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Research Article

Comparative Study of Nutritional Status and Academic Performance in Schools with and without School Canteens in South-west Benin

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Abstract

Introduction: Food is recognized as an essential factor for school performance because poor nutrition among school-aged children seriously compromises their health and their ability to learn. The purpose of this study was to compare nutritional status and academic performance in schools with and without school canteens; and identify factors associated to school performance.

Methods: This was a cross-sectional analytical study which took place from May 26 to June 12, 2020 in public primary schools in rural Ouidah districts with or without government school canteens. A total of 366 pupils were surveyed, including 183 in canteen schools and 183 in schools without canteens. Data on nutritional status, school performance, socio-demographic characteristics, individual characteristics and diet were collected.

Results: The prevalence of thinness was higher in schools without canteens (44.81%) compared to schools with canteens (28.96%). The prevalence of stunting was also higher in schools without canteens (26.23%) compared to schools with canteens (19.67%). However, overweight was higher in canteen schools (1.09%) compared to schools without canteens (0.00%). Academic performance was acceptable among 51.37% of pupils in canteen schools, compared with 40.44% among pupils not benefiting from the school canteen project. In multivariate regression, factors associated to academic performance were, the sixth-grade class (OR = 12,03 avec IC 95% = [4,15-34,82]), moderate chronic malnutrition (OR = 6,67 avec IC 95% = [2,12-21,00]), the consumption of meat, fish or eggs 3 to 6 times a week (OR = 0,13 avec IC 95% = [0,01-0,97]), non-consumption of legumes in a week (OR = 9,12 avec IC 95% = [5,75-42,64]), vegetables consumption 1 to 2 times in a week (OR = 10,63 avec IC 95% = [2,09-53,99]) and the non-consumption of dairy products in a week (OR = 8,52 avec IC 95% = [3,32-21,88]).

Conclusion: These results show that malnutrition is a health problem that remains present in schools in Benin and that it affects the academic performance of pupils. Actions to improve the food supply of the school feeding program and to extend it to all schools in rural districts as well as in urban districts are necessary.

Keywords: Pupils; Nutritional Status; School Performance; School Canteen

Introduction

Malnutrition is a group of disorders or conditions resulting from the deficiency or excess of one or more essential nutrients [1]. It encompasses several nutritional disorders and pathological conditions such as intrauterine stunting, acute malnutrition, stunting, iron deficiency anaemia, vitamin A deficiency, iodine deficiency, chronic energy deficiency, overweight and obesity. Among the main factors involved in the occurrence of malnutrition in children

is food insecurity [2]. Indeed, the prevalence of undernutrition in African regions increased between 2015 and 2016, from 20.8% to 22.7% [2]. Food insecurity affects the health and nutritional status of pre-school children and these consequences persist during school age, subsequently affecting children's school performance [3]. Several studies have highlighted the effect of nutritional status on school performance. Indeed, a recent study conducted in Ethiopia on the correlation between nutritional status and school performance of pupils revealed that pupils with the lowest academic performance were wasted (14.1%), underweight (35.50%) and stunted (41.9%). In addition, multivariate logistic regression analysis showed that stunted and underweight children had a very low probability of performing well academically compared to children with good nutritional status [4].

According to several authors around the world and particularly in Africa, student performance is linked not only to the quality of the food and their nutritional status, but also to the socio- economic level of the parents, the school environment, poverty-related factors such as unemployment, illness and illiteracy of the parents, but also to the learner himself/herself as well as to the supervision he/she receives at home [4-7].

In response to these findings, in 2017 the government of Benin signed an agreement with the World Food Program for the implementation of a 4-years Integrated National School Feeding Project (PNASI) in food insecure and under-schooling areas [5]. The general objective of this project is to strengthen school feeding in Benin by developing a multisectoral approach and by favoring local food purchases to improve school performance, dietary diversity and student nutrition in schools with canteens. The aim of the present study was to compare nutritional status and school performance between public primary schools with and without government school canteens; and to identify factors associated with school performance in the commune of Ouidah in southern Benin.

Materials and Methods of the Study

Settings

Ouidah is a small urban-rural coastal town in the south-west of Benin, located 35km from the economic capital Cotonou. It is bordered to the north by the communes of Kpomassè and Tori-Bossito, to the south by the Atlantic Ocean, to the west by the commune of Grand-Popo and to the east by the commune of Abomey-Calavi. The city has 10 arrondissements and 60 villages and city districts. Its population is estimated at 162,034 inhabitants in 2013, with a growth rate of 3.5% per year based on projections from the last census in 2013 [8]. In the education sector, the commune of Ouidah has a public university training institution (IRSP- CAQ) of regional scope, eight (8) general education colleges and seventy-five (75) public primary schools. Of the 75 primary schools, 26 have government school canteens [5,8].

Type and population of study

- This was a cross-sectional exposure/non-exposure study with an analytical focus that took place from 26 May to 12 June 2020.
- The study population consisted of school children enrolled in public primary schools in the city of Ouidah for the 2019-2020 academic year.

Sampling

Sample size

The minimum sample size was 183 pupils in both schools with and without canteens. This size was determined using the Schwartz formula with an α error of 5%, a precision of 5% and an estimated rate of good school performance of 12.8% in a rural study [9]. A 5% margin was added to the resulting sample size.

Selection of participants

In the framework of this study, we worked only in the rural districts of the city of Ouidah because the National School Feeding Project is not implemented in the urban districts of the commune of Ouidah. The pupils were selected by a random survey at three levels:

- **At the first level:** Four rural districts were selected out of the six in the city of Ouidah,
- **At the second level:** One school with a canteen was drawn at random from each district, using the numbered list of schools in the district as a sampling frame. A school without a canteen was also chosen in the same boroughs as the schools with canteens and as close as possible;
- **At the third level:** In each selected school, pupils from fourth-grade to sixth-grade aged between 8 and 14 were randomly selected from the list of each class, with 15 pupils per class.

The variables of the study

Dependent variable

The dependent variable was academic performance with its modalities: 'acceptable' and 'poor'. The academic performance of students was measured by calculating the total average of summative assessments already completed for each student in each grade. Thus, students who would have had a total average of previously completed assessments of less than 10/20 were considered to have performed poorly; while those who had an average of 10/20 or more were considered to have performed acceptably.

Independent variables

The independent variables included:

- Socio-demographic and economic factors of the pupils: age, gender, religion, household size, school and class attended, distance from school to home, parents' occupation, nature of the guardian, the socio-economic level of the pupils's household;
- Individual factors of the pupils: preferred subject, history of repetition, school delay, absenteeism, homework help, parents as teachers;
- Nutritional and health factors of pupils: nutritional status, eating habits and history of illness in the last 30 days before the survey.

Data collection procedures

Data were collected using a questionnaire that was pre-tested in a school outside the study area. The errors observed were then corrected in the final version of the questionnaire.

Data analysis

The data were analyzed with STATA 11.0 software. The sample was described by factor group. To determine school performance, the averages of the pupils were grouped into two groups in order to obtain the proportion of pupils who had reached the 10/20 threshold on the one hand and the proportion of those who had not reached this threshold on the other. We then proceeded to a comparison test of proportions (chi-square) between the two categories of schools. The same approach was used for the comparison of the indices related to the nutritional status of pupils in the two types of schools. The significance level chosen for these different tests was 5%. Next, a bivariate analysis was performed using logistic regression. This allowed us to determine the associations between the school performance of the pupils and the different factors through the crude odds ratios or Odd Ratio (OR) and their 95% confidence interval [95% CI]. In the multivariate analysis, the variables that had a p-value of less than 20% in the bivariate analysis were entered into an initial multivariate logistic regression model and we proceeded to a stepwise top-down elimination to search for factors associated with school performance. The variables retained in the final model were those with a p-value of less than 5%. The fit of the final model was then tested using the Hosmer Leme show test. According to this test, the model is said to be adequate when the p-value is greater than 5%.

Ethical aspects

Authorization from the school district and the head teachers of the various schools was obtained before the survey began. All targets were informed of the nature and objectives of the study. Free and informed signed consent was obtained from the respondents. We guaranteed confidentiality to our respondents and collected data in absolute anonymity.

Results

Socio-demographic and economic characteristics of pupils

Most of the pupils surveyed were 12 years old and the median age was 12 ± 6 years. Male students were the most numerous (53.28%). The fourth grade was the least represented (32.24%). The average household size of the pupils was 7.19 ± 3 persons and the average socio-economic well-being score of the pupils's households was 18.07 ± 0.21 with extremes ranging from 7 to 30. All households of the surveyed pupils had a low level of socio-economic well-being. More than half of the surveyed pupils reported that the distance from their home to school was long (53.83%). Most of the students lived with both parents (86.89%).

Anthropometric nutritional status of school children

Table 1 below summarizes the anthropometric nutritional status of the school children surveyed. The prevalence of thinness in the present study was 36.88%, that of stunting was 22.95% and that of obesity was 0.55%. In schools without canteens, the prevalence of thinness was 44.81% and that of stunting was 26.23%. In schools with a canteen, the prevalence of thinness was 28.96%, that of stunting was 19.67% and that of overweight was 1.09%.

The prevalence of thinness was significantly higher in schools without a canteen, while the prevalence of overweight was higher in schools with a canteen (p = 0.007).

Nutritional index	Schools without canteens		Schools with canteens		Total		p
	n	%	n	%	n	%	
BMI-for-age index							0.007
Normal	101	55.19	128	69.95	229	62.57	
Moderate thinness	67	36.61	40	21.86	107	29.23	
Severe thinness	15	8.20	13	7.10	28	7.65	
Overweight	0	0.00	2	1.09	2	0.55	
Height-for-age index							0.308
Normal	135	73.77	147	80.33	282	77.05	
Moderate stunting	45	24.59	33	18.03	78	21.31	
Severe stunting	3	1.64	3	1.64	6	1.64	

Table 1: Nutritional status of pupils according to BMI-for-age and height-for-age index.

Academic performance of pupils

Figure 1 below presents the academic performance of the pupils. The average academic performance of the students was 9.85 ± 1.76 with extremes ranging from 4.75/20 to 15.75/20. The assessment of academic performance at the threshold of 10/20 showed acceptable performance in 54.10% of the pupils and poor performance in 45.90% of them. In schools with a canteen, 51.37% of pupils had an acceptable performance against 48.63% who had a poor performance. In schools without a canteen, 40.44% of the pupils had an acceptable performance compared to 59.56% who had a poor performance. The average performance of pupils in schools with a canteen (10.03 ± 0.12) was significantly higher than that of pupils in schools without a canteen (9.51 ± 0.13; p = 0.0001). At the 10/20 threshold, there was a significantly higher acceptable performance in schools with a canteen (51.37%), compared to schools without a canteen (40.44%) (p = 0.03).

Factors associated with school performance of pupils

The univariate analysis of socio-demographic and nutritional factors associated with school performance of pupils showed that age, class, distance from school and mother's occupation were the

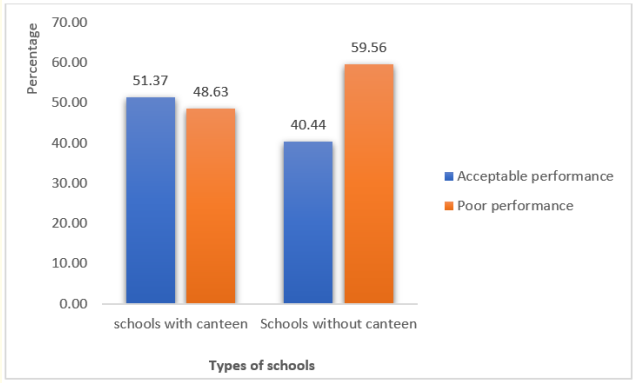

Figure 1: Comparison of school performance between schools with and without school canteen.

factors associated with school performance of pupils. Regarding nutritional factors, height-for-age index, frequency of consumption of meat, fish or eggs, frequency of consumption of legumes, frequency of consumption of vegetables and frequency of consumption of dairy products were associated with school performance of pupils (Appendix 1: Table a).

In multivariate logistic regression (Table 2), pupils in the sixth grade were more likely to perform poorly in school compared to pupils in the fourth grade (OR = 12.03 with 95% CI = [4.15-34.82]); moderately stunted pupils were more likely to perform poorly in school compared to normal height pupils (OR = 6.67 with 95% CI = [2.12-21.00]); pupils who consumed meat, fish or eggs 3-6 times a week were less likely to perform poorly at school compared to pupils who consumed them every day, adjusting for other variables (OR = 0.13 with 95% CI = [0.01-0.97]). Among pupils, those who did not consume pulses in a week were more likely to perform poorly at school compared to pupils who consumed pulses every day of the week, adjusting for other variables (OR = 9.12 with 95% CI = [5.75-42.64]); students who ate vegetables once or twice a week were more likely to perform poorly at school than students who ate vegetables every day, adjusting for other variables (OR = 10.63 with 95% CI = [2.09-53.99]); students who did not consume dairy products at all in a week were more likely to perform poorly at school compared to students who consumed dairy products every day, adjusting for other variables (OR = 8.52 with 95% CI = [3.32-21.88]).

Variables	Poor school performance		
	$_{adjusted}$OR	[95% CI]	p-value
Classe			
4th grade	1	-	-
5th grade	2.60	[0.97-6.93]	0.055
6th grade	12.03	[4.15-34.82]	0.000
Mother's occupation			
Unemployed	1.99	[0.69-5.69]	0.197
Farmer	11.33	[0.73-174.35]	0.082
Artisan	1	-	-
Trader	2.82	[1.05-7.62]	0.040
Size-for-age index			
Normal	1	-	-
Moderate stunting	6.67	[2.12-21.00]	0.001
Severe stunting	NA	-	-
Consumption of meat, liver, fish			
Every day	1	-	-
1-2 times a week	2.84	[0.37-21.77]	0.313
3-6 times a week	0.13	[0.01-0.97]	0.047
No day	NA	-	-
Pulses			
Every day	1	-	-
1-2 times a week	4.81	[0.62-37.28]	0.132
3-6 times a week	0.18	[0.02-1.43]	0.106
No day	9.12	[5.75-42.64]	0.000
Vegetables			
Every day	1	-	-
1-2 times a week	10.63	[2.09-53.99]	0.004
3-6 times a week	1.91	[0.51-7.15]	0.336
No day	0.54	[0.03-9.69]	0.677
Dairy products			
Every day	1	-	-
1-2 times a week	NA	-	-
3-6 times a week	2.90	[0.09-86.55]	0.539
No day	8.52	[3.32-21.88]	0.000

Table 2: Factors associated with school performance of pupils (multivariate logistic regression).

NA: number of modality too small for comparison.

Discussion

The study explored the differences between the nutritional status and academic performance of pupils in public primary schools with and without government school canteens in the commune of Ouidah in 2020 and the factors that explain the variation in academic performance. The prevalence of underweight and stunting is significantly higher in schools without canteens; while the prevalence of overweight is higher in schools with canteens. The assessment of the performance of pupils at the threshold of 10/20 showed a significantly higher acceptable performance in schools with a canteen, compared to schools without a canteen. Factors associated with the school performance of the pupils were class; height-for- age index; frequency of consumption of meat, fish or eggs; frequency of consumption of legumes; frequency of consumption of dairy products and frequency of consumption of vegetables.

Nutritional status of school children

This study found that the prevalence of thinness was higher in schools without canteens (44.81%) compared to schools with canteens (28.96%). The same conclusion was reached by Walingo., *et al*. in a study of food consumption and nutritional status of pupils participating and not participating in a school feeding programme, where the prevalence of thinness was 5% for pupils participating in the school feeding programme and 18.2% for those not participating [10]. Another study by Devara., *et al*. in India on the impact of nutritious meals on the nutritional status of pupils showed a higher prevalence of thinness among pupils who did not receive meals (26.30%) compared to those who did receive meals (21.90%) [11]. This observation could be explained by the fact that pupils who receive school meals receive meals that allow them to cover most of their nutritional needs. The food basket provided by WFP to schools with canteens contains cereals, pulses, vitamin A-rich oil and iodized salt, and the children's daily contributions allow them to purchase the other ingredients needed to prepare meals, including protein sources [5]. In addition, pupils in the school feeding programme do not have to travel long distances to go home for lunch, rest and return to school at 3pm like their counterparts in schools without canteens. They eat at school, rest and pick up their notebooks to revise before afternoon classes; whereas their counterparts in schools without canteens have to go home and may not find nutritious meals to eat at home before returning to school, given the absence of parents or the socio-economic precariousness

in which the household lives. All these conditions could explain this difference in prevalence between schools and point to a likely effect of the school feeding project on the nutritional status of school children.

The prevalence of overweight was higher in schools with canteens (1.09%) than in schools without canteens (0.00%). This difference is similar to that found by Wamba., *et al*. in Cameroon [12]. This observation could be explained by the fact that pupils in schools with canteens eat better and are more sedentary than those in schools without canteens.

Academic performance of pupils

The percent of pupils with acceptable performance was significantly higher in schools with canteens (51.37%) than in schools without canteens (40.44%). This difference could be explained by the fact that in schools with canteens, pupils are more supervised by teachers because they stay at school at lunchtime to eat and are better supervised by teachers than their counterparts in schools with canteens who go home. Moreover, the presence of the canteen and the desire to make it permanent could be an additional motivating factor for teachers and headmasters of certain schools with canteens. Several authors have come to the same conclusion as reported in a meta-analysis of quasi-experimental studies of 18 articles on the relationship between diet and school performance. The authors concluded that the provision of hot, nutritious meals to learners had a positive short-term effect on the academic performance of learners from a population with a high prevalence of undernutrition [13]. However, the long-term effects of school feeding on school performance remain unknown.

Factors associated with school performance

The Pupils's Classroom

In this study, pupils in the sixth grade had a higher risk of poor performance compared to pupils in the fourth grade (OR = 12.03 with 95% CI = [4.15-34.82]). We did not find any studies in the literature that observed this association. However, it could be explained by the fact that fifth graders in the examination class are subjected to more complex concepts as well as more complex tests than those in third grade. However, this trend remains empirical in our countries.

Stunting

Moderately stunted pupils were more likely to perform poorly at school compared to normal height pupils (OR = 6.67 with 95% CI = [2.12-21.00]). This result is in agreement with other studies that have found the prevalence of stunting to be higher in poorly performing pupils compared to normal-sized children [4,9].

Frequency of consumption of meat, fish or eggs

In this study, pupils who consumed meat, fish or eggs 3-6 times a week were less likely to perform poorly at school compared to pupils who consumed them every day (OR = 0.13 with 95% CI = [0.01-0.97]). Veugelers., *et al*. in the USA came to the same conclusion [14]. This observation could be explained by the fact that pupils who often consume animal proteins such as fish have a good intake of omega-3 fatty acids, which are involved in improving their cognitive abilities.

Frequency of legumes consumption

Pupils who did not consume legumes during a week were more likely to perform poorly at school compared to those who consumed legumes every day of the week (OR = 49 with 95% CI = [5.75-428.64]). These results are consistent with those reported by Veugelers., *et al*. [14].

Frequency of vegetable consumption

Pupils who consumed vegetables once or twice a week were more likely to perform poorly at school compared to pupils who consumed vegetables every day (OR = 10.63 with 95% CI = [2.09-53.99]). Veugelers., *et al*. came to the same results [14]. This is because vegetables contain vitamins such as vitamin B9. Thus, pupils who do not consume them often may be deficient. This result raises the importance of reinforcing the school diet with the preparation of vegetables at every meal in schools with canteens.

Frequency of consumption of dairy products

Pupils who did not consume dairy products at all in a week were more likely to perform poorly at school compared to pupils who consumed dairy products every day (OR = 8.52 with 95% CI = [3.32-21.88]). The relationship between school performance and frequency of dairy consumption was not investigated in the studies that were consulted. However, this result could be explained by the

fact that dairy products also contain animal protein and vitamin B12, which is essential for the proper functioning of cognitive processes in school children.

Conclusion

Malnutrition is present among pupils in the commune of Ouidah. As the nutritional situation and school performance are better in schools with canteens than in schools without canteens, it can be concluded that the PNASI school feeding program has a positive effect on the nutritional status and school performance of pupils. The program should therefore be extended to all public primary schools.

Appendix 1: Univariate analysis

Poor school performance			p-value
Socio-demographic and nutritional factors	**$_{gross}$ OR**	**[95% CI]**	
Age (in years)			
8	1	-	-
9	9,33	[0,89-97,61]	0,06
10	4,84	[0,54-42,86]	0,15
11	9,33	[1,08-80,43]	0,04
12	8,53	[1,07-72,23]	0,04
13	10,28	[1,20-87,63]	0,03
14	9,17	[1,06-78,61]	0,04
Class			
4th grade	1		
5th grade	2,30	[1,37-3,86]	0,002
6th grade	2,87	[1,71-4,82]	0,000
Distance from home to school			
Long	2,35	[1,50-3,68]	0,000
Short	1	-	-
Mother's occupation			
Unemployed	1,12	[0,56-2,23]	0,782
Farmer	2,26	[0,43-11,82]	0,334
Artisan	1	-	-
Trader	1,65	[0,79-3,46]	0,089
Height-for-age index			
Normal	1	-	-
Moderate stunting	6,10	[3,21-11,57]	0,000
Severe stunting	NA*	-	-
Frequency of consumption of meat,			
eggs, fish	1	-	-
1-2 times a week	4,52	[1,63-12,56]	0,004
3-6 times a week	0,30	[0,12-0,70]	0,006
No day	NA*	-	-
Fréquence de consommation de légumes			
Everyday	1	-	-
1-2 times a week	0,77	[0,21-2,78]	0,691
3-6 times a week	0,11	[0,03-0,41]	0,001
No day	5,61	[1,41-22,21]	0,014
Frequency of vegetable consumption			
Every day	1	-	-
1-2 times a week	2,21	[0,95-5,13]	0,063
3-6 times a week	0,34	[0,17-0,68]	0,002
No day	2,5	[0,26-23,50]	0,423
Frequency of consumption of dairy products			
Every day	1	-	-
1-2 times a week	NA	-	-
3-6 times a week	5	[0,78-31,94]	0,08
No day	6,04	[3,49-10,44]	0,000

Table a: Socio-demographic and nutritional factors associated with school performance (univariate analysis).

NA: number of modality too small for comparison.

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Volume 5 Issue 4 April 2022