

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

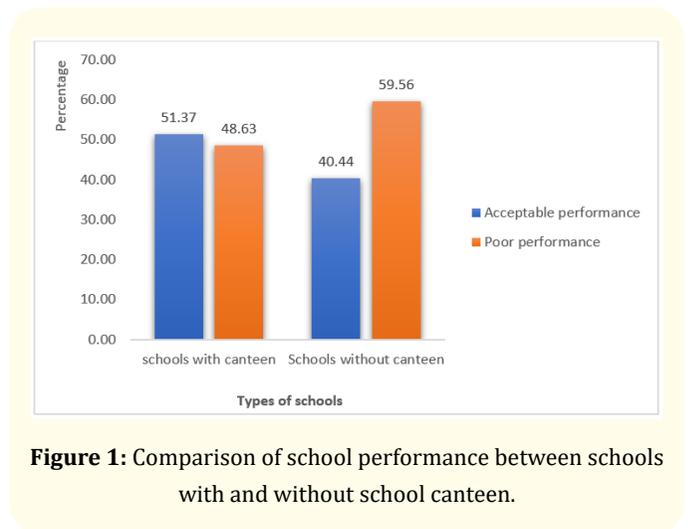


Figure 1: Comparison of school performance between schools with and without school canteen.

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			
4 th grade	1	-	-
5 th grade	2.60	[0.97-6.93]	0.055
6 th 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			
4 th grade	1		
5 th grade	2,30	[1,37-3,86]	0,002
6 th 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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