gross national income; ISO, International Organization for Standardization; NF, Norme Française (French standards); USD, United States Dollars; UNSCN, United Nations Standing Committee on Nutrition; WFP, World Food Program.

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approximately half of their total daily energy intake (O'Halloran et al., 2020). It is also possible that for most of the children, the meals consumed at schools may constitute the major sources of daily nutrient intake.

The United Nations Standing Committee on Nutrition (UNSCN) has recommended to Member States to implement school feeding policies in order to improve the health of school-age children (UNSCN, 2017). Although school feeding policies exist in several countries including several African countries, their implementation is not always effective (WHO, 2018). In 2012, about one-third of first-year and primary-school students were receiving food or eating school meals worldwide (UNSCN, 2017). Of these, 12% were living in low-income countries (gross national income, GNI per capita < USD 1045) (Fantom & Serajuddin, 2016) compared to 37% in upper-middle-income countries (GNI per capita: USD 4125–12,735) (UNSCN, 2017). In West Africa, few studies have looked at the hygienic and nutritional quality of foods served at schools and their findings showed that school meals were largely comprised of energy-dense staples, vegetables and fish, with no or minimum amounts of eggs, dairy or fruit served (Agbozo et al., 2018; Bigson et al., 2019). Moreover, various reports showed significant differences in the content of meals depending on the geographic locations within the same country, the type of schools (i.e. public or private), or the socio-economic conditions of the parents (Parish & Gelli, 2015; Ugochukwu et al., 2014). Besides, previous studies also showed that meals served at schools in West Africa are poorly diversified and may not provide adequate supply of essential micronutrients especially iron, vitamins A and C, and iodine (Bigson et al., 2019; Parish & Gelli, 2015). From a hygienic point of view, there have been many reports of chemical and microbiological contaminants in foods served at schools in several African countries, and even episodic cases of gastroenteritis due to *Salmonella* infection and other food-poisoning events in schools (Bigson et al., 2019; Parish & Gelli, 2015). Existing microbiological contamination of raw materials, inadequate cooking temperatures, contaminated cooking materials, cross-contamination, inappropriate food preservation and processing methods, and untrained staff may be the major causes of foodborne illness in schools (Motladiile et al., 2019).

Between 2008 and 2013, the Togolese Government initiated a “School lunch” programme with the support of the World Bank and the World Food Program (WFP), under the Togolese Community Development Project (CDP) (WFP, 2016). The Togolese School lunch programme aimed at providing at least one hot meal to preschool and primary school children, particularly to the poorest children residing in rural areas so as to increase school attendance and subsequently reduce dropouts and improve academic achievement. From 2014 the programme was officially launched by the Togolese government, with yearly budget to fund school feeding programmes put in place (FAO, 2020).

Since the implementation of this school feeding program in Togo, and to the best of our knowledge, no studies have been carried out to examine nutritional and hygienic quality of meals served in school canteens. Thus, we aimed at evaluating the hygienic and nutritional quality of meals served to schoolchildren from school canteens located in Southern Togo.

2. Materials and methods

2.1. Framework of study

From October to November 2016, our cross-sectional and descriptive study collected data on school feeding in the Zio prefecture, one of the three prefectures with school feeding programmes implemented in Southern Togo. Zio has 16 schools with school canteens serving a total of 2532 beneficiary students and those schools whose officials agreed to participate were included in the study. Thus, eight (8) out of 16 schools were divided by random draw. In each school canteen, foods were prepared following a standard menu and guidelines developed by the national board in charge of school feeding in Togo i.e. the CDP (WFP,

2016). A standardized food portion was provided daily to school children in uniform containers in all schools. The weekly list of meals served is summarized in Table 1. A sample of each meal was collected for microbiological analyses and for the quantification of micronutrient intakes in all selected schools.

2.2. Data collection

2.2.1. Hygienic quality of meals

A workstation analysis by direct observation was performed in school canteens using a hygiene assessment grid. We used the 5 M approach to evaluate the performance of each hygiene parameter at each “M” in the food preparation environment (FAO, 2009). Meal preparation staff (canteen workers) were not aware of the investigators’ visit to prevent changes in their usual practices. Three means of assessing hygiene parameters were defined, namely: minor (where the non-compliance is of minor importance), major (where the non-compliance is significant), and very serious (where the level of non-compliance is very high; i.e., excessive). To assess the violation on each “M”, a score of 1–3 was assigned to each level of failure for the parameter. The average of the scores was computed to assess the overall level of failure at each “M”: (minor: < 1.5, major: [1.5–2.5 [, excessive: ≥ 2.5); the number of hygiene parameters to be observed at each “M” being variable.

2.2.2. Microbiological quality of meals

Meals were aseptically collected and stored in coolers using cold packs that allowed storage at their initial temperature during transport. They were analysed at the National Hygiene Institute in Lomé. Thirty samples were analysed for the presence of three pathogenic microorganisms (coliforms, staphylococci and *Salmonella*). The standards used to assess compliance were French standards NF V 08–060 for thermo-tolerant coliforms at 44 °C (AFNOR, 2009), International Organization for Standardization (ISO) 6888–1 for coagulase-positive staphylococci at 37 °C (ISO, 1999) and ISO 6579 for *Salmonella* spp (ISO, 2017).

2.2.3. Nutritional quality of school meals

2.2.3.1. Food balance. For each meal, the nutritional composition was determined based on the classification of the foods included in the meal according to the Beninese Food Guide (Food and nutrition council Benin, 2015). The Beninese Food Guide was used in the absence of a Togolese food guide because of the similarities in the eating habits of the populations in these two neighbouring countries. In this guide, foods are classified into five main groups: group 1: cereals and tubers; group 2: meat, fish, beans and other protein sources; group 3: vegetables; Group 4: fruit; group 5: dairy products. The frequency of each food group in the school menu was calculated. A meal was considered balanced (qualitatively) when it contained all five (5) food groups.

2.2.3.2. Intakes of essential micronutrients. Meals served, and supposedly consumed by each schoolchild were quantified using the food models referenced in the Benin Food Guide (i.e., bowl and spoons). Iron, vitamins A and C, and calcium intake were evaluated and recorded for each menu. The daily and weekly averages were then calculated for all

Table 1

Standard weekly menu served in school canteens in Zio Prefecture, Togo, 2016

Day	Menu
Monday	Corn flour paste + tomato sauce + fish + seasonal fruit
Tuesday	Bean + gari ^a + fried tomato + seasonal fruit
Wednesday	“Ayimolou” (Rice + bean) + fried (tomato) + fish + seasonal fruit
Thursday	Pasta + fried/tomato sauce + bread/yam + seasonal fruit
Friday	White rice + tomato sauce + fish + seasonal fruit

^a Gari is local recipe made from cassava.

selected schools. The evolution of weekday-specific micronutrient intake by schoolchildren was assessed through the week progression plots. The micronutrient intake from school meals was compared to the recommendations by the National Institute of Medicine (IoM) for children aged 4–8 years and 9–13 years (Institute of Medicine, 2006).

2.3. Statistical analysis

Data collected was entered and cleaned (i.e., exploring missing data and coding of categorical variables) using Microsoft Office Excel® (Microsoft 2010; USA). Quantitative variables were expressed as mean and standard deviation, whereas frequency and percentage were reported for qualitative variables. West Africa's food composition table (Stadlmayr et al., 2012) and Alimetheque Pro v5.0 (Paradis, 2015) were used to determine the composition of the menus in iron, calcium, and vitamins A and C. We used one-sample t-tests to compare levels of intakes to the recommendations. *P*-values < 0.05 were considered statistically significant. The statistical analyses were carried out using Stata 14.0 (StataCorp, College Station, TX, USA) and R (R Foundation for Statistical Computing, Vienna, Austria).

2.4. Ethical considerations

Authorizations were obtained from the Ministry of primary education, the CDP, the school administrative officials, and from canteen workers. Data were collected anonymously and coded confidentially.

3. 3- Results

3.1. Presence of bacteria and hygiene conditions in the meal preparation environment

Salmonella was not detected in any meal. Nevertheless, total coliforms and staphylococci were present (i.e., ≥ 10 or ≥ 100 cfu/g) in 30 and 6.6% of samples, respectively (Table 2). Overall, of the 30 meals analysed, 33.3% ($n = 10$) were of poor microbiological quality. Major breaches were observed regarding hygienic rules by the cooking personal, contamination routes for the raw materials, and processing methods in all schools (Table 3). Very serious deficiencies in the handling of the cooking materials (kitchenware) were observed in all the surveyed schools. Hygiene deficiencies in meal preparation conditions (medium) were also noticed, classified as major in 50% of schools and very serious (excessive) in the other 50%.

3.2. presence of different food groups in the school menu

Meals served to schoolchildren contained the first four food groups in the Beninese food guide. Cereals and tubers (Group 1) were the most frequently served foods with an estimated daily provision of 36.6%, followed by protein-derived foods (Group 2) which were included in

Table 2

Distribution of meals served in school canteens in Zio Prefecture according to microbiological compliance, 2016 ($n = 30$).

Meals analysed	n (%)	Standard	Compliance n (%)
Presence of bacteria			
NO*	20 (66.6)		
YES	10 (33.3)		
- Total coliforms		< 1×10 cfu/g*	21 (70)
		$\geq 1 \times 10$ cfu/g	9 (30)
- Staphylococci		< 1×10^2 cfu/g	28 (93.3)
		$\geq 1 \times 10^2$ cfu/g	2 (6.6)
- <i>Salmonella</i> spp.		Absence	30 (100)

*NO corresponds to <10 cfu/g and <100 cfu/g for total coliforms and staphylococci, respectively, whereas designates also the absence of *Salmonella* spp.

**cfu/g: colony-forming units per g.

33.6% of meals. Vegetables (Group 3) and fruit (Group 4) were served in 26.7% and 3.4% of school meals, respectively. No dairy products (Group 5) were served in any of the canteens. None of the meals served to the school children were nutritionally balanced.

3.3. Daily and weekly average intakes of micronutrients

The average daily intakes of iron, vitamin A, vitamin C and calcium for each menu and for all schools are shown in Fig. 1. Variations in nutrient content (from D1-D5 i.e., Monday-Friday) were observed with the daily menu. The menu on D2 was the richest in iron and calcium, while the menus on D4 and D5 were the lowest in iron and calcium, respectively. On the other hand, D2 menu had the lowest content in vitamins A and C. The highest levels of Vitamin C and Vitamin A were observed for D1.

The average weekly intakes of micronutrients compared to the nutritional recommendations by school age groups are shown in Fig. 2. The average iron intake was not different from the recommendations in children aged 9–13 years ($P = 0.169$), but it was significantly below recommended intakes for children aged 4–8 years ($P < 0.001$). The mean intakes of calcium, and vitamin A and C were below the recommended intakes for the children irrespective of their age group (All $P < 0.001$).

4. 4- Discussion

This study is the first to evaluate both the hygienic and nutritional quality of school meals in Togo. Our findings highlighted major or very serious deficiencies on all points of the 5 M approach. Meals were contaminated with total coliforms and staphylococci in 30 and 6.6% of the samples analysed, respectively, and none of the meals served were nutritionally balanced. Variations in nutrient content of the menus were observed throughout the days of the week. The assessment of micronutrient intake showed low content of nutrients in the school menu, with the exception of iron intake for children aged 9–13 years, which was in line of recommended guidelines.

Our findings confirmed that the quality of meals served in school canteens is a concern in Togo, as is the case in several other developing countries. A school feeding study conducted in N'Djamena, Chad, reported that the safety and hygiene of the food offered were inadequate, despite the relatively good diversity (constituted with foods items from several food groups) (Naibe Maimangyang, 2019). In another study in primary schools in Yaoundé, Cameroon, foods were prepared and served under poor hygiene conditions; 85% of the schools surveyed did not have adequate facilities (drinking water, tables, chairs, toilets), which posed a high risk of contamination during the preparation of the meals (Pial et al., 2017). In contrast to the situation widely described in different African countries, the level of hygiene is generally satisfactory in school restaurants in developed countries, ensuring the good microbiological quality of meals (Cummings, 2019). The results of our study showed that if appropriate analyses are conducted, they could help in spotting critical contamination routes and these could be addressed, even in a low income countries like Togo.

Suboptimal quality of the foods and inadequate hygiene conditions in their preparation environment could be explained by an often-inadequate framework and facilities for group catering. Moreover, a lack or insufficiency of awareness among canteen staff and the absence of sanctions against restaurant owners for non-compliance with good hygiene practices may explain poor handlings of the foods. The absence of *Salmonella* in meals found in this study is definitely a positive result which needs to be highlighted, particularly because contamination by *Salmonella* is often observed with meals prepared and sold onsite in places of high population-density, such as university campuses. As an example, the food analysis performed in meals sampled at the University of Abomey-Calavi in Benin revealed the presence of many bacteria, including two strains of *Salmonella enteritidis* (Ahojo et al., 2010).

Table 3
Hygiene score for each parameter of 5 M in school canteens studied in Togo, 2016

Schools	Manipulator		Medium		Material		raw Material		Methods	
	n*	%	n	%	n	%	n	%	n	%
1	1.8		2.8		2.5		2.3		2.1	
2	1.8		2.8		2.5		2.2		2.1	
3	1.7		2.4		2.5		2.2		2	
4	1.7		2.4		2.5		2.2		2	
5	1.7		2.4		2.5		2.2		2	
6	1.8		2.8		2.5		2.2		2.1	
7	1.7		2.4		2.5		2.2		2	
8	1.8		2.8		2.5		2.2		2	
Results**										
Minor		–		–		–		–		–
Major		100		50		100		100		100
Excessive		–		50		100		–		–
Total		100		100		100		100		100

* Score.

** Classification of results at each M as described in paragraph 2.2.1

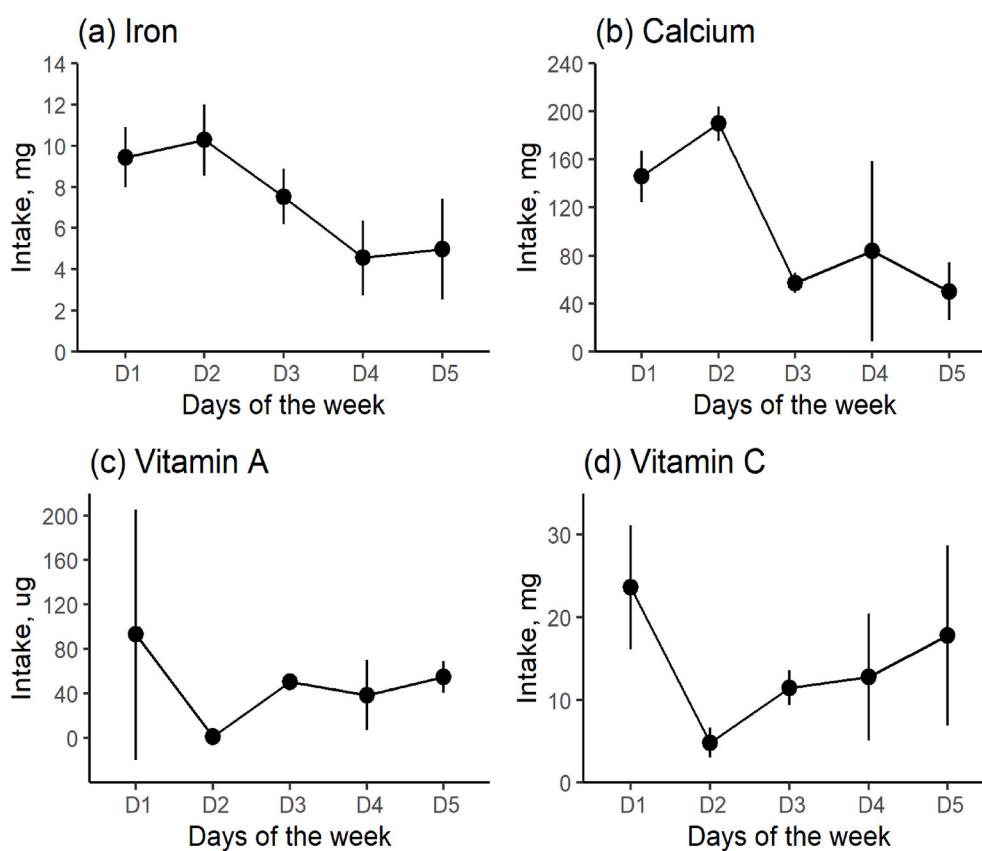


Fig. 1. Micronutrient change (mean \pm standard deviation) in meals served to Togolese schoolchildren during a week. (a) Iron intake, (b) Calcium intake, (c) Vitamin A intake, and (d) Vitamin C intake for 5 different menus served each day of the week in 8 schools. D1-D5 are days of the weeks, from Monday to Friday.

The nutrient composition of the foods consumed in the canteens was diverse enough, albeit improvement is needed. Dietary intakes of calcium and vitamins A and C that were low and variables from day to day in this study may have been due to non-consumption of dairy products (calcium) and very low consumption of fruit (vitamins A and C). Similar results for calcium, iron, vitamin A, and other essential nutrients (vitamin D, folates and zinc) were found in the assessment of the nutritional quality of meals consumed by school-aged children (5–10 years) and adolescents (10–19 years) in countries of the Eastern Mediterranean Region (Al-Jawaldeh et al., 2020). These deficiencies can have a significant impact on children's health, as for many children with unfavourable socio-economic conditions, the school meals likely

constitute the sole meal of the day.

The low content of essential nutrients in some menus and the inter-school variation in the nutrient composition of meals justify that the managers of the school canteen programmes in Togo should revise the weekly menu for school children and standardize the cooking practices. The use of local foods for enrichment could be recommended, while increasing awareness and training of employees working in the canteens to assure optimal handling and improvement of the cooking conditions and methods. The presence of fish in meals three days out of five was significant considering fish's richness in proteins of high biological value, iron, and essential fatty acids. Nevertheless, the quantity of fish consumed by school children should be increased.

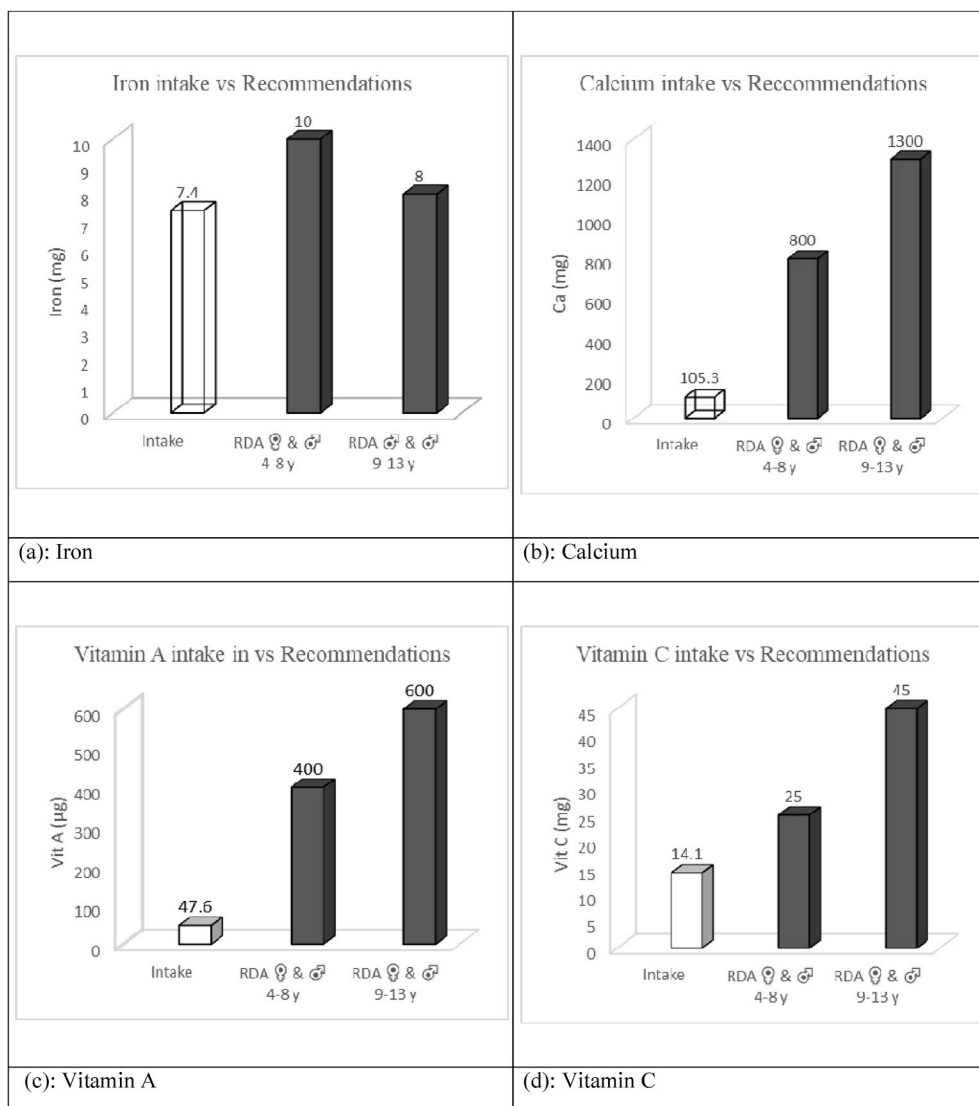


Fig. 2. Intakes of a) Iron, b) Calcium, c) Vitamin A and d) Vitamin C, from meals served in school canteens in Togo, compared to recommendations for school aged children proposed by Institute of Medicine. Intakes of iron, calcium, and vitamins A and C (white bars) were compared to Recommended Dietary Allowance (grey bars) for daily intakes in children aged 4–8 years (all *P*-values were <0.001), and 9–13 years (*P*-values were <0.001, except for iron with a *P*-value of 0.169).

This study covers only one in five regions of Togo and may not necessarily reflect the situation in other areas of the country. It would also have been interesting to measure iodine in the salt used by canteen employees for meal preparation, given its importance in the growth of school children, but this aspect has not been addressed due to lack of financial resources. Finally, in the absence of a Togo-specific food guide, the Beninese food guide was used and this may not totally reflect the situation in Togo.

Future national studies should deepen the nutritional contribution of meals served to school children in terms of portions (balanced plate) and coverage of all essential nutrients. They should also look at the impact of school feeding on student achievement, which has not been considered in this study.

5. Conclusion

Several deficiencies were noted in relation to the hygienic quality of meals served to schoolchildren in Togo’s Zio Prefecture. In addition, none of the meals served were balanced and micronutrient intakes were mostly below the recommended levels. However, the Togolese Government’s efforts to feed almost all schoolchildren free of charge, and subsequent institutionalization of school feeding, are positive and beneficial in a country where various forms of malnutrition coexist. There is still work to be done to improve the hygiene and nutritional

qualities and to introduce regular inspections in school canteens to ensure healthy meals for school children.

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CRedit authorship contribution statement

Carmelle Mizéhoun-Adissoda: Conceptualization, Methodology, Writing – original draft, Formal analysis, Writing – review & editing, Review & editing. **Koffi Alouki:** Investigation, Data curation, Formal analysis. **Menonli Adjobimey:** Writing – review & editing. **Achille Yémoa:** Investigation, Data curation. **Raïssa Itiblitse:** Investigation, Data curation. **Florence Alihonou:** Data curation, Writing – review & editing, review. **Elom K. Aglago:** Writing – review & editing, Validation, Supervision. **Jean-Claude Desport:** Writing – review & editing, Validation, Supervision.

Declaration of competing interest

None.

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