Original Research Article

Assessment of the Nutritional Status of Schoolchildren in the Commune of Abobo

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Abstract: ***Context:*** The covid-19 pandemic has shaken the world in a deadliest way and also disrupted the food system. In Ivory Coast, malnutrition already exists, so it was important to assess the impact of this pandemic on the nutritional status of schoolchildren after this crisis. Thus this study is carried out to evaluate the relationship of sociodemographic characteristics on the nutritional status of schoolchildren. ***Methods***: A cross-sectional study took place from September 2021 to January 2022, with 1,374 schoolchildren aged 5 to 15 years in the commune of Abobo. Sociodemographic characteristics as well as anthropometric parameters were obtained using a questionnaire administered to schoolchildren. Characteristics such as gender, age, profession as well as the level of education of parents and practice of sporting activity were provided. Anthropometry was measured and thinness, overweight and obesity were defined using a standard protocol. ***Result***: The nutritional status of schoolchildren indicates that 15.3% of schoolchildren in the commune of Abobo suffer from thinness and 3.4% are overweight/obese according to the BMI-age indicator. The nutritional status of children according to gender indicates that 17.2% of boys are thin compared to 13.4% of girls. As for overweight/obesity, it is 4.4% among girls and 2.4% among boys. This difference between the nutritional status of schoolchildren and gender is significant (p<0.05). The level of education of the children's father and the level of education of the schoolchildren are significantly linked to the nutritional status of the schoolchildren. On the other hand, the age of schoolchildren, the level of education of the mother, as well as the practice of sporting activity are not linked to malnutrition. ***Conclusion***: The present study shows that the BMI of schoolchildren is influenced by socio-demographic characteristics such as age, the educational level of the father and that of the schoolchildren as well as the sex of the schoolchildren. The nutritional status observed is substantially identical to that of school-age children after the post-COVID period. Efforts must therefore be made to improve the socio-economic situation of families in this community.
Keywords: COVID-19, sociodemographic characteristics, nutritional status, schoolchildren.

INTRODUCTION

Malnutrition is a public health problem worldwide, particularly in developing countries. It can take the form of thinness, stunting, underweight or overweight 1. Acute and/or chronic malnutrition of populations throughout the world is worrying because of its immediate impacts on morbidity and mortality but also because of its long-term consequences on physical growth, cognitive development, reproduction, and physical ability to work (UNICEF, 2004).

In sub-Saharan Africa, the number of undernourished people has increased from 200 to 224 million, representing 25 percent of the 815 million undernourished people in the world in 2016 (FAO, 2017). A few years later, stunting affected approximately 22.2%, or 150.8 million children under the age of 5 worldwide; Wasting continued to threaten the lives of about 7.5%, or 50.5 million of these children. Also estimating the global population of overweight children under 5 at 38.3 million, or 5.6% (UNICEF, 2018).

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Until now, the health sector has mainly been more concerned with the health of pregnant women and children aged 0 to 5 years, believing that older children have passed the critical threshold of infant mortality and that they are in healthier and better nourished than young children. However, the consequences of malnutrition on intellectual and physical development, health and life expectancy have been established by several studies (Ake Tano *et al.*, 2010). In addition, the COVID19 pandemic has disrupted the entire world, particularly developing countries.

What could be the impact of malnutrition and this pandemic on the lives of school-age children?

Some studies reveal that malnutrition is present today among school-age children. In Morocco, El-Badraouy *et al.*, (2020) in their studies in 322 children aged 12 to 19 showed that short stature, thinness, overweight and obesity were 6.6%, 15.3%, 11.6% and 3.4%. Growth retardation and obesity were found respectively in 8.99% and 4.76% of children aged 6 to 14 years in the Kenitra region of Morocco (Achouri *et al.*, 2016). In addition, in Ethiopia, among 494 schoolchildren aged 6 to 19, malnutrition was 27.94%, including 7.29% of the severe form and 20.65% of the moderate form (Berhanu *et al.*, 2023). In Ghana, the overall prevalence of undernutrition and overweight/obesity were 21.5% (CI = 17.7, 25.7) and 24.8% (CI = 20.8, 29.2), respectively (Aboagye *et al.*, 2021). Then, without forgetting the effects of Covid 19, which on March 16, 2020, forced the Ivorian government to take 13 restrictive measures to reduce the spread of COVID-19 in the country, in accordance with the directives of the World Health Organization. These restrictions included social distancing, border closures, movement restrictions and the closure of non-essential services in the country for more than a year. These restrictions are likely to have caused unintended effects on food access and availability by disrupting food systems; thereby worsening the pre-existing food crisis and significantly increasing poverty levels, including job loss (Milleliri *et al.*, 2021; Anyiam *et al.*, 2022). This pandemic has favored food insecurity in environments where school meals constitute the only daily meal for children. The Covid-19 crisis has allowed pre-existing vulnerability to grow, particularly for girls and the most marginalized people. It has also caused a lack of physical activity, socialization and interaction with their peers, having an impact on the physical and mental health and well-being of children and young people (Milleliri *et al.*, 2021).

School age is a phase of active growth in childhood (UNICEF, 2004). It represents a dynamic period of physical growth as well as mental development and the formation of attitudes, behaviors and habits (Bouterakos *et al.*, 2021). The world population in 2019 included nearly 1.6 billion school-aged children, including 131 million overweight school children (UNICEF, 2020). Until today, little attention has been paid to the nutritional problems of the school-age population.

In Côte d'Ivoire, few studies on the nutritional status and socio-demographic characteristics of post-COVID 19 schoolchildren have been highlighted. However, the studies carried out showed that undernutrition and overweight/obesity were respectively among 13.6% and 6.8% of schoolchildren aged 8 to 14 in the commune of Yopougon and Bingerville (Zahe *et al.*, 2017). According to the council of ministers of November 18, economic growth in Côte d'Ivoire, initially forecast to be 7.2%, fell to 1.8% in 2020 (World Bank, 2020). The high cost and low accessibility of food by households also means that billions of people cannot eat a healthy and balanced diet appropriate for their age. And more people will fall into poverty as a result, making it difficult for many families to afford a variety of nutritious foods for their children (Abay *et al.*, 2021, Ntambara & Chu 2021). This means that more children are consuming cheaper unhealthy foods and poor nutrition can have a devastating impact on the growth and development of these children (UNICEF, 2019). As a result, there could be an upsurge in malnutrition and nutritional abnormalities such as stunting, underweight, overweight and obesity.

Children are vulnerable to malnutrition and therefore constitute a group of interest for nutrition research. It is evident that the COVID-19 pandemic has disrupted food security in many countries, particularly in Côte d'Ivoire. While rapid analyzes have been conducted to estimate the economic effects of the pandemic on families, its impact on the food intake and nutritional status of children in Côte d'Ivoire is currently unknown which has become an obstacle to addressing the malnutrition and associated risks among children during the post-pandemic period. In this study, the nutritional status of school children and sociodemographic characteristics in the context of the post COVID-19 pandemic will be presented. The results of this study will contribute to decision-making and evaluations in the field of nutrition and health policy at the national and international level.

MATERIALS AND METHODS

A cross-sectional study was carried out during a period marked by food shortages and the high cost of food, elements likely caused by measures to contain the COVID-19 epidemic. Children from public primary schools in the commune of Abobo in the District of Abidjan were selected for the study.

Study location

Abobo is a commune in the District of Abidjan, Ivory Coast. It is located in North Abidjan. It is the second most populous commune in the Abidjan district with a population of 1,340,083 inhabitants according to

the latest general population and housing census (RGPH) of 2021. The vast majority belongs to the modest-income class mainly exercising in commerce and other so-called informal activities. At the educational level, the commune of Abobo has approximately 498 public primary schools and 168,816 schoolchildren with a ratio of 70 students per class. It includes a higher education unit, Nangui Abrogoua University, which it shares with the commune of Adjamé (DREN Abidjan, Pocket Statistics 2019-2020).

Methodology

During this study, which took place from September 2021 to January 2022, 1,374 schoolchildren aged 5 to 15 from Guy Nairay, Agbeikoi, N'tanouan school groups, who were potentially eligible, were included in this study. Permission from the Ministry of National Education and Literacy was obtained through the Constituency Inspector to conduct the study. Agreement was also obtained from the children's parents or guardians for them to participate in the study. Subsequently, the children's parents/legal guardians granted permission to recruit their children into the study. Only children whose parents/legal guardians consented to their participation were finally allowed to participate in the study as well as all apparently healthy children. The main objective and focus of this study is to determine the prevalence and sociodemographic factors associated with the nutritional status of schoolchildren and adolescents aged 5 to 15 after the COVID19 period.

General information, namely age, gender, parental education and occupation, physical activity and lifestyle characteristics, was collected using a questionnaire. Thus, age was obtained from their school records. Socio-demographic characteristics were obtained using an interviewer-administered questionnaire.

Anthropometry

Anthropometric measurements were carried out. Height was measured standing up using a local measuring rod with a length of 200 cm and graduations allowing the tenth of a centimeter to be appreciated. As for the weight, it was measured with a Seca 762 TM type scale (accuracy 0.5 kg). These measurements were taken on children dressed lightly according to recommended techniques (WHO, 1995). BMI is calculated using the formula (weight/height2 in kg/m2). The nutritional status of the children according to their BMI, according to age and sex was determined. For the assessment of the nutritional status of adolescents and in the absence of a local reference, we used the new WHO references (Cole *et al.*, 2000) of the body mass index at the age of 5 years until the age of 19.

Arm circumference (MUAC) was measured using a tape measure to the nearest centimeter. In right-handers, the measurement is made on the left arm halfway between the acromion and the olecranon. The arm must be straight and clear of the body. The operator then wraps the tape around the arm making sure the tape is not folded. The result is read and recorded to within 0.1 cm at the exit of the measuring tape from the case (Zahzeh *et al.*, 2011).

Statistical analysis

All data are analyzed with SPSS version 25 software. Comparative studies could be carried out using the following statistical tests: Student-Fisher t test was used to compare the means. As for the Chi-square test (X2), it is a statistical test which made it possible to check whether there is a significant difference between the proportions. The p-value or p-value, in all interpretations with a 5% significance level, was considered. A risk of error α=0.05 was accepted. If p≤ 0.05, the null hypothesis Ho is rejected, the observed difference is significant. If p> 0.05, the null hypothesis Ho is accepted, the difference is not significant.

Ethics Committee

After reading the study protocol respecting the rules of a scientific study, approval from the national ethics committee for life and health sciences (CNESVS) referenced: N: ref 043-20/MSHP/CNESVS- kp was granted.

RESULT

Table I presents the sociodemographic characteristics of schoolchildren. In this study, the proportion of boys is 49.1% compared to 50.9% of girls. Regarding the age of schoolchildren, the age group of 9-12 years is the most represented with 53.5%, then that of 5-8 years with a proportion of 39% and finally the age group aged 13-15 which concerns 7.5% of this population. Regarding the distribution according to the location of the school, 885 or 64.4% of schoolchildren live in a peri-urban area compared to 489 or 35.6% who live in an urban area.

Concerning the distribution of schoolchildren according to the level of education of the parents, as for the fathers of schoolchildren, 27.6% of them are not in school, 30.2% have a primary level and, 28.8% and 13.3% have secondary and higher education respectively. As for the mothers of schoolchildren, 45.4%, 35.0%, 16.5% and 3.0% of mothers have respectively no level, a primary level, secondary level and a higher level of study (Table I).

Table I: Sociodemographic characteristics of schoolchildren

Characteristics	Modalities	Frequency	Percentage (%)
Gender	Boys	674	49,1
	Girls	700	50,9
Age (years)	5-8	536	39,0
	9-12	735	53,5
	13-15	103	7,5
Mean age (years)	9,39±2,17		
Location of the school	Peri-urbaine	885	64,4
	Urbaine	489	35,6
Level of schoolchildren	CP	419	30,5
	CE	408	29,7
	CM	547	39,8
Profession of Father	Civil servant	87	8,4
	Trader	359	34,5
	Worker	217	20,8
	Prvate sector	308	29,5
	Not working	70	6,8
Profession of Mother	Civil servant	20	1,9
	Trader	585	57,9
	Female worker	31	3,1
	Private sector	50	4,9
	Housewife	325	32,2
Father's education level	None	281	27 ,6
	Primary	311	30,2
	Secondary	308	28,8
	Superior	145	13,3
Mother's education level	None	467	45,4
	Primary	360	35,0
	Secondary	170	16,5
	Superior	31	3,0

The distribution of anthropometric parameters of schoolchildren according to socio-demographic characteristics indicates that the average weight (28.49 ± 8.97 kg), the average height (133.53 ± 13.00 cm), the body mass index (BMI) average (15.60±2.38 Kg /m2) and the average arm circumference (17.34±4.71 cm) of the girls is significantly higher (p < 0.01) than that of the boys which is respectively 25.43±6.03 kg, 129.92 ±11.10 cm, 15.06±1.57 Kg/m2. 16.51±4.66cm (Table II).

Regarding the distribution by age, the observation is that the average weight, average height, average BMI and average MUAC increase as the age of schoolchildren increases. The average weight is 21.06±3.23 kg, 29.38±6.17 kg and 40.70±8.84 kg for schoolchildren aged 5-8 years, 9-12 years and 13- years respectively. 15 years old. The difference observed between these age groups and the average weight is significant (p<0.01). As for the average height, it is 120.40±7.09 cm, 136.70±8.40 cm and 150.35±8.06 cm for schoolchildren aged 5-8 respectively, 9-12 years old and 13-15 years old. Regarding BMI, schoolchildren aged 13-15 years have a BMI (17.86±2.80 Kg/m2) significantly higher (p<0.01) than those aged 9-12 (15.59±1.95 Kg/m2) and 5-8 years (14.49±1.41 Kg/m2).

Regarding the upper arm circumference, also, schoolchildren aged 13-15 have a higher upper arm circumference (19.51±2.93 cm) (p<0.01) than those aged 9-12 (17. 49±4.56 cm) and those aged 5-8 years (15.69±4.84 cm) (Table II).

Stratifying according to the location of the school, the BMI of schoolchildren in peri-urban areas is 15.34±2.07 Kg/m2 compared to 15.32±1.99 Kg/m2 for those in urban areas. No significant difference (p > 0.05) is observed between BMI and school location area. Regarding the upper arm circumference, the average MUAC of schoolchildren from the urban area (17.82±5.26 cm) is significantly higher (p<0.01) than for schoolchildren from the peri-urban area (16.44 ±4.29 cm) (Table II).

Stratification according to the level of study of schoolchildren shows that the BMI of schoolchildren aged 13-15, 9-12 and 5-8 years is respectively 16.25±2.34 Kg/m2, 14 .99±1.59 Kg/m2 and 14.47±1.46 Kg/m2. The difference observed between these different BMIs in relation to age is significant (p<0.01). AS for MUAC, it is higher among schoolchildren aged 13-15 years (18.06±2.66 cm) than among their peers aged 9-12

years (16.38±2.72 cm) and 5- 8 years (16.00±7.31 cm) (Table II).

Table II: Distribution of anthropometric parameters of schoolchildren according to socio-demographic characteristics

Sociodemographic characteristics		Anthropometric characteristics			
	Modalities	Weight (Kg)	Height (cm)	BMI (Kg/m²)	PB (cm)
Gender	Boys	25,43±6,03	129,92±11,10	15,06±1,57	16,51±4,66
	Girls	28,49±8,97	133,53±13,00	15,60±2,38	17,34±4,71
	P	0,00	0,00	0,00	0,00
Age group	5-8	21,06±3,23	120,40±7,09	14,49±1,41	15,69±4,84
	9-12	29,38±6,17	136,70±8,40	15,59±1,95	17,49±4,56
	13-15	40,70±8,84	150,35±8,06	17,86±2,80	19,51±2,93
	P	0,00	0,00	0,00	0,00
Location of the school	Peri-urbain	27,07±7,81	131,56±11,74	15,34±2,07	16,44±4,29
	Urbain	26,82±7,83	131,01±13,26	15,32±1,99	17,82±5,26
	P	0,56	0,43	0,91	0,00
Educational level of pupils	CP	20,83±3,65	119,73±7,86	14,47±1,46	16,00±7,31
	CE	25,52±4,95	129,98±7,99	14,99±1,59	16,38±2,72
	CM	32,79±7,80	141,31±9,02	16,25±2,34	18,06±2,66
	P	0,00	0,00	0,00	0,00

Table III shows the distribution of schoolchildren according to socio-demographic characteristics. Thus, systolic blood pressure (SBP) in this study was higher in girls (104.94±16.18 mmHg) than in boys (102.85±15.77 mmHg). This difference between sex and PAS is significant (p≤0.01). When it comes to diastolic blood pressure, it is 69.28±13.87 in girls and 68.90±15.52 in boys without any significant difference (P>0.05).

The distribution according to age indicates that blood pressure evolves in the same direction as age. Thus, in terms of systolic blood pressure, it is significantly higher (p<0.01) in schoolchildren aged 13-15 (110.99±14.42 cm) than in their peers aged 9-12 years (106.07±15.09) and those aged 5-8 years (99.60±16.49). Regarding DBP, it is 73.25±12.59 mmHg, 69.56±13.82 mmHg and 67.66±16.01mmHg respectively in schoolchildren aged 13-15, 9-12 years and 5-8 years. The difference observed is significant (p<0.01).

Regarding the location of the school, there is no significant difference (p>0.05) between the blood pressure of girls and boys.

Regarding the educational level of schoolchildren, blood pressure increases as the age of schoolchildren increases. The systolic blood pressure of CM schoolchildren (107.99±14.72 mmHg) is significantly higher (p < 0.01) than that of CE schoolchildren (104.48±15.13 mmHg) and CP (98.05±16.72 mmHg). Regarding the PAD, it is 71.31 ± 13 mmHg, 86, 68.52 ± 14.81 mmHg and 66.77 ± 15.27 mmHg respectively in CM, CE and CP schoolchildren. The difference observed between the level of schoolchildren and the PAD is significant (p < 0.01).

Table III: Distribution of blood pressure in schoolchildren according to socio-demographic characteristics

Sociodemographic characteristics		Blood pressure	
	Modality	PAS	PAD
Gender	Boys	102,85±15,77	68,90±15,52
	Girls	104,94±16,18	69,28±13,87
	P	0,01	0,62
Age group	5-8	99,60±16,49	67,66±16,01
	9-12	106,07±15,09	69,56±13,82
	13-15	110,99±14,42	73,25±12,59
	P	0,00	0,00
Location of school	Peri-urbain	103,83±14,65	69,38±13,68
	Urbain	104,06±18,24	68,57±16,38
	P	0,79	0,33
Educational level	CP	98,05±16,72	66,77±15,27
	CE	104,48±15,13	68,52±14,81
	CM	107,99±14,72	71,31±13,86
	P	0,00	0,00

Figure 1 shows that 15.3% of schoolchildren in the commune of Abobo suffer from thinness and 3.4% are overweight/obese according to the BMI-age indicator.
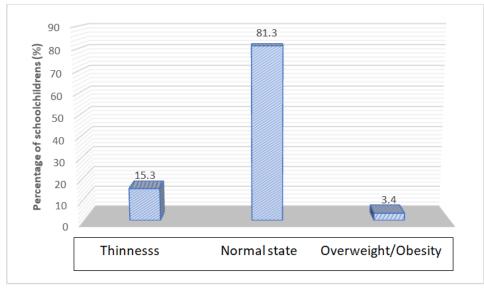

Figure 1: Nutritional status of schoolchildren

The anthropometric classification, i.e. the nutritional status of children according to gender, indicates that 17.2% of boys are thin compared to 13.4% of girls. As for overweight/obesity, it is 4.4% among girls and 2.4% among boys. This difference between the nutritional status of schoolchildren and gender is significant (p < 0.05). With regard to age, overweight/obesity is 3.2%, 3.1% and 6.8% respectively among school children aged 5-8 years, 9-12 years and 13-15 years. As for thinness, it is 14.2%, 15.9% and 16.5% among schoolchildren aged 5-8, 9-12 and 13-15 years respectively. However, the difference observed between the age of schoolchildren and their nutritional status is not significant (p > 0.05). The stratification of nutritional status according to the area where the school is located shows that schoolchildren in peri-urban areas who are overweight/obese are 3.1% and those with thinness are 15.8% and those in urban overweight/obese are 4.1% and 14.3% for thin people. The difference between nutritional status and the school location area is not significant (p > 0.05) (Table IV).

With regard to the school level of schoolchildren, overweight/obesity is significantly more present among CM schoolchildren (4.8%) than among CE (1.5%) and CP (3.6%) schoolmates.

Table IV: Distribution of nutritional status of schoolchildren according to socio-demographic characteristics

Sociodemographic characteristics		Nutritional status of schoolchildren			P
	Modality	Overweight/Obesity n (%)	Normal state n (%)	Thinness n (%)	
Sex	Boys	16 (2,4)	542 (80,4)	116 (17,2)	0,02
	Girls	31 (4,4)	575 (82,10)	94 (13,4)	
Age group (Years)	5-8	17 (3,2)	443 (82,6)	76 (14,2)	0,30
	9-12	23 (3,1)	595 (81,0)	117 (15,9)	
	13-15	7 (6,8)	79 (76,7)	17 (16,50)	
Location of school	Peri-urbain	27 (3,1)	718 (81,1)	140 (15,8)	0,48
	Urbain	20 (4,1)	399 (81,6)	70 (14,3)	
Education level	CP	15 (3,6)	338 (80,7)	66 (15,8)	0,02
	CE	6 (1,5)	329 (80,6)	73 (17,9)	
	CM	26 (4,8)	450 (82,3)	71 (13,0)	
Father's level of education	Illiterate	18 (6,1)	238 (80,7)	39 (13,2)	0,01
	Literate	29 (15,8)	879 (81,5)	171 (2,7)	
Mother's level of education	Illiterate	20 (4,3)	381 (81,6)	66 (14,1)	0,34
	Literate	27 (15,9)	736 (81,1)	144 (15,9)	

Table V indicates schoolchildren practicing sporting activity are 3.3%, 82.3% and 15.4% respectively for overweight/obese, normal and thin compared to 7.4%, 81.5% and 11.1% respectively for the overweight/obese, the normal and the thin who do not practice sport. No significant difference (p > 0.5) exists between those who practice sport and those who do not. Regarding the means of transport, the overweight/obese,

normal and thin people who walk to school are respectively 3.5%, 81.3% and 15.3%, those who go to school. Cycling to school are respectively 0.0%, 33.3% and 66.7% compared to 0.0%, 93.3% and 16.7% of those who walk. However, there is no significant difference (p > 0.5) between the means of transport and the nutritional status of schoolchildren.

Table V: Répartition de l'état nutritionnel des écoliers en fonction de l'activité sportive

Activity characteristics		Nutritional status of schoolchildren			p
	Modalités	Overweight/Obesity	Normal state	Thinness	
Practice of sporting activity	Yes	45 (3,3)	1095 (81,3)	207 (15,4)	
	No	2 (7,4)	22 (81,5)	3 (11,1)	0,45
Locomotion	Feet	47 (3,5)	1102 (81,3)	207 (15,3)	
	Bicycle	0 (0,00)	1 (33,3)	2 (66,7)	0,10
	Motor vehicle	0 (0,0)	14 (93,3)	1 (6,7)	

DISCUSSION

This study took place in the commune of Abobo, one of the most populated communes of the Autonomous District of Abidjan in Ivory Coast. It involved 1,374 schoolchildren whose average age was 9.39±2.17 years, made up of 674 boys versus 700 girls. The objective of the study was to assess the nutritional status of schoolchildren in relation to their socio-demographic characteristics after the post-COVID-19 period. The analysis of the results concerning the distribution of anthropometric parameters of schoolchildren according to socio-demographic characteristics reveals that a significant relationship exists between gender, age of schoolchildren, educational level of schoolchildren and anthropometric parameters such as weight, height, BMI and MUAC of schoolchildren. Indeed, girls with the evolution of age which evolves concomitantly with the educational level of schoolchildren seem to present greater height, weight and upper arm circumference than their counterparts. The same is true for biological parameters such as systolic blood pressure.

Malnutrition is a real public health problem in Côte d'Ivoire as it is in other developing countries. Thus, in the present study, the prevalence of thinness and overweight/obesity are respectively 15.3% and 3.4% among school-age children. A study carried out in Ivory Coast, in the communes of Yopougon and Bingerville before the appearance of COVID-19, reports a prevalence of thinness which is 13.6% and overweight/obesity which is 6.8% in 426 schoolchildren aged 8 to 14 (Zahe *et al.*, 2017). Also in the commune of Yopougon, Kokore et al. (2018) found thinness to be 22.2% in 251 school children aged 10-15 years. The COVID-19 crisis with its restrictions established by the Ivorian government have had repercussions on the life of the population as well as in general on the diet of the population (The Lancet, 2020; Carducci *et al.*, 2021). However, the observation is that the prevalence of thinness after the COVID-19 period is slightly higher than that of the work of Zahe *et al.*, (2017). It is however very high than that found in the Center-South of Côte d'Ivoire precisely in Taabo. Ou Traoré *et al.*, (2022) observed a prevalence of 5%. But the prevalence of the study is lower than that of Kokore et al. Several studies must be carried out to see the impact of the pandemic on the nutritional status of schoolchildren. This fact can perhaps be explained by the motivation of health workers during this period, who were still at their posts and also the connection of inter-regional trucks transporting foodstuffs.

Compared to other countries, similar rates of thinness were observed. In Nigeria, Anyiam *et al.*, (2022) in their work among 384 schoolchildren aged 6 to 12 years old, found a prevalence of thinness which was 14.06%. On the other hand, authors have reported higher rates in Ethiopia, Ghana and Niger. In Ethiopia, 27.94% of adolescents, including 7.29% and 20.65%, are classified as severely thin and moderately thin, respectively (Berhanu *et al.*, 2023). The report by Aboagye *et al.*, (2022) reports a rate of 21.5% thinness among 423 schoolchildren aged 6 to 12 years. Niger has a higher rate of thinness with a prevalence of 35.89% (Garba *et al.*, 2023).

When it comes to overweight and obesity, the current study found a combined rate of 3.4%. This prevalence is much lower than that observed by Zahe *et al.*, and Kokore *et al.*, who reported respective rates of 6.8% and 7.1% in the Abidjan district before the COVID pandemic. Also, it is lower than that reported by Traoré *et al.*, in the South Center of Côte d'Ivoire which is 15%. Furthermore, other studies in other countries have shown high rates of overweight and obesity compared to the prevalence observed in the present study. In Ghana, the prevalence of overweight/obesity was 24.8% (Aboagye *et al.*, 2022) and in Niger, 10.5% (Garba *et al.*, 2023). Although some authors have tried to dissociate overweight and obesity, the prevalence still remains high compared to that of this study, in Sri Lanka, Sathiadas *et al.*, (2021) reported that overweight and obesity were 11% and 6.3%, respectively. In Egypt, overweight and obesity were present respectively in 31.6% and 13.1% of 433 schoolchildren aged 6 to 12 (Shimaa *et al.*, 2018). Another study in Morocco carried out among 322 adolescents aged 12 to 19 years in the city of Kenitra indicates that overweight was 11.6% and obesity 3.4% (Rachid El-Badrouy and Youssef Aboussaley, 2020). On the other hand, by stratifying according to schools,

Asiagbu *et al.*, (2017), documented that overweight was 1.2% and 0% in public schools and 5% and 3% in private schools in the metropolis. Abakaliki of Ebonyi State, southeastern Nigeria. This difference in prevalence reported in these studies may probably be due to the number of participants involved, geographical location, variation in lifestyles and also the different definition thresholds used for malnutrition. Also, the school market in our tropics presents more and more foods high in calories and fat to schoolchildren, which is part of the explanation of overweight and obesity.

In the present study, malnutrition was found to be significantly associated with gender, parental education, particularly that of the father, and the educational level of schoolchildren. Overweight/obesity is more marked in girls (4.4%) than in boys (2.4%). These results are superimposable to those of Achouri *et al.*, (2016) in Morocco, Akinsola *et al.*, (2018), Rachid El-Badraouy (2020), Anietor and Animu (2021) in Nigeria and Garba *et al.*, (2023) in Niger who observed an association between malnutrition and sex. This gender difference is due to the earlier onset of the pubertal growth spurt in girls than in boys (Amuta et al., 2009). While Olanipekun *et al.*, (2012) attribute this to the fact that girls in this age group are more welcoming, stay with their mother in the kitchen and thus receive an extra portion of food. However, it would be justified by the fact that girls are less active than boys of this age and that boys tend to lose more of their body reserves during active games (Olanipekun *et al.*, 2012).

Concerning parental education, the fathers' educational level seems to be correlated with the BMI of the participants in this study. Indeed, overweight/obesity was 15.8% among children of literate fathers against 6.1% of children of illiterate fathers. On the other hand, thinness was 13.2% in children of illiterate fathers against 2.7% of children of literate fathers. This observation could be explained by the fact that literate and commercial parents give pocket money to children who treat themselves to foods rich in fat and sugar and also live in obesogenic environments. On the other hand, no relationship was observed between the nutritional status of schoolchildren and the educational level of the mother. This result is similar to that of Aliyu Hassan *et al.*, (2012). However, most studies reveal a significant relationship between maternal education and children's nutritional status. The higher the level of education of the mother, the less malnourished the children are (Hassan *et al.*, 2012; Hassan *et al.*, 2017; Anietor and Animu, 2021 and Sathiadas *et al.*, 2021).

By examining whether there was an influence of age on the nutritional status of children, this study revealed no difference between the age of schoolchildren and their nutritional status. Some studies such as that of Kokore *et al.*, (2018) and Akinsola *et al.*, (2018) report that malnutrition gradually decreases with age.

In this study, the practice of sporting activity as well as the means of communication showed no relationship on the nutritional status of schoolchildren. However, the literature indicates that nutritional status improves when people participate in regular sporting activity (Ekelund *et al.*, 2004).

CONCLUSION

The present study shows that the prevalence of BMI-age after the post-COVID-19 period is substantially the same as before. However, sociodemographic characteristics such as the sex of the child, the father's education level, and the schoolchildren's level of study seem to influence the nutritional status of schoolchildren. We must therefore strive to improve the health and food system in order to improve the nutritional status of schoolchildren.

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