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Prevalence of Child Malnutrition Through Their Anthropometric Indices in School Canteens of Abidjan (Côte D'ivoire)

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Abstract: Malnutrition in Côte d'Ivoire is a major concern. It mainly concerns children who are most vulnerable. Its consequences dramatic are on the fate and future of this population segment. In Côte d'Ivoire, 5259 canteens exist in more than 10,009 primary schools. The main purpose of our study was to determine the prevalence of different possible malnutrition in school canteens of Abidjan. Volunteers children aged 05 to 11 years, regularly enrolled in primary schools with canteens were selected. A determination of anthropometric indices using a computer program "Epi Info" has yielded the Z scores weight for height, height for age and weight for age. With these values of Z scores, we determined and compared the different prevalence of acute malnutrition (moderate and severe), chronic malnutrition (moderate and severe) and underweight. In addition, different levels of thinness in children aged 9 to 11 years have been reported with their Body Mass Index (BMI). Furthermore, computer programs Statsoft Statistica Windows version 7.1 and R.2.0.1 version Windows were used for comparison purposes. A probability threshold of p less than 0.05 was chosen for testing significant. The prevalence of malnutrition was 5.8% for chronic malnutrition and 26.7% acute malnutrition among all children selected in our study. The results of the study showed that through the Z scores that girls are exposed to severe chronic malnutrition compared to boys. Conversely, the boys were most affected by underweight than girls. No significant difference was observed between boys and girls in the prevalence of different forms of malnutrition among these children. Moreover, girls of 10 years are most at risk of grade 3 thinness with 26.5% compared to other children. Age and municipality household size of children have been factors associated with malnutrition. The prevalence of malnutrition among children of 5 to 11 years are observed to varying degrees. They seem less important compared to children under 05 years.

Key words: Malnutrition, children, anthropometric indices, school canteens, abidjan (côte d'ivoire)

INTRODUCTION

The nutritional status of an individual is intimately linked to their health. Better child health is a goal of the Millennium Development Goals (MDGs) that the World Health Organization (WHO) would like to achieve by 2015. Children's nutritional status is the best indicator of overall well-being (Onis *et al*., 2000). Malnutrition remains a public health problem in most developing countries (Geervani and Devi, 1994). It is a major preoccupation especially in large cities of developing countries, because of their rapid growth and the phenomenon of anarchic pseudo-urbanization resulting (Sinnaeve *et al*., 2006).

In Côte d'Ivoire, nearly a third of children suffer from acute malnutrition, despite the fact that the soils are fertile on a large part of the territory. Malnutrition currently contributes, directly or indirectly, more than half of all deaths among children under 5 years in Côte d'Ivoire (UNICEF, 2008). Measures are taken in schools by equipping canteens. These canteens provide at least one balanced complete meal daily for children in schools. The quantity and quality of food in school canteens do they prevent malnutrition in children? The consequences of malnutrition are numerous on the body of children. Malnutrition also causes irreversible damage to long-term on the health and physical development, cognitive and intellectual development of children. These manifestations of malnutrition lead to poor school performance in children (Mendez and Adair, 1999). It silently destroys the future productivity of nations. In addition, malnutrition increases the economic burden to society because it leads to an increased risk of death from infectious diseases (WHO, 1996). The assessment of child malnutrition requires several methods.

The methodology that we have chosen in our study is based on the determination of anthropometric indices of children in developing countries (Hakeem *et al*., 2004).

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In Côte d'Ivoireas we know no research has been conducted on the prevalence of malnutrition in school canteens. Therefore, this study aims to determine the prevalence of malnutrition among children of 5 to 11 years in school canteens of Abidjan. Malnutrition is multifactorial, that is why we would like to specifically: - Determine the prevalence of different forms of malnutrition among children:

- Define the group of children most vulnerable to malnutrition between boys and girls
- Identify the different levels of thinness in children aged 9 to 11 years
- Reveal the risk factors associated with child malnutrition

MATERIALS AND METHODS

Sites and study population: The present study is a cross-sectional study descriptive and analytical in children living in three municipalities of district of Abidjan and attending school canteens. It was conducted between September 2010 and December 2010. The study population consists of children from the school group "Libanaise" Ananeraie Yopougon, primary school "BAD" Cocody "Belle Côte" and the School Group "Agbékoi" Abobo (Fig. 1).

On an initial enrollment of 350 volunteers children aged 5 to 11 years with a mean age of 7.7±0.1 years, randomly selected, 310 children were selected based on inclusion and exclusion criteria of well established. For the selection of subjects, a set of criteria including clinical and biological signs allowed to exclude and include topics for the needs of our investigations. This is especially haematological complications, digestive and inflammation in the three months preceding the study. The number of final study included 172 girls with a mean age of 7.8±0.1 years and 138 boys with 7.6±0.2 years (Table 1).

Sociodemographic data were collected from a questionnaire survey completed by parents. The socio-economic status was defined by the following parameters: the mother's and father's level of education, the mother's and father's occupation, parents' marital status, household size and sibling position.

All general characteristics of the study population are summarized in Table 1. These children were informed of the experimental protocol and their parents signed a consent form free. Our investigation was conducted under the supervision of school officials and school health.

Determination and classification of anthropometric indices of nutritional status: The main anthropometric indices which helped to assess the nutritional status of children in school canteens were calculated based on the values of the age, size and weight. These three

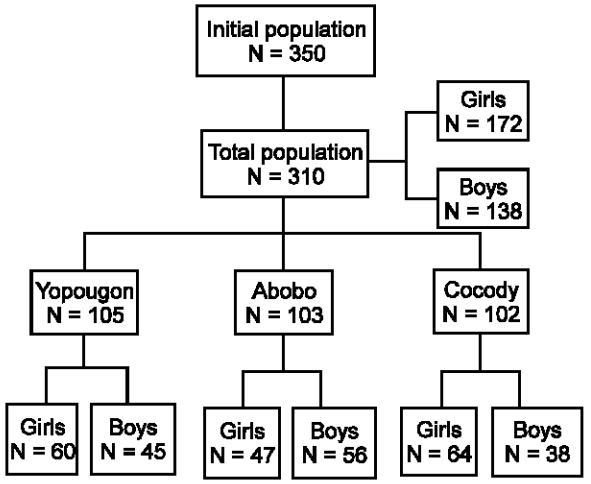

Fig. 1: Sampling of study population according to selected sites and sexes. N: Total number of each subject group

anthropometric parameters were measured according to the standard method of the World Health Organization (WHO) and United Nations Fund for Children (WHO, 1983; Bruce, 2003). Height was measured to the nearest 0.1 centimeter (Cm) closest with a balance band mobile local construction. The usual weight of the child in school canteens has been estimated at 0.1 kilograms (Kg) closest to a new mechanical scales with an accuracy of 0.5 kilograms (Kg). The measurements were taken barefoot with only the required education. The balance was calibrated regularly to avoid outliers.

The age of the child was determined from the date of birth given by parents and confirmed with the academic record of each child.

Three anthropometric indices namely weight for height (W/H), height for age (H/A) and weight for age (W/A) were selected for the evaluation of nutritional status children in school canteens. These three anthropometric indices combining body mass index (BMI/children aged 9 to 11 years) were used to express Z-scores calculated with the computer program "Epi Info" using the references National Center for Health Statistics, 1977 and National Health and Nutrition Examination Survey, 2000. Different Z-scores determined helped establish the nutritional status of children in school canteens as follows:

- Acute malnutrition based on the Z-scores of weight for height (W/H)
- The severe acute malnutrition (SAM) considered from a Z-score less than -3 SD
- The moderate acute malnutrition (MAM) expressed from the Z-scores between -3 SD and -2 SD
- The normal nutritional status (NNS) as the values of Z-scores greater than or equal to -2 SD
- Chronic malnutrition based on the Z-scores of height for age (H/A)

Table 1: General characteristics of the study population

General characteristics	Total population N = 310	Girls N = 172	Boys N=138
Age (years)	7.7±0.1	7.8±0.1	7.6±0.2
0-5	5±0.0	5±0.0	5±0.0
6-11	8±0.1	8.1±0.1	8±0.1
Height (cm)	124.5±0.6	125.9±0.9	122.8±0.2
Weight (kg)	22.7±0.3	23.3±0.4	21.8±0.4
Sex*	310 (100)	172 (55.5)	138 (45.5)
Level of father's instruction			
Illiterate	43 (13.9)	31(18)	12(8.7)
Educated	267 (86.1)	141(82)	126(91.3)
Level of mother's instruction			
Illiterate	112 (36.1)	75 (43.6)	37 (26.8)
Educated	198 (63.9)	97 (56.4)	101 (73.2)
Occupational status of father			
Unemployed	42 (13.5)	25 (14.5)	17 (12.3)
Employed	268 (86.5)	147 (85.5)	121 (87.7)
Occupational status of mother			
Unemployed	135 (43.5)	77 (44.8)	58 (42)
Employed	175 (56.5)	95 (53.2)	80 (58)
Marital status			
Live in couple	234 (75.5)	128 (74.4)	106 (76.8)
Live apart	76 (24.5)	44 (25.6)	32 (23.2)
Household size			
=5	220 (70.9)	53 (30.9)	37 (26.8)
>5	90 (29.1)	119 (69.1)	64 (73.2)
Sibling position			
=4	286 (92.3)	159 (94.4)	127 (92)
>4	24 (07.7)	13 (5.6)	11 (8)

N: Total number of each subject group, *: From this parameter, the values concerning the number of children by anthropometric parameters are associated with proportions.

Table 2: Different values of body mass index by age and sex (Cole *et al*., 2000 and 2007)

Classification of BMI (Kg/m^2)	Boys/years 9	10	11	Girls/years 9	10	11
<16 Thinness grade 1	<12.50	<12.66	<12.89	<12.44	<12.64	<12.95
16-17 Thinness grade 2	12.5-13.2	12.66-13.45	12.89-13.72	12.44-13.18	12.64-13.43	12.95-13.79
17-18.5 Thinness grade 3	13.2-14.4	13.45-14.6	13.72-14.97	13.18-14.28	13.43-14.61	13.79-15.05
18.5-25 Normal	14.4-19.1	14.64-19.8	14.97-20.55	14.28-19.07	14.61-19.86	15.05-20.74
25-30 Overweight	19.1-22.8	19.84-24	20.55-25.10	19.07-22.81	19.86-24.11	20.74-25.42
>30 Obesity	>22.7	>24	>25.10	>22.81	>24.11	>25.42

BMI: Body mass index

- The severe chronic malnutrition (SCM) seen from a Z-score less than -3 SD
- The moderate chronic malnutrition (MCM) expressed from Z-scores between - 3 and -2 SD
- The normal nutritional status (NNS) as the values of Z-scores greater than or equal to -2 SD
- The weight change is characterized by weight Z-scores of weight for age (W/A)
- The Underweight (UW) from a Z-score below -2 SD
- The normal weight status (NWS) expressed as Z-scores greater than or equal to -2 SD (Butte, 2007)
- The weight status based on body mass index for children 9 to 11 years
- The Underweight (UW) with different classes of thinness
- The Normal status of weight (NSW)
- The Overweight (OW)
- The Obesity (Table 2)

Statistical analyzes: For statistical analysis, the data were analyzed with the computer program Statistica Statsoft Windows version 7.1 (Statsoft, 2005). The mean values of anthropometric indicators were calculated using the software Epi Info using the reference (NCHS/WHO, 2000) of the different parameters investigated in children. Which values were compared with reference values using the nonparametric Mann-Whitney U test and ANOVA Kruskal-Wallis H test. Comparisons of different proportions observed major anthropometric indices were performed by G test of

Table 3: Nutritional status of children based on anthropometric indices according to sex

Anthropometric parameters	Total population N = 310	Girls N = 172	Boys N =138	p values
Weight for age (W/A)/(Mean-Z score)	-0.9±0.6	-0.8±0.1	-1.1±0.1	0.04^{S}
Underweight (<-2 SD)	-2.8±0.1	-2.6±0.2	-3±0.2	0.02^{S}
Normal weight status (= -2 SD)	-0.6±0.1	-0.5±0.1	-0.7±0.1	0.1N^{S}
Height for age (H/A)/(Mean-Z score)	-0.1±0.01	0.0±0.1	-0.3±0.1	0.04^{S}
Severe chronic malnutrition (<-3 SD)	-4±0.5	-5.4±0.01	-3.5±0.1	0.01^{S}
Moderate chronic malnutrition (between -3 SD and -2 SD)	-2.4±0.05	-2.5±0.1	-2.8±0.1	0.5^{NS}
Normal nutritional status (= -2 SD)	4.0±0.1	0.12±0.1	0.12±0.1	1^{NS}
Weight for height (W/H) (Mean-Z score)	-1.3±0.01	-1.2±0.1	-1.5±0.1	0.06^{NS}
Severe acute malnutrition (<-3 SD)	-3.8±0.1	-3.9±0.2	-3.8±0.2	0.6^{NS}
Moderate acute malnutrition (between -3 SD and -2 SD)	-2.3±0.01	-2.3±0.01	-2.4±0.01	0.1^{NS}
Normal nutritional status (= -2 SD)	-0.7±0.1	-0.6±0.1	-0.8±0.1	0.2^{NS}

N: Total number of each subject group, SD: Standard deviation, S: Statistically different for p value<0.05, NS: Not statistically significant for p value>0.05

reasonableness or log Likelihood ratio test with the statistical software R.2.0.1 Windows (Ihaka and Gentleman, 1996).

A probability level (p) of less than 0.05 was chosen for significance in all statistical analyzes of data.

RESULTS

Anthropometric indices

According to sex: The comparison of mean Z scores between boys and girls did not indicate statistically significant difference (p>0.05) in weight for height. Different levels of acute malnutrition (moderate and severe) were similar between the two groups of children. However, in terms of weight for age children, a significant difference was observed (p = 0.04). Boys (-1.1±0.1) of the study showed a mean value of Z score lower than girls (-0.8±0.1). The overall average of the entire population is -0.9±0.6. In the same vein, the boys showed a lower mean Z score in the underweight (-3±0.2) compared to girls (-2.6±0.2).

In addition, the mean value of all subjects with underweight was -2.8±0.1 (Table 3). Moreover, the level of chronic malnutrition showed a statistically significant difference (p = 0.04) between boys and girls. Thus, girls showed a higher value of Z score (0.0±0.1) compared to boys (-0.3±0.1). Furthermore, severe chronic malnutrition was more increased in girls (-5.4±0.01) than boys (-3.5±0.1). In contrast, no significant difference between the two groups of children was reported for moderate malnutrition (p>0.05) according the mean values of Z scores (Table 3).

The results of the study summarized in Table 4, indicated that 15.5% of the study population are underweight. This proportion included 7.4% of boys and 8.1% girls. No significant difference (p>0.05) was observed between these groups of children. At the level of chronic malnutrition, all children showed a prevalence of 5.8% with 1.3% severe chronic malnutrition and 4.5% moderate chronic malnutrition. Malnourished boys and girls did not show significant difference (p>0.05). However, the prevalence of acute malnutrition was higher (26.7%) among chosen children in school canteens. Following the example of chronic malnutrition, no significant difference (p>0.05) was also revealed between boys and girls. In the same way, over 70% of children reported normal nutritional status (Table 4).

Depending on the age groups: The comparison of mean values of anthropometric indices between the different age groups of children showed among boys Z scores of height for age significantly (p = 0.03, p = 0.02, p = 0, 02, respectively) lower (-0.8±0.2, -1.2±0.3 and -1±0.5, respectively) compared to girls (-0.1±0.2 -0.3±0.3 and -0.1±0.3, respectively) between 9 and 11 years. In addition, boys aged 10 years have also presented the lowest values of Z scores of weight for age compared to girls of this age. In addition, the mean Z scores of weight for height in boys 5 years of age and 8 years were significantly (p = 0.01 and p = 0.03, respectively) were lower (-2.5±0.5 and -1.2±0.2, respectively) compared to girls (-1.4±0.4 and -0.6±0.2, respectively) of the same age. In contrast, no significant difference (p = 0.9, p = 0.2, p = 0.6, p = 0.2, respectively) intra sex (between boys or girls) was observed between age of children in the study in terms of weight for age on the one hand and on the other hand to the weight and size. Regarding the size for age, boys reported a significant difference between age groups chosen (p = 0.02). In the same vein, the same observation was indicated in girls (p = 0.009). To this end thus, boys (0.9±0.2) and girls (1.2±0.4) 05 years of age reported the highest mean values of Z scores (Table 5).

Thinness and overweight status: Children aged 9 to 11 years were selected to determine the thinness's degree of this age group (Table 6). Different forms depending on the level of thinness grade were observed in these children with prevalence of 5% (thinness grade 1), 7.5% (thinness grade 2) and 30.8% (thinness grade 3) in all subjects. The thinness of grade 3 was significantly (p = 1, 3.10^{-6}) higher compared to the two other types of thinness. By sex, no significant difference (p>0.05) was

Table 4: Prevalence of child malnutrition based on anthropometric indices by sex

Anthropometric parameters	Total population N = 310 n (%)	95% CI	Girls N = 172 n (%)	95% CI	Boys N = 138 n (%)	95% CI	p-values
Weight for age (W/A, Z score)							
Underweight (<-2 SD)	48 (15.5)	11.5-19.5	23 (7.4)	4.5-10.3	25 (8.1)	5.1-11.1	0.8^{NS}
Normal weight status (= -2 SD)	262 (84.5)	80.5-88.5	149 (48.1)	42.5-53.7	113 (36.5)	31.1-41.9	0.2^{NS}
Height for age (H/A, Z score)							
Severe chronic malnutrition (<-3 SD)	4 (1.3)	0-2.6	1 (0.3)	0.3-0.9	3 (1)	0.1-2.1	0.5^{NS}
Moderate chronic malnutrition (between -3 SD and -2 SD)	14 (4.5)	2.2-6.8	6 (1.9)	0.4-3.4	8 (2.6)	0.8-4.4	0.7^{NS}
Normal nutritional status (= -2 SD)	292 (94.2)	91.6-96.8	165 (53.2)	47.6-58.8	127 (41)	35.5-46.5	0.2^{NS}
Weight for height (W/H, Z score)							
Severe acute malnutrition (<-3 SD)	41 (13.2)	9.4-17	19 (6.1)	3.4-8.8	22 (7.1)	4.2-10	0.8^{NS}
Moderate acute malnutrition (between -3 SD and -2 SD)	42 (13.5)	9.7-17.3	22 (7.1)	4.2-10	20 (6.5)	3.8-9.2	0.9^{NS}
Normal nutritional status (= -2 SD)	227 (73.2)	68.2-78.1	131 (42.3)	36.8-47.8	96 (31)	25.9-36.2	0.2^{NS}

N: Total number of each subject group, n: subject number observed in each anthropometric indice group, SD: Standard deviation, S: Statistically different for p value<0.05, NS: Not statistically significant for p value>0.05

Table 5: Changes in anthropometric characteristics according to age groups and sex

Age (years)	Sexes	H/A (Z score)	p^2	W/A (Z score)	p2	W/H (Z score)	p^2
5 (29)$^{\alpha}$	B (15)$^{\beta}$	0.9±0.2	0.7^{NS}	-0.7±1.2	0.1^{NS}	-2.5±0.5	0.01^{S}
	G (14)	1.2±0.4		-0.1±0.3		-1.4±0.4	
6 (70)	B (37)	0.2±0.2	0.9^{NS}	-0.8±0.2	1^{NS}	-1.6±0.2	0.9^{NS}
	G (33)	0.3±0.2		-0.8±0.2		-1.7±0.3	
7 (38)	B (13)	-0.2±0.3	0.7^{NS}	-1.1±0.3	0.4^{NS}	-1.8±0.4	0.2^{NS}
	G (25)	-0.1±0.3		-0.8±0.2		-1.2±0.3	
8 (53)	B (21)	-0.6±0.2	0.6^{NS}	-1.1±0.2	0.05^{NS}	-1.2±0.2	0.03^{S}
	G (32)	-0.4±0.2		-0.6±0.2		-0.6±0.2	
9 (63)	B (28)	-0.8±0.2	0.03^{S}	-1.2±0.3	0.4^{NS}	-1±0.2	0.6^{NS}
	G (35)	-0.1±0.2		-0.8±0.2		-1.1±0.2	
10 (49)	B (20)	-1.2±0.3	0.02^{S}	-1.8±0.3	0.03^{S}	-1.4±0.2	0.5^{NS}
	G (29)	-0.3±0.3		-1.1±0.3		-1.1±0.2	
11 (8)	B (4)	-1±0.5	0.02^{S}	-1.3±0.5	0.2^{NS}	-0.9±0.3	1^{NS}
	G (4)	-0.1±0.3		-0.7±0.3		-0.9±0.6	
p^1		0.02^{S} - 0.009^{S}		0.9^{NS}; 0.2^{NS}		0.6^{NS}; 0.2^{NS}	

1: Threshold values of probability (p) for intra-sex comparison according to anthropometric index, 2: Threshold values of probability (p) for inter-sexes comparison by age according to anthropometric indices, alpha: Number of selected children by established age group, beta: Number of observed children for each age group by sex, B: Boy, G: Girl, S: Statistically different for p value<0.05, NS: Not statistically significant for p value>0.05.

Table 6a: Classification of thinness in preadolescents by sex

	Total population		Boys		Girls		
Classification of BMI	n	(%)	n	(%)	n	(%)	p-values
Thinness Grade 1	6	(5)	2	(1.7)	4	(3.3)	0.5^{NS}
Thinness Grade 2	9	(7.5)	6	(5)	3	(2.5)	0.4^{NS}
Thinness Grade 3	37	(30.8)	12	(10)	25	(20.8)	0.04^{S}
Normal	69	(57.5)	35	(29.2)	34	(28.3)	0.9^{NS}
Overweight	2	(1.7)	1	(0.8)	1	(0.8)	1^{NS}

Tableau 6b: Classification of thinness in preadolescents by sex and age

	Boys/years				Girls/years				
	9 N = 28	10 N = 20	11 N = 4		9 N = 35	10 N = 29	11 N = 4		
Classification of BMI		n (%)		p^3		n (%)		p^3	p^1
Thinness Grade 1	1 (1.6)	1 (2)	0 (0)	0.2^{NS}	3 (4.8)	1 (2)	0 (0)	0.02^{S}	0.2-1-1
Thinness Grade 2	3 (4.8)	3 (6.1)	0 (0)	0.003^{S}	1 (1.6)	2 (4.1)	0 (0)	0.003^{S}	0.2-0.5-1
Thinness Grade 3	5 (7.9)	6 (12.2)	1 (12.5)	0.02^{S}	10 (15.9)	13 (26.5)	2 (25)	0.0001^{S}	$0.02\text{-}0.03\text{-}0.02^{S}$
Normal	22 (34.9)	10 (20.4)	3 (37.5)	3.10^{-6S}	20 (31.8)	12 (24.5)	2 (25)	$4.4.10^{-5\,S}$	$0.6\text{-}0.5\text{-}0.1^{NS}$
Overweight	0 (0)	1 (1.6)	0 (0)	0.1^{NS}	1 (2)	0 (0)	0 (0)	0.09^{NS}	$0.1\text{-}0.1\text{-}1^{NS}$
p^2	7.10^{-15S}	6.10^{-6S}	2.10^{-16S}		2.10^{-13S}	1.10^{-13S}	2.10^{-16S}		

N: Total number of each subject group, n: Number of observed subject in each BMI class, 1: Threshold values of probability (p) for inter-sex comparison by age, 2: Threshold values of probability (p) for intra-age comparison by BMI class, 3: Threshold values of probability (p) for intra-sex by age comparison, S: Statistically different for p value<0.05, NS: Not statistically significant for p value>0.05

revealed between boys (29.2%) and females (28.3%). However, girls (20.8%) had a rate of thinness grade 3 significantly (p = 0.04) higher than boys (10%). For all subjects, no other significant differences between boys and girls for the other components of the body mass index (Table 6a).

The results of the study also showed that only two children had overweight. In contrast, all children of this age group indicated significant differences for thinness grade 2 and 3. At this level, boys (6.1%) aged 10 years reported a prevalence of thinness grade 2 increased more than other children. At the thinness grade 3, girls showed a higher rate (26.5%) compared to boys in the study. Most notable is the significant difference between boys and girls at the thinness grade 3 (p = 0.02, p = 0.03, p = 0.02, respectively) for each age group. In addition, different age groups indicated highly significant differences ($p = 7.10^{-15}$, $p = 6.10^{-6}$, $p = 2.10^{-16}$, respectively for boys and $p = 2.10^{-13}$, $p = 1.10^{-13}$; $p = 2.10^{-16}$, respectively among girls) between the different classifications of body mass index (Table 6b).

Influences of socio-economic and demographic parameters: The rates of underweight among children was 21.4, 10.8 and 14.3%, respectively in Abobo, Cocody and Yopougon. No significant difference (p>0.05) was observed between the municipalities. However, the rate of underweight in children of Abobo is high. The same observation was reported by sex among children in selected canteens sites.

The prevalence of chronic malnutrition was 7.7% in Abobo, from 5.9 to 3.9% Cocody and Yopougon. No girl showed a severe chronic malnutrition in Abobo and Yopougon. However, 1% of girl indicated this type of malnutrition in Yopougon. For acute malnutrition, the rates of 31, 22.5 and 26.7%, respectively were revealed in Abobo, in Cocody and Yopougon. Children of Abobo who presented a high rate of malnutrition did not differ significantly from those of Cocody and Yopougon. As underweight, no statistically significant difference (p>0.05) was observed between boys and girls in the study (Table 7).

In Table 8, the results of the study showed that household size has an impact on the prevalence of child malnutrition. Indeed, the children of a household whose size exceeds 5 showed the rates of 11.1 and 2.2%, respectively for moderate and severe chronic malnutrition. At the level of underweight, moderate and severe malnutrition, higher prevalences respectively 36.7, 27.8 and 36.7% were observed in these children compared to those with household size is less than or equal to 5. The other sociodemographic variables showed no significant effect (p>0.05) on the prevalence of child malnutrition (Table 8).

DISCUSSION

The use of anthropometric indices in determining the nutritional status is an essential entity developed by the

Table 7: Prevalence of malnutrition in children according selected sites

		Total population N = 310		Abobo N = 103		Cocody N = 102		Yopougon N = 105		
Anthropometric paramèters		n (%)	p[1]	n (%)	p[1]	n (%)	p[1]	n (%)	p[1]	p[2]
Weight for age (W/A. Z score)	T	48 (15.5)	0.8[NS]	22 (21.4)	0.6[NS]	11 (10.8)	0.3[NS]	15 (14.3)	0.4[NS]	0.1[NS]
Underweight (<-2 SD)	B	25 (08)		12 (11.7)		7 (6.9)		6 (5.7)		0.2[NS]
	G	23 (07.4)		10 (9.7)		4 (3.9)		9 (8.6)		0.1[NS]
Normal weight status (= -2 SD)	T	262 (84.5)	0.2[NS]	81 (78.6)	0.4[NS]	91 (89.2)	0.001[S]	90 (85.7)	0.2[NS]	0.1[NS]
	B	114 (36.8)		44 (42.7)		31 (30.4)		39 (37.1)		0.1[NS]
	G	148 (47.4)		37 (35.9)		60 (58.9)		51 (48.6)		0.02[S]
Height for age (H/A. Z score)	T	4 (1.3)	0.5[NS]	2 (1.9)	0.1[NS]	1 (1)	0.2[NS]	1 (1)	0.2[NS]	0.8[NS]
Severe chronic malnutrition (<-3 SD)	B	3 (1)		2 (1.9)		1 (1)		0 (0)		0.3[NS]
	G	1 (0.3)		0 (0)		0 (0)		1 (1)		0.3[NS]
Moderate chronic malnutrition	T	14 (4.5)	0.7[NS]	6 (5.8)	0.4[NS]	5 (4.9)		3 (2.9)	0.5[NS]	0.5[NS]
(between -3 SD and -2 SD)	B	8 (2.6)		4 (3.9)		3 (2.9)	0.7[NS]	1 (1)		0.4[NS]
	G	6 (1.9)		2 (1.9)		2 (2)		2 (1.9)		0.9[NS]
Normal nutritional status (= -2 SD)	T	292 (94.2)	1[NS]	95 (92.2)	0.6[NS]	96(94.1)	0.01	101 (96.2)	0.2[NS]	0.06[NS]
	B	165 (53.2)		50 (48.5)		34 (33.3)		44 (41.9)		0.06[NS]
	G	165 (53.2)		45 (43.7)		62 (60.9)		57 (54.3)		0.04[S]
Weight for height (W/H. Z score)	T	41 (13.2)	0.7[NS]	15 (14.6)	0.4[NS]	13 (12.7)	0.8[NS]	13 (12.4)	0.8[NS]	0.6[NS]
Severe acute malnutrition (<-3 SD)	B	22 (7.1)		9 (8.7)		7 (6.9)		6 (5.7)		0.6[NS]
	G	19 (6.1)		6 (5.8)		6 (5.9)		7 (6.7)		0.8[NS]
Moderate acute malnutrition	T	42 (13.5)	0.8[NS]	17 (16.5)	0.1[NS]	10 (9.8)	0.2[NS]	15 (14.3)	0.2[NS]	0.3[NS]
(between -3 SD and -2 SD)	B	20 (6.5)		12 (11.7)		3 (2.9)		5 (4.8)		0.03[S]
	G	22 (7.1)		5 (4.9)		7 (6.9)		10 (9.5)		0.4[NS]
Normal nutritional status (= -2 SD)	T	227 (73.2)	0.2[NS]	70 (68)	0.8[NS]	80 (78.4)	0.02[S]	77 (73.3)	0.3[NS]	0.07[NS]
	B	97 (31.3)		34 (33)		29 (28.4)		34 (32.4)		0.3[NS]
	G	130 (41.9)		36 (35)		51 (50)		43 (40.9)		0.07[NS]

N: Total number of each subject group, n: Number of observed subject in each anthropometric indice classe, SD: Standard deviation,

1: Threshold values of probability (p) between different sexes, 2: Threshold values of probability (p) between selected sites, T: Total population,

B: Boys, G: Girls, S: Statistically different for p value<0.05, NS: Not statistically significant for p value>0.05

World Health Organization (WHO) in children. They are used to indicate different levels of growth in height and weight among children. The observed values of Z scores among children in our study compared with those of the World Health Organization (WHO) and the centre of control and prevention for disease of United States (CDC/US), are increased in weight for height (-1.3 against -0.3 and -0.5 respectively) and weight for age (-0.9 against -0.2 and -0.5, respectively) and weight for age (Kuczmarski *et al*., 2002; Onis *et al*., 2007). However, the Z scores of the WHO and CDC/US are higher than those of subjects in our investigation regarding the height for age (-0.2 and -0.2 against -0.1). Moreover, the set of compared values of Z scores are normal (WHO, 2006).

The study also reveals that children in school canteens of Abidjan have malnutrition. This malnutrition includes acute and chronic aspects involving moderate and severe forms. The acute form of malnutrition is increased more than the chronic form. Different prevalence (5.8 and 26.7%, respectively) observed in children of our study are lower compared to those (43.4 and 52.7%, respectively) reported in Nigeria from 2015 children aged 9 to 12 in Makurdi primary schools (Goon *et al*., 2011). In addition, in the South West of Nigeria, children and adolescents reported a prevalence of chronic malnutrition of 17.4% with a 22.2% rate of severe malnutrition among these subjects (Senbanjo *et al*., 2011). Moreover, the global prevalence (31.3%) according to the World Organization (WHO) is above those of our study subjects (26.7%). Furthermore, the rate of underweight (15.5%) is also lower than the overall work carried out in Kenya (30%) and Nigeria (43.7%) by Goon *et al*. (2011) and Kwena *et al*. (2003).

Garhwal Himalayas in India, Dutta *et al*. (2009) reported that 88.7% and 89.7% of 353 children aged 0 to 12 years are concerned respectively with chronic malnutrition and underweight. In contrast, a study conducted in Ouagadougou (Burkina Faso) showed a low rate of chronic malnutrition (13.7%) involving a prevalence of obesity of 2.3% compared to our work (DaBone *et al*., 2011). This study shows no prevalence of obesity except 1.7% overweight. A Lahore in Pakistan, Mushtaq *et al*. (2012) found that 8 and 5%, respectively of overweight and obesity in 1860 children aged five 5 to 12 years. Higher rates of overweight (17%) and obesity (3%) have been reported in Sweden in 4538 children aged 7 to 9 years (Sjöberg *et al*., 2011).

Different forms of thinness in children aged 9 to 11 years are observed. They are predominated by the thinness degree 3 with 30.8%. This type of thinness has not been sufficiently indicated in preadolescents in Nigeria. During their investigation Goon *et al*. (2011) reported a prevalence of thinness grade 1 (77.3%) against 5% in children in this study.

The difference in prevalence between the subjects of this study and those of other studies may be explained by age, sex, diet and environment of children. Children in Nigeria and Kenya respectively aged 9 to 12 years and 3 months to 2 years. The last group of children is more vulnerable than children Nigerians and this investigation subjects (UNICEF, 2007; Uthman, 2009).

Between boys and girls in our study, the males have Z scores of weight for age higher than girls. This difference is greater in underweight. However, the boys indicate Z scores of height-for-age lower than girls. Their mean value above -3 which reflects an increased growth delay compared to girls. This stunting among boys is a state of general decline and physical decay due to more severe chronic malnutrition more observed in these subjects than in girls (-5.4±0.01 against -3.5±0.1). In the same way, the work in 10 countries with 64000 children under 5 years Wamani *et al*. (2007) showed that boys in sub-Saharan Africa are experiencing a greater stunting than girls. In contrast, to our results, Dutta *et al*. (2009) in India found that girls are stunted compared to boys. In Sri Lanka, Wickramasinghe *et al*. (2004) reported that, no difference was observed between girls (5.2%) and boys (5.1%) with stunting. This result is similar to that obtained in our study (3.6% against 2.2%).

According to the World Health Organization (WHO), malnutrition includes undernutrition and overnutrition. These two components are characterized by malnutrition, deficiency, excess or imbalance of energy, protein and/or nutritional intake. Overnutrition is a state of absorption of food in excess relative to energy needs and generates overweight and/or obesity. Malnutrition is a condition due to a persistent mismatch between the metabolic needs of the body and the bio-availability of energy and/or protein and/or micronutrients. It usually results in weight loss, a deep decay or stunting of the subject (WHO, 1999).

From these definitions, the malnutrition of children in our study is characterized by undernutrition. It is caused by a deficiency or malabsorption of nutrients consumed.

The subjects of our investigation are guaranteed at least one meal by canteens. This could justify the low prevalence of malnutrition and underweight compared to the work reported in other regions of the world. Feeding children has always been considered an important component of nutrition. Adequate nutrition provides a balanced protein-energy children to prevent their growth retardation, stunting and wasting (Rao *et al*., 2005; Som *et al*., 2007). In addition, a previous study in these same children indicated a good hematological status (82.9%) combined with low prevalence (30.3%) of anaemia (Kokoré *et al*., 2012).

A diet high in carbohydrate on the one hand and on the other hand the low consumption of micronutrient is responsible for this delay to thrive according to (Faber *et al*., 2001).

Table 8: Child malnutrition by socio-demographic and anthropometric characteristics

Sociodemographic parameters	H/A			W/A		W/H		
	NNS	MCM	SCM	NWS	UW	NNS	MAM	SAM
Sexes	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Boys	127 (92.1)	8 (5.8)	3 (2.2)	113 (81.9)	25 (18.2)	96 (69.6)	20 (14.5)	22 (15.9)
Girls	165 (95.9)	6 (3.5)	1 (0.6)	150 (87.2)	22 (12.8)	131 (76.2)	22 (12.8)	19 (11)
Level of father's instruction								
Illiterate	40 (90.1)	4 (9.1)	0 (0)	33 (76.7)	10 (23.3)	34 (79.0)	3 (7)	6 (14)
Educated	252 (94.7)	10 (3.8)	4 (1.5)	230 (86.1)	37 (13.9)	193 (72.3)	39 (14.6)	35 (13.1)
Level of mother's instruction								
Illiterate	103 (92)	6 (5.4)	3 (2.7)	94 (83.9)	18 (16)	86 (76.8)	14 (12.5)	12 (10.7)
Educated	189 (95.5)	8 (4)	1 (0.5)	179 (94.7)	19 (9.6)	141 (71.2)	27 (13.6)	30 (15.2)
Occupational status of father								
Unemployed	37 (88.1)	4 (9.5)	1 (2.3)	35 (83.3)	7 (16.7)	32 (79.2)	6 (14.3)	4 (9.5)
Employed	255 (95.2)	10 (3.7)	3 (1.1)	228 (85)	40 (14.9)	195 (72.8)	36 (13.4)	37 (13.8)
Occupational status of mother								
Unemployed	124 (91.9)	8 (5.9)	3 (2.2)	119 (88.1)	16 (11.9)	99 (73.3)	19 (14.1)	17 (12.6)
Employed	168 (96)	6 (3.4)	1 (0.6)	158 (90)	17 (9.7)	128 (73.1)	23 (13.1)	24 (13.7)
Marital status								
Live in couple	221 (94.4)	9 (3.4)	4 (1.7)	201 (85.9)	33 (14.1)	180 (76.9)	28 (12)	26 (11.1)
Live apart	71 (93.4)	5 (6.6)	0 (0)	62 (81.6)	14 (18.4)	48 (63.1)	14 (18.4)	14 (18.4)
Household size								
=5	214 (94.7)	4 (1.8)**	2 (0.9)	206 (93.6)	14 (6.4)***	195 (88.6)**	17 (7.7)**	8 (3.6)***
>5	78(86.7)	10 (11.1)	2 (2.2)	57 (63.3)	33 (36.7)	32 (35.6)	25 (27.8)	33 (36.7)
Sibling position								
=4	269 (94.1)	13 (4.1)	4 (1.4)	241 (84.3)	45 (15.7)	207 (72.4)	40 (14)	39 (13.6)
>4	23 (95.8)	1 (4.2)	0 (0)	22 (91.7)	2 (8.3)	20 (83.3)	2 (8.3)	2 (8.3)

Our study also shows that household size is associated with a high prevalence of malnutrition among children in school canteens. As the number of people in the household more increases the prevalence of malnutrition is high. This factor would have a direct impact on the food of household members.

Work of Senbanjo *et al.* (2011) reported that polygamous families, low maternal education and poor social class, are exposed to profound malnutrition in Nigeria. These factors along with the history of diseases and lactation were observed in children aged 1 to 4 years in India (Basit *et al.*, 2012). However, in a region of Pakistan, studies Mushtaq *et al.* (2011) showed that the favorable situations wage and education for parents of children are associated with a high prevalence of overnutrition (overweight and obesity).

According to the UN (UNICEF, 2000) mothers with higher education are more likely to make decisions that improve the health and nutrition of their children.

Conclusion: The study conducted among children in school canteens of Abidjan has underlined the prevalence of different forms of malnutrition. Malnutrition which predominates is the undernutrition with acute and moderate aspects based on anthropometric indices. Undernutrition rates observed in children aged 5 to 11 years are lower compared to those established by the World Health Organization (WHO). They are justified by food in school.

Overweight is the only form of overnutrition observed in these children. No child in school canteens of Abidjan has been declared obese. No significant difference in the prevalence of malnutrition was shown between boys and girls. Household size is associated with malnutrition of children in school canteens. To better explain the reasons for malnutrition among children in school canteens of Abidjan, blood samples and meals will be performed to determine the various evaluation indexes of malnutrition and nutrient composition of meal.

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