

## Low Anthropometric Indices of Malnutrition in Children of School Canteen Located in Cocody (Abidjan/Cote d'Ivoire)

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### ABSTRACT

Malnutrition continues to always be a health problem despite the decline of poverty in most countries. Furthermore, school children are an attractive target for assessing the impact of school feeding.

In Côte d'Ivoire., scarce are studies that addressed the impact of distributed lunch in canteens on the nutritional status of school children

That study aim was to assess the nutritional status of school children in canteen in comparison with those who do not eat in the canteen according to anthropometric indices.

In total, 402 children from 5-14 years in a public primary school of Cocody (Abidjan) were enrolled following selection criteria for this study including 302 controls and 101 children in canteen. Nutritional anthropometry is the method used for assessing the nutritional status of children with WHO anthroplus software 3.2.2. The treatment was achieved through Excel Window 2010 software and comparing results with Student t test and Mann Withnney test for means values through software Graph Pad 5 and proportions by test G through R 2.0.1 software. The significance level was  $p < 0.05$ .

The mean age of our study sample was  $8.75 \pm 1.92$  years (50.62% were boys and 49.38% girls). Within the whole study population wasting (0.74%), underweight (2.23%), stunting or chronic malnutrition of (3.47%), overweight (8.93%) and obesity (5.07%). In school canteen children, we observed no cases of wasting, but 0.99% of underweight, stunting (1.98%), overweight (8.91%) and obesity (3.97%). In control group we noticed wasting (0.99%), underweight (2.65%), stunting (3.97%), overweight (8.94%) and obesity (6.29%). Thinness was more moderate among girls with a

ratio of 3.19%. In contrast, overweight was common among girls 5.40% against 2.70% of boys also among school children of 10 years.

**Keywords:** School Canteen, School Children, Anthropometric Indices, Nutritional Status, Malnutrition, Cocody-Abidjan.

### INTRODUCTION

Nutrition can be seen as a process by which a living body uses food for maintenance, growth, renewal of damaged and ruined tissues. [1] So any energy or nutrient deficiency during that growing period can disrupt these physiological processes and therefore hamper the current and future life of individuals growing. [2] Nowadays, one of major health problems in world that developing countries are facing after infections is malnutrition. [3] Malnutrition particularly under nutrition remains a major public health problem in sub-Saharan Africa and South Asia East including India. [4] Cote d'Ivoire, according to United Nations Development Programme (UNDP) in its 2015 report on the Human Development Index (HDI), occupies 172<sup>th</sup> place out of 188 countries in the world. [5] The regression concerning the HDI in Cote d'Ivoire has a worse consequence on the individual life style, eating habits, healthy and nutritional status of the society. The most affected population by malnutrition remains children and women; in particular children less than 5 years. Malnutrition and infection remain the mains causes of all deaths among children under 5 years. [6] Moreover, like most developing countries,

Cote d'Ivoire is confronted with nutrition transition phenomenon which refers to changes in food composition, due to urbanization, globalization, lifestyle changes and eating habits, leading to overweight and obesity. [7] Sometimes it is unlikely that children in food insecurity or malnourished are interested in learning. Therefore, fight against hunger at school and improve nutrition and academic learning are challenges that are trying to make school feeding programs. School canteens role is to provide balanced meals for lunch to schoolchildren at fixed and low costs. [8] In Cote d'Ivoire, to our knowledge scarce are the studies that have investigated the impact of school feeding programs on nutritional status with control subjects. So this study aims to assess nutritional status of school children aged from 5-14 years in canteen of Cocody (Abidjan) in comparison with those who do not take lunch in this structure. Specifically our study seeks to determine different forms of malnutrition through various anthropometric parameters in the study population. In addition, calculations and an evaluation of anthropometric indices used to assess nutritional status of the children according to sex and age groups will be carried out.

## **MATERIAL, STUDY POPULATION AND METHODS**

### **Material and study population**

#### **Study area and population**

This study took place from 22 January to 10 June 2015 within 5 Rosier School of Cocody in Abidjan (Cote d'Ivoire). Two schools named "Rosier 5A" and "Rosier 5B" were selected randomly. The total number of pupils was 500 in the school; all classes were involved in this study (from preparatory courses to Middle Course). The mean age of the children was  $8.75 \pm 1.92$  years with a minimum of 5 years and a maximum of 14 years. For this study, we included 403 pupils regularly enrolled among them 101 children regularly benefited from school meal feeding program and 302 do not benefit from this diet.

This investigation was authorized by Authorities of Nangui Abrogoua University and the Ministry of Education with parents' consent.

### **Criteria choice of study population**

In this study we included all school-age children, especially children aged from 5-14 years who attended regularly school and were apparently healthy, without being hospitalized days preceding our survey. These criteria have been observed with the documents provided by the headmasters of selected schools. The pupils who were not regularly enrolled at school and those who did not complete school records were excluded. Moreover, children who have shown clinical signs of disease and whose parents did not give their consent were not included for that study.

### **Socio-demographic characteristics of study population**

The school children (boys and girls) aged from 5 to 14 years were the study sample. However, the target population consists only of pupils who used to take regularly their lunch at the school canteen. Table 1 shows study population distribution by sex, household size, and amount of consumed fruits, parent's instruction level, parents' marital status and health status. This table indicates that in our sample among 403 school children, 204 were boys (50.62%) and 199 girls (49.38%). A number of 101 children (25.06%) took lunch at canteen. The control group was consisted of 302 children (74.96%) with lunch outside school canteen. The mean age of study population was  $8.75 \pm 1.92$  years, ranging from 5 to 14 years. In addition, the age group the most represented was composed of children from 5 -9 years (295 children with a proportion of 73.20%), the age group from 10-14 years were only 108 children (26.80%). The means height, weight and body mass index (BMI) of study population were respectively  $1.65 \pm 0.16$  m,  $29.31 \pm 9.38$  kg and  $16.44 \pm 2.76$  kg/m<sup>2</sup>. The mean household size was  $7.38 \pm 2.56$  individuals; mean of child per room was  $3.07 \pm 1.70$  persons. Regarding the number of consumed

fruits, most of the children consumed on average  $1.75 \pm 1.29$  fruit per day. Regarding mother's education, 12.40% were illiterate, 24.81% with primary education, 36.72% for secondary level and 25.80% for high level. Concerning father's education level, illiteracy was 5.45%, primary level was 7.94%, secondary level was 38.95%, and finally 47.14% of fathers had a higher level. In what concerning the parents' marital status, 97.51% were in couples against

2.48% of single parent families. For health situation, 83.41% of pupils went to the hospital, against 16.12% were not ill during school year 2014-2015. Most consultations were due to malaria (50%), diarrhea and abdominal pain (25%), asthma and respiratory problems (10%), anemia (5%), dental caries (5%) and 5% for chickenpox, flu and physical injury, and other pathologies.

Table I. General characteristics of study population \*

Characteristics	Total Population (403)			Control (302)			School canteen (101)		
	Boys (n and %)	Girls (n and %)	Total (n and %)	Boys (n and %)	Girls (n and %)	Total (n and %)	Boys (n and %)	Girls (n and %)	Total (n and %)
Study population	204 (50.62)	199(49.38)	403 (100)	150(49.66)	152(50.8)	302(100)	54 (53.4)	47(46.6)	101 (100)
Age (years)	8.80±1.78	8.69±2.06	8.75±1.92	8.99±2.05	8.94±2.05	8.96±1.89	8.29±1.87	7.87±1.89	8.10±1.88
5-9	8.10±1.38	7.82±1.50	7.96±1.44	8.24±1.34	7.91±1.40	8.08±1.38	7.76±1.12	7.59±1.70	7.68±1.32
10-14	11.04±0.74	11.34±1.01	11.19±0.90	10.98±0.71	11.38±1.03	11.19±0.91	11.34±0.98	10.99±0.62	11.22±0.86
Weight (kg)	28.69±8	29.95±10.59	29.31±9.38	29.13±7.37	30.77±11.11	29.95±9.4	27.45±9.51	27.31±8.27	27.39±8.91
Height (m)	1.31±0.1	1.32±0.13	1.65±0.16	1.31±0.1	1.33±0.13	1.76±7.5	1.29±0.12	1.28±0.13	1.28±0.12
Household size	7.08±2.25	7.68±2.82	7.38±2.56	7.19±2.33	7.54±2.87	7.37±2.62	6.79±2.04	8.33±2.64	7.41±2.42
≤5	52(12.90)	44(10.91)	96(23.82)	39(12.91)	38(12.58)	77(25.49)	13(12.87)	5(4.95)	18(4.46)
>5	152(37.71)	155(38.46)	307(76.17)	111(36.7)	114(37.7)	225(74.50)	41(40.59)	42(41.58)	83(20.59)
BMI (kg/m <sup>2</sup> )	16.41±2.5	16.47±3.06	16.44±2.76	16.42±2.67	16.66±2.93	16.54±2.8	16.11±3.00	16.24±2.14	16.17±2.63
Room size	2.85±1.28	3.31±1.61	3.07±1.70	2.82±1.31	3.38±2.23	3.10±1.85	2.94±1.20	3.08±1.05	3.01±1.13
Total eaten fruits	1.68±1.26	1.82±1.32	1.75±1.29	1.66±1.12	1.75±1.30	1.71±1.25	1.72±1.58	2.04±1.13	1.87±1.39
≤4	197(48.88)	189(46.89)	386(95.78)	144(47.6)	146(48.3)	290(96.02)	53(52.47)	45(44.55)	98(97.03)
>4	7(1.73)	9 (2.23)	16 (3.97)	6(1.98)	6(1.98)	12(3.97)	1(0.99)	2(1.98)	3(2.97)
<b>Education level</b>									
<b>Mothers</b>									
No	26(6.45)	24(5.95)	50(12.40)	25(8.27)	22(7.28)	47 (11.41)	03 (2.97)	02(1.98)	5(4.95)
Elementary	46(11.41)	54(13.4)	100(24.81)	33(10.92)	42(13.90)	75(18.61)	13(12.87)	12(11.88)	25(24.75)
Secondary	75(18.61)	73(18.11)	148(36.72)	52(18.87)	51(16.88)	103(25.55)	20(19.80)	22(21.78)	42(41.58)
Superior	57(14.14)	47(11.66)	104(25.80)	41(13.57)	37(12.25)	78(19.35)	18(17.82)	10(9.90)	28(27.72)
<b>Fathers</b>									
No	09(2.23)	13(3.22)	22(5.45)	8(2.64)	11(3.64)	19(4.71)	01(0.99)	02(1.98)	3(0.74)
Elementary	21(5.21)	12(2.97)	32(7.94)	16(5.29)	11(3.64)	27(6.7)	05(4.95)	01(0.99)	6(5.94)
Secondary	69(17.12)	88(21.83)	157(38.95)	55(18.21)	69(22.84)	124(30.76)	14(13.86)	19(18.81)	23(22.77)
Superior	105(26.05)	85(21.09)	190(47.14)	71(23.51)	61(20.20)	132(32.75)	34(33.66)	24(23.76)	58(57.42)
<b>marital status (parents)</b>									
Couple	200(49.62)	193(47.8)	393(97.51)	147(48.67)	148(49)	295(97.68)	52(51.48)	46(45.54)	98(97.03)
separated	4(0.99)	6(1.48)	10(2.48)	05(1.65)	02(0.66)	7 (2.31)	02(1.98)	01 (0.99)	3(2.97)
<b>How many times were you sick?</b>									
No	31(7.69)	34(8.43)	65(16.12)	25(8.27)	24(7.94)	49(16.22)	06 (5.94)	11(10.89)	16(15.84)
≤3	142(35.23)	135(33.50)	277(68.73)	106(35.09)	109(36.09)	264(87.41)	35(33.66)	26(25.74)	61(60.39)
>3	31(7.69)	29(7.19)	61(14.88)	19(6.29)	19(6.29)	38 (12.58)	13(12.87)	10(9.90)	23(22.77)
<b>Observed Pathologies</b>									
Malaria	108(26.79)	94(23.32)	202(50)	86(28.47)	82(27.15)	168(55.63)	19(18.81)	15(14.85)	34(33.66)
Abdominal pain and diarrhea	52(12.71)	48(11.91)	101(25)	43(14.23)	39(12.91)	82(27.15)	10(9.90)	9(8.91)	19(18.81)
Asthma and bronchitis	21(5.21)	19(4.71)	40(10)	17(5.62)	15(4.96)	32(10.59)	5(4.95)	3(2.97)	08(7.92)
Tooth decay	11(2.73)	9(2.23)	20(5)	3(2.97)	5(1.65)	08(2.64)	7(6.93)	5(4.95)	12(11.88)
Anaemia	12(2.97)	8(1.98)	20(5)	8(7.92)	9(2.98)	17(5.62)	2(1.98)	1(0.99)	03(2.97)
Other diseases and injuries	10(2.77)	9(2.23)	19(5)	6(1.98)	5(1.98)	11(3.64)	5(4.95)	3(2.97)	08(7.92)

\*: Results were expressed as mean involving errors of the mean. Some have been indicated with the number of samples and their proportion

## METHODS

### Anthropometric measurements

For decades, nutritional anthropometry is the indirect right tool for assessing nutritional status of populations especially in children because it requires non-invasive and expensive means with satisfactory results. The weight and height

of the children were measured according to World Health Organization (WHO)-recommended procedures. [9] Duplicate measurements of weight and height were taken, and the mean value was determined. Weight was measured to the nearest 0.1 kg by a Beryl portable electronic scale with the children wearing school uniforms with

barefoot. And standing height was measured to the nearest 0.1 cm with a locally made (Scientific Mart) height rod.

### Anthropometric indices

Sex, birth date, weight (kg) and height (cm) of all subjects were imported into the "Nutritional Survey" field in the Anthroplus software 3.2.2 which then calculated their z-score weight-for-age (WAZ), height-for-age (HAZ) and BMI-for-age (BAZ). For age groups, sex, Z-scores means of WAZ, HAZ (Z score Height for Age) and BAZ (BMI for Age) were calculated, except for the WAZ (Z score weight for Age), calculated only for children aged from 5-9 years. This was justified by the fact that the WHO considers the WAZ is no longer a good indicator of nutritional status over the age of 10 years old, since children have already started their growth spurt could be considered in

overweight while they were simply larger. Wasting was defined by WAZ <-2 SD, Stunting was defined by HAZ <-2 SD, underweight or thinness for BAZ <-2 SD, overweight for BAZ >1 SD and obesity for BAZ > 2 SD. [10] Therefore, we were used BAZ or body mass index for age for children of 10 years and more.

### Statistical data processing

Final sample of data was processed with Microsoft Excel 2010 to bring together various ranges of z-scores for each indicator and data processing. We also used the computer Graph Pad Prism 5 for analysis of mean values using Student t test and the non-parametric Mann Whitney U test. For analysis of proportions, G test or Likelihood ratio with R version 2.10.1 software was used. A value of  $p < 0.05$  was considered as indicative of significance.

## RESULTS

**Table II a: Mean of anthropometric indices of total study population and comparison between total controls and canteen group**

Anthropometric parameters	Total population (403)	Total girls	Total boys	P values	Controls (302)	School canteen (101)	p velour
Weight for age (WAZ)/(Mean-Z score)	0.14±1.14	0.20±1.10	0.09±1.18	0.43	0.15±1.16	0.13±1.09	0.895
Height for age (HAZ)/(Mean-Z score)	0.10±1.22	0.26±1.26	-0.05±1.15	0.007	0.06±0.07	0.23±0.12	0.213
(BMI for Age (BAZ) (Mean-Z score)	-0.02±1.07	0.00±1.03	-0.01±1.10	0.89	-0.001±1.08	-0.02±1.03	0.83

BMI: Body Mass Index; BAZ: Body Mass Index for Age Z score; WAZ: Weight for Age Z score; HAZ: Height for Age Z score; p. p value of comparison of mean values of anthropometrical parameters ( $p=0.05$ )

**Table II b: Mean of anthropometric indices according to subjects groups and sex**

Anthropometric variables	Control				School canteen				P2
	Total Population (302)	Girls (152)	Boys (150)	P1	Total Population (101)	Girls (47)	Boys (54)	P1	
Weight for age (WAZ)/(Mean-Z score)	0.15±1.16	0.18±1.11	0.12±1.21	0.98	0.13±1.09	0.24±0.16	0.02±0.16	0.34	0.89
Underweight (<-2 SD)	-2.33±0.15	-2.23±0.20	-2.53±0.00	0.72	0	0	0	-	-
Normal weight status (= -2 SD)	-0.01±0.06	-0.07±0.09	0.04±0.08	0.34	0.00±0.09	0.09±0.14	-0.07±0.13	0.40	0.70
Height for age (HAZ)/(Mean-Z score)	0.06±0.07	0.22±0.10	-0.11±0.09	0.01	0.23±0.12	0.39±0.20	0.10±0.14	0.23	0.21
Severe chronic malnutrition (<-3 SD)	-3.05±0.0	-3.05±0.0	0±0.0	-	0	0	0	-	-
Moderate chronic malnutrition (between -3 SD and -2 SD)	-2.64±0.11	-2.34±0.12	-2.71±0.21	0.14	-2.83±0.04	-	-2.70±0.00	0.47	0.23
Normal nutritional status (= -2 SD)	-0.04±0.05	0.06±0.07	-0.15±0.07	0.04	0.10±0.009	0.10±0.14	0.10±0.12	0.99	0.15
BMI for Age (BAZ) (Mean-Z score)	-0.00±0.06	-0.01±0.08	0.01±0.08	0.79	0.05±0.15	0.05±0.13	-0.09±0.15	0.46	0.31
Severe acute malnutrition (<-3 SD)	0	0	0	-	0	0	0	-	-
Moderate acute malnutrition (between -3 SD and -2 SD)	-2.30±0.08	-2.38±0.09	-2.07±0.01	0.10	-2.08±0	0	-2.08±0	-	0.83
Normal (-2 < SD < 1)	-0.10±0.04	0.07±0.06	0.14±0.07	0.48	-0.12±0.08	-	-0.03±0.12	0.30	0.41
Overweight (> 1 SD)	2.33±0.06	0.025±0.07	2.35±0.07	0.84	2.91±0.53	2.07±0.07	3.75±0.79	0.16	0.66
Obesity (> 2 SD)	3.63±0	3.1±0	3.45±0.18	0.52	4.55±0.0	4.55±0.0	4.55±0.0	1	0.87

SD: Standard deviations; WAZ: Weight for age Zscore; HAZ: Height for age Z score; BMI for Age (BAZ): Body mass index for age Z score, P1: p value for comparison of anthropometrics parameters between boys and girls, p2: p value for comparison of anthropometric parameters between canteens an controls group.



### Anthropometric indices distribution

Table II a presents the distribution of anthropometric indices means values. This distribution was normal according to WHO (World Health Organization) values between -2 and + 2 Standard Deviation (SD) in study population. These mean values were  $0.14 \pm 1.14$  and  $0.10 \pm 1.22$  and  $-0.02 \pm 1.07$  respectively for Weight for Age Z score (WAZ), Height for Age (HAZ) and Body Mass Index for Age (BAZ) for all subjects. A significant difference was observed between boys ( $-0.05 \pm 1.15$ ) and girls ( $0.26 \pm 1.26$ ) for HAZ mean value ( $p=0.007$ ). The distribution of mean values of anthropometric variables by sex summarized in Table II b was normal in total population. However, we observed a significant difference ( $p = 0.01$ ) for Height for Age Z score (HAZ) mean between girls and boys respectively in controls group ( $0.22 \pm 0.10$  vs.  $-0.11 \pm 0.09$  SD). The distribution of means values of anthropometric indices according to age in

the study population compared to normal values of WHO is indicated in Table III. The values of anthropometric indices (WAZ, HAZ, BAZ) of children in age group of 5-9 years were respectively normal conforming to WHO references ( $0.15 \pm 1.16$ ;  $0.20 \pm 0.08$ ;  $0.03 \pm 0.07$ ) in control group and ( $0.13 \pm 0.11$ ;  $0.26 \pm 0.12$ ;  $-0.04 \pm 0.10$  SD) in the school canteen group. Concerning the HAZ indices, a significant difference ( $p = 0.0009$ ) was reported within control group between children under 10 years old and 10-14 years olds children with respective values ( $0.20 \pm 0.08$  vs  $-0.30 \pm 0.12$ ). In canteen group, the mean value of (BAZ>1) Z score among children aged 10-14 years ( $2.95 \pm 0.05$  SD) was significantly upper than the value among children under 10 years ( $2.07 \pm 0.07$ ) ( $p=0,006$ ). Thus the mean value of BAZ>2 was lower ( $3.45 \pm 0.18$  SD) in controls than canteen group ( $4.55 \pm 0.00$  SD) among children of 5-9 years with a significant difference ( $p=0.001$ ).

Table III: Changes of anthropometric indices in school children according to age range (years)

Anthropometric variables	Control			School canteen		
	5-9 ans (216)	10-14 ans (86)	P values	5-9 ans (89)	10-14 ans (12)	P values
Weight for age (W/A)/(Mean-Z)	0.15±1.16	NA	-	0.13±0.11	NA	0.41
Underweight (<-2 SD)	-2.33±0.15	NA	-	-	NA	-
Normal weight status (= -2 SD)	-0.01±0.06	NA	-	0.00±0.09	NA	0.58
Height for age (H/A)/(Mean-Z score)	0.20±0.08	-0.30±0.12	0.0009	0.26±0.12	0.04±0.24	0.55
Severe chronic malnutrition (<-3 SD)	-3.05±0.0	0±0	-	-	-	-
Moderate chronic malnutrition (between -3 SD and -2 SD)	-2.37±0.14	-2.46±0.19	0.71	-2.79±0.0	-2.88±0.0	0.78
Normal nutritional status (= -2 SD)	-0.09±0.15	0.05±0.13	0.46	0.11±0.10	0.06±0.28	0.88
BMI for age (BAZ) (Mean-Z score)	0.03±0.07	-0.09±0.12	0.34	-0.04±0.10	0.11±0.36	0.62
Severe acute malnutrition (<-3 SD)	0	0	-	0	0	-
Moderate acute malnutrition (between -3 SD and -2 SD)	-2.35±0.10	-2.22±0.15	0.50	0	0	-
Normal (-2 < SD < 1)	-0.07±0.05	-0.19±0.10	0.29	-0.12±0.08	-0.14±0.26	0.94
Overweight (Z > 1 SD)	2.41±0.08	2.20±0.06	0.11	2.07±0.07	2.95±0.05	0.006
Obesity (Z > 2 SD)	3.45±0.18	0.0±0.0	0.0001	4.55±0.0	0±0	0.001

NA: Not available; SD: Standards deviation; BMI: Body Mass Index; BAZ: Body Mass Index for Age Z score; WAZ: Weight for Age Z score; HAZ: Height for Age Z score; p: p value of comparison between children aged 5-9 years and 10-14 years in canteen and control groups .

### Nutritional status and malnutrition types

The distribution of different types of malnutrition in the study population is represented in Table IV showed that the prevalence of wasting was 0.74%, chronic malnutrition or stunting 3.47%: (0.25% of severe form and 3.22% of moderate form), thinness (2.23%), overweight (8.93%), and obesity 5.07% (4.72% of grade 1 and 0.99%

of grade 2). In control populations, stunting was 3.97% (0.33 % of severe form and 3.64% of moderate form), underweight (2.65%), overweight (8.94%), and obesity of 6.29% (5.30% of grade 1 and 0.99% of grade 2). In school canteen group, proportion of stunting was 1.98%, underweight 0.99% and the overweight 8.91%, obesity was 3.97% (2.97 % grade 1

and 0.99 of grade 2) For all these proportions no statistically differences were observed in this study population. Overweight ( $Z > 1SD$ ) was 8.94% (4.64% of girls against 4.31% boys) in control group and 8.91 % (2.97% among boys and 5.94 % among girls) in canteen groups. According to age group, finding in Table V, showed that 0.98% of children aged from 5-9 years were suffered from underweight no child

from 10-14 was underweight. No child in canteen population presented this type of malnutrition. Severe chronic malnutrition was 0.33% in children 5-9 years and no case of severity was observed among children aged 10-14 years.

No difference was reported between different age groups and according to population group ( $p > 0.05$ ).

Table IV: Nutritional status of school children according to sex

Anthropometric parameters	Total Population (403)			Control (302)			School canteen (101)			p values		
	Boys (204)	Girls (199)	TP (403)	Boys (150)	Girls (152)	TP (302)	Boys (54)	Girls (47)	TP (101)	P1	p2	P3
Weight for age (W/A)/(Mean-Z score)												
Underweight (<-2 SD)	02 (0.49)	01 (0.25)	03 (0.74)	02 (0.66)	01 (0.33)	03 (0.99)	0 (0)	0 (0)	0(0)	0.33	0.50	0.24
Normal weight status (= -2 SD)	142 (35.23)	141 (34.99)	283 (70.22)	97 (32.12)	101 (33.44)	198 (65.56)	45 (44.55)	40 (39.60)	85 (84.16)	0.15	0.47	0.12
<b>Height for age (H/A)/(Mean-Z score)</b>												
Severe chronic malnutrition (<-3 SD)	01 (0.25)	0 (0)	01 (0.25)	01 (0.33)	0 (0)	01 (0.33)	0 (0)	0 (0)	0 (0)	0.50	-	0.49
Moderate chronic malnutrition (between -3 SD and -2 SD)	8 (1.99)	05 (1.24)	13 (3.22)	07 (2.32)	04 (1.33)	11 (3.64)	01 (1.85)	01 (2.12)	02 (1.98)	0.45	0.82	0.48
Normal nutritional status (= -2 SD)	185 (45.90)	180 (44.66)	365 (90.57)	133 (44.04)	134 (44.37)	267 (88.41)	52 (51.48)	46 (45.54)	98 (97.03)	0.55	0.90	0.52
<b>BMI for Age (BAZ) (Mean-Z score)</b>												
Severe acute malnutrition (<-3 SD)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	-	-	-
Moderate acute malnutrition (between -3 SD and -2 SD)	03 (0.74)	06 (1.49)	09 (2.23)	02 (0.66)	06 (1.99)	08 (2.65)	01 (0.99)	0(0)	01 (0.99)	0.80	0.10	0.37
Normal (-2 < SD < 1)	173 (42.93)	162 (40.20)	335 (83.13)	125 (41.39)	123 (40.73)	248 (82.12)	48 (47.52)	39 (38.61)	87 (84.14)	0.80	0.81	0.87
Overweight ( $Z > 1SD$ )	16 (3.97)	20 (4.96)	36 (8.93)	13 (4.31)	14 (4.64)	27 (8.94)	03 (2.97)	06 (5.94)	09 (8.91)	0.62	0.69	0.99
Obesity grade 1 (2 < Z < 3)	09 (2.23)	10 (2.48)	19 (4.72)	08 (2.65)	08 (2.65)	16 (5.30)	01 (0.99)	02 (1.98)	3 (2.97)	0.38	0.76	0.41
Obesity grade 2 ( $\geq 3$ )	03 (0.74)	01 (0.25)	04 (0.99)	02 (0.66)	01 (0.33)	03 (0.99)	01 (0.99)	0 (0)	01 (0.99)	0.80	0.50	1

TP: Total population; p1: p values between boys in canteen group and those in control group; P2: p values between groups of girls in canteens and those of control group; p3: p value between total population in control and canteen groups; SD: Standards deviation; BMI: Body Mass Index; BAZ: Body Mass Index for Age Z score; WAZ: Weight for Age Z score; HAZ: Height for Age Z score

Table V. Nutritional status in school children according to age range (years)

Anthropometric parameters	Total Population (403)			Control (302)			School canteen (101)			p values		
	5-9 (305)	10-14 (98)	P1	5-9 (216)	10-14 (86)	P1	5-9 (89)	10-14 (12)	P1	P2	P3	
<b>Weight for age (W/A)/(Mean-Z score)</b>												
Underweight (<-2 SD)	03 (0.98)	0 (0)	0.24	03 (1.39)	0 (0)	0.16	0 (0)	0 (0)	-	0.16	-	
Normal weight status (= -2 SD)	282 (92.46)	88 (89.80)	0.84	197 (91.20)	77 (89.53)	0.90	85 (98.50)	11 (91.66)	0.61	0.59	0.87	
<b>Height for age (H/A)/(Mean-Z score)</b>												
Severe chronic malnutrition (<-3 SD)	01 (0.33)	0 (0)	0.49	01 (0.46)	0(0)	0.42	0 (0)	0 (0)	0.92	0.42	-	
Moderate chronic malnutrition (between -3 SD and -2 SD)	08 (2.62)	05 (5.10)	0.36	07 (3.24)	04(4.65)	0.61	01 (1.12)	01 (0.99)	0.92	0.26	0.10	
Normal nutritional status (= -2 SD)	296 (97.05)	93 (94.90)	0.87	208 (96.30)	82 (95.35)	0.94	88 (98.88)	11 (91.67)	0.60	0.85	0.78	

*Continued table no. V...*

BMI for Age (BAZ) (Mean-Z score)											
Severe acute malnutrition (<-3 SD)	0 (0)	0 (0)	-	0 (0)	0 (0)	-	0 (0)	0 (0)	-	-	-
Moderate acute malnutrition (between -3 SD and -2 SD)	06 (1.97)	03 (3.06)	0.62	05 (2.31)	03 (3.49)	0.62	01 (1.12)	0 (0)	0.21	0.51	0.02
Normal (-2 < SD < 1)	257 (84.26)	78 (79.59)	0.71	180 (83.33)	68 (79.07)	0.73	77 (86.52)	10 (83.33)	0.80	0.80	0.73
Overweight (Z > 1 SD)	26 (8.53)	10 (10.20)	0.69	18 (8.33)	09 (10.46)	0.48	08 (8.99)	01 (8.33)	0.87	0.87	0.62
Obesity grade 1 (2 < Z < 3)	12 (3.93)	7 (7.14)	0.33	10 (4.63)	06 (6.98)	0.62	02 (2.25)	01 (8.33)	0.05	0.35	0.72
Obesity grade 2 (≥3)	04 (1.31)	0 (0)	0.17	03 (1.39)	0 (0)	0.16	01 (1.12)	0 (0)	0.21	0.86	-

P1: p values for comparison intra group; P2: p values for comparison inter groups in children with 5-9 years; P3: p values for comparison inter groups in children with 10 -14 years. ; BMI: Body Mass Index; BAZ: Body Mass Index for Age Z score; WAZ: Weight for Age Z score; HAZ: Height for Age Z score

**Table VI: Global classification of thinness accordance with anthropometric indices by sex among pre-adolescents (9-11 years)**

Anthropometric parameters	Total Population (197)			Control (160)			School canteen (101)			P values	
	Boys (103)	Girls (94)	TP (197)	Boys (83)	Girls (77)	TP (160)	Boys (20)	Girls (17)	TP (37)	P1	p2
BMI (kg/m <sup>2</sup> )	16.95± 2.81	16.94± 2.69	16.95± 2.75	16.96± 2.31	16.98± 2.56	16.97± 2.56	16.95± 4.31	16.74± 2.02	16.85± 3.47	0.10	0.10
Thinness grade 1 (< 16)	47 (23.85)	39 (19.79)	86 (43.65)	36 (18.27)	32 (16.24)	68 (34.51)	11 (5.58)	7 (3.55)	18 (9.13)	7.30.10 <sup>-7</sup>	0.007
Thinness grade 2 (16-17)	19 (9.64)	22 (11.16)	41 (20.81)	14 (7.10)	17 (8.63)	31 (15.73)	05 (2.53)	05 (2.53)	10 (5.07)	0.02	0.13
Thinness grade 3 (17-18,5)	18 (9.13)	15 (7.61)	33 (16.75)	16 (8.12)	11 (5.58)	27 (13.70)	02 (1.01)	01 (0.51)	03 (1.52)	0.0008	0.01
Normal (18,5-25)	15 (7.61)	16 (8.12)	31 (15.73)	15 (7.61)	15 (7.61)	30 (15.22)	0 (0)	4 (2.03)	4 (2.03)	0.0007	0.001
Overweight (25-30)	3 (1.52)	2 (1.01)	5 (2.53)	02 (1.01)	02 (1.01)	4 (2.03)	01 (0.5)	0 (0)	01 (0.5)	0.32	0.68
Obesity (≥ 30)	01(0.5)	0(0)	1(0.5)	0(0)	0(0)	0(0)	01(0.50)	0(0)	01(0.50)	0.41	0.41
BMI for age (BAZ) (Z score)	0.07± 1.14	0.03± 1.09	0.05± 1.11	0.11± 1.05	0.02± 1.12	0.07± 1.08	-0.11± 1.44	0.03± 0.92	-0.04± 1.23	0.93	1
Severe thinness (< -3ET)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	-	-
Moderate thinness (<3 < Z < 2)	02 (1.02)	04 (2.03)	06 (3.05)	01 (0.51)	04 (2.03)	05 (2.54)	01 (0.51)	0 (0)	01 (0.51)	0.23	1
Slight thinness (-2 < Z < -1)	13 (6.50)	09 (4.57)	22 (11.17)	11 (5.58)	07 (3.55)	18 (9.15)*	02 (1.02)	02 (1.02)	4 (2.03)*	0.03	0.06
Normal nutritional status (-1 < Z < 1)	70 (35.53)	65 (33.00)	135 (68.53)	55 (27.92)	54 (27.41)	109 (55.33)	15 (7.61)	11 (5.58)	26 (13.20)	1.39.10 <sup>-7</sup>	0.0001
Overweight (1 < Z < 2)	11 (5.58)	10 (5.08)	21 (10.66)	11 (5.58)	7 (3.55)	18 (9.14)	0 (0)	3 (1.52)	3 (1.52)*	0.01	0.005
Obesity grade 1 (2 < Z < 3)	05 (2.54)	05 (2.54)	10 (5.80)	04 (2.03)	04 (2.03)	08 (4.06)	01 (0.51)	01 (0.51)	02 (1.02)	0.16	0.32
Obesity grade 2 (≥3)	02 (1.02)	01 (0.51)	03 (1.52)	01 (0.51)	01 (0.51)	02 (1.02)	01 (0.51)	0 (0)	01 (0.51)	0.68	1
P3	0.964	0.093	0.223	0.063	0.236	-	0.967	0.002	0.060	7.25.10 <sup>-5</sup>	

TP: Total population; BMI: Body mass index; SD: Standard deviation; P1: p values for comparison of proportions in total population between canteens and control groups. P2: p values for comparison of subjects proportions between boys of canteen group and those of control group. P3: p values for comparison of subjects proportions between girls of canteen group and those of control group; BMI: Body Mass Index; BAZ: Body Mass Index for Age Z score; WAZ: Weight for Age Z score; HAZ: Height for Age Z score

### Classification of thinness with anthropometric indices in preadolescents

The pooled data in Tables VI and VII showed the different forms of thinness among pre-adolescents according to body mass index (BMI) and BMI for age. Moreover, children from control group are likely to be thinner than children belonging to canteen group (9.15% vs. 2.03%) p=0.03. Concerning thinness grades, boys are more likely to be thinner than girls except thinness grade 2. Regarding the thinness of grade 2, girls of 10 years old with a ratio of 3.19% was significantly thin (p = 0.03). No boy has been concerned by that thinness

(Table VII). According to BAZ score, moderate thinness with a proportion of 3.19% was presented among girls, no boy has suffered from this form of thinness (Table VII) (p = 0.03). The distribution of thinness according to study group in Table VIII showed no cases of thinness grade 1 or grade 2 in preadolescents' boys in study population. However, children of 10 years were significantly overweight compared to their peers canteen group (p = 0.001). BMI for age slight thinness (-2 < Z < -1) was present in 3.61% of controls of 9 years and no cases were observed in children of the same age in canteen (p = 0.02). No cases of

overweight were observed among boys in canteens. In the other hand, proportions of 3.61% and 7.23% overweight were observed among children in the control group of 9 years and 10 years respectively ( $p = 0.01$ ;  $p = 0.001$ ). Obesity grade 2 touched 3.61% of 10 year olds in the control group and no cases in children in the canteen group ( $p = 0.02$ ). In view of Table IX, 3.90% of 10 years preadolescents

experienced grade of thinness 2. For the moderate form, no cases were observed in canteen group of same age ( $p = 0.02$ ). From the analysis of Table X, no cases of thinness grade 1 and grade 2 were observed in all groups. Within canteen group 5.40% of preadolescent girls of 11years old against 2.70% of boys 11 years suffered from overweight ( $p = 0.006$ )

**Table VII. Classification of thinness accordance with anthropometric indices by sex in all study preadolescents**

Anthropometric parameters	Boys (103)			Girls (94)			p values		
	9 years (28)	10 years (43)	11 years (32)	9 years (30)	10 years (39)	11 years (25)	P1	P2	P3
BMI (kg/m <sup>2</sup> )	17.00±3.66	16.95±1.96	16.92±2.92	16.64±2.25	17.03±3.13	17.15±2.37	0.66	0.89	0.75
Thinness grade 1 (< 16)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	-	-	-
Thinness grade 2 (16-17)	0(0)	0(0)	0(0)	0(0)	03(3.19)	01(1.06)	-	0.03	0.22
Thinness grade 3 (17-18,5)	03(2.91)	01(0.97)	06(5.82)	01(1.06)	04(4.25)	02 (2.13)	0.34	0.13	0.17
Normal (18,5-25)	20.38	38(36.89)	23(22.30)	26(27.66)	28(29.79)	20(21.28)	0.88	0.38	0.87
Overweight (25-30)	02(1.94)	04(3.88)	01(0.97)	01(1.06)	02(2.13)	02(2.13)	0.60	0.47	0.50
Obesity (≥ 30)	02(1.94)	0(0)	02(1.94)	02(2.13)	02(2.13)	0(0)	0.92	0.08	0.10
BMI for age (Z score)	0.25±1.37	0.14±0.95	-0.19±1.11	0.18±0.89	0.01±1.22	-0.13±1.04	0.83	0.60	0.85
Severe thinness (< -3ET)	0 (0)	0(0)	0(0)	0 (0)	0(0)	0(0)	-	-	-
Moderate thinness (-3 < Z < -2)	01 (0.97)	0(0)	01(0.97)	0(0)	03(3.19)	01(1.06)	0.27	0.03	0.94
Slight thinness (-2 < Z < -1)	03(2.91)	03(2.91)	07(6.79)	03(3.19)	03(3.19)	03(3.19)	0.90	0.90	0.24
Normal nutritional status (-1 < Z < 1)	19(18.44)	31(30.09)	20(19.41)	03(3.19)	26(27.66)	17(18.05)	0.0005	0.74	0.82
Overweight (1 < Z < 2)	03(2.91)	06(5.82)	02(1.94)	03(3.19)	04(4.25)	03(3.19)	0.90	0.62	0.57
Obesity grade 1 (2 < Z < 3)	0 (0)	03(2.91)	02(1.94)	02(2.13)	02(2.13)	01(1.06)	0.08	0.72	0.60
Obesity grade 2 (≥ 3)	02(1.94)	0(0)	0(0)	0(0)	01(1.06)	0(0)	0.10	-	0.22

P1: p values for comparison of subjects proportions aged 9 years olds in study population by sex and pre pubertal age; P2: p values for comparison of subjects proportions aged 10 years olds in study population by sex and pre pubertal age; P3: p values for comparison of subjects proportions aged 11 years olds in study population by sex and pre pubertal age; BMI: Body Mass Index

**Table VIII: Comparison of thinness, overload and obesity prevalences among study preadolescent boys**

Anthropometric parameters	Control (83)			School canteen (37)			p values		
	9 years (22)	10 years (34)	11 years (27)	9 years (6)	10 years (9)	11 years (5)	P1	P2	P3
BMI (kg/m <sup>2</sup> )	16.77±2.54	17.30±2.03	16.67±2.38	17.84±6.17	15.63±0.74	18.24±4.69	0.54	0.02	0.28
Thinness grade 1 (< 16)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	-	-	-
Thinness grade 2 (16-17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	-	-	-
Thinness grade 3 (17-18,5)	02(2.41)	0(0)	05(6.02)	01(2.70)	01(2.70)	01(2.70)	0.89	0.05	0.25
Normal (18,5-25)	17(20.48)	30(36.14)	20(24.09)	04(10.81)	08(21.62)	03(8.11)	0.08	0.05	0.003
Overweight (25-30)	02(2.41)	14(16.87)	01(1.20)	0(0)	0(0)	0(0)	0.06	0.001	0.19
Obesity (≥ 30)	01(1.20)	0(0)	01(1.20)	01(2.70)	0(0)	01(2.70)	0.20	-	0.44
BMI for age (Z score)	0.26±1.09	0.32±0.98	-0.26±1.00	0.20±2.08	-0.52±0.42	0.23±1.49	0.93	0.01	0.36
Severe thinness (< -3SD)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	-	-	-
Moderate thinness (-3 < Z < -2)	0(0)	0(0)	01(1.20)	01(2.70)	0(0)	0(0)	0.05	-	0.19
Slight thinness (-2 < Z < -1)	03(3.61)	02(2.41)	06(7.23)	0(0)	01(2.70)	1(2.70)	0.02	0.89	0.14
Normal nutritional status (-1 < Z < 1)	15(18.07)	23(27.71)	17(20.48)	04(10.81)	08(21.62)	03(8.11)	0.17	0.38	0.01
Overweight (1 < Z < 2)	03(3.61)	06(7.23)	02(2.41)	0(0)	0(0)	0(0)	0.02	0.001	0.06
Obesity grade 1 (2 < Z < 3)	0(0)	03(3.61)	01(1.20)	0(0)	0(0)	01(2.70)	-	0.02	0.44
Obesity grade 2 (≥ 3)	01(1.20)	0(0)	01(1.20)	01(2.70)	0(0)	0(0)	0.44	-	0.19

P1: p values for comparison of subjects proportions among preadolescents boys aged 9 years olds between control and canteen group; P2: p values for comparison of subjects proportions among preadolescents boys aged 10 years olds between control and canteen group; P3: p values for comparison of subjects proportions among preadolescents boys aged 11 years olds between control and canteen group; BMI: Body Mass Index



**Table IX: Comparison of thinness, overload and obesity prevalences among study preadolescent girls**

Anthropometric parameters	Control (77)			School canteen (17)			p values		
	9 years (26)	10 years (28)	11 years (23)	9 years (4)	10 years (11)	11 years (02)	P1	P2	P3
BMI (kg/m <sup>2</sup> )	16.70±2.30	16.99±3.42	17.29±2.42	16.28±1.87	17.14±2.21	15.50±0.12	0.28	0.89	0.32
Thinness grade 1 (< 16)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	-	-	-
Thinness grade 2 (16 – 17)	0(0)	03(3.90)	01(1.30)	0(0)	0(0)	0(0)	-	0.02	0.17
Thinness grade 3 (17 – 18,5)	01(1.30)	03(3.90)	02(2.60)	0(0)	01(5.88)	0(0)	0.17	0.52	0.05
Normal (18,5 – 25)	23(29.87)	19(24.67)	18(23.38)	03(17.64)	09(52.94)	02(11.74)	0.07	0.001	0.04
Overweight (25 – 30)	01(1.30)	01(1.30)	02(2.60)	01(5.88)	01(5.88)	0(0)	0.07	0.07	0.05
Obesity (≥ 30)	01(1.30)	02(2.60)	0(0)	0(0)	0(0)	0(0)	0.17	0.05	0
BMI for age (Z score)	0.21±0.88	-0.04±1.31	-0.08±1.07	-0.01±0.90	0.19±0.93	-0.62±0.64	0.35	0.59	0.42
Severe thinness (< -3SD)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	-	-	-
Moderate thinness (-3 < Z < -2)	02(2.60)	03(3.90)	01(1.30)	0(0)	0(0)	0(0)	0.05	0.02	0.17
Slight thinness (-2 < Z < -1)	02(2.60)	02(2.60)	03(3.90)	01(5.88)	01(5.88)	0(0)	0.25	0.25	0.02
Normal nutritional status (-1 < Z < 1)	20(25.97)	19(24.67)	15(19.48)	02(11.76)	07(41.18)	02(11.76)	0.04	0.16	0.25
Overweight (1 < Z < 2)	02(2.60)	02(2.60)	03(3.90)	01(5.88)	02(11.76)	0(0)	0.01	0.02	0.05
Obesity grade 1 (2 < Z < 3)	02(2.60)	01(1.30)	01(1.30)	0(0)	01(5.88)	0(0)	0.07	0.17	-
Obesity grade 2 (≥ 3)	0(0)	01(1.30)	0(0)	0(0)	0(0)	0(0)	-	0.17	-

P1: p values for comparison of subjects proportions among preadolescents girls aged 9 years olds between control and canteen group; P2: p values for comparison of subjects proportions among preadolescents girls aged 10 years olds between control and canteen group; P3: p values for comparison of subjects proportions among preadolescents girls aged 11 years olds between control and canteen group; BMI: Body Mass Index

**Table X: Distribution of thinness, overload and obesity prevalences among canteen pre-adolescents according to age**

Anthropometric parameters	Boys (20)			Girls (17)			p values		
	9 years (06)	10 years (09)	11 years (05)	9 years (04)	10 years (11)	11 years (02)	P1	P2	P3
BMI (kg/m <sup>2</sup> )	17,84±6,17	15,63±0,74	18,24±4,69	16,28±1,87	17,14±2,21	15,50±0,12	0,67	0,08	0,51
Thinness grade 1 (< 16)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	-	-	-
Thinness grade 2 (16-17)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	-	-	-
Thinness grade 3 (17-18,5)	01(2,70)	01(2,70)	01(2,70)	0(0)	01(2,70)	0(0)	0,05	1	0,05
Normal (18,5-25)	04(10,81)	08(21,62)	03(8,10)	03(8,10)	09(24,32)	02(5,40)	0,53	0,69	0,46
Overweight (25-30)	0(0)	0(0)	0	01(2,70)	01(2,70)	0(0)	0,05	0,05	-
Obesity (≥ 30)	01(2,70)	0(0)	01(2,70)	0(0)	0(0)	0(0)	0,05	-	0,05
BMI for age (Z score)	0,20±2,08	-0,52±0,42	0,23±1,49	-0,01±0,90	0,19±0,93	-0,62±0,64	0,86	0,05	0,47
Severe thinness (< -3SD)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	-	-	-
Moderate thinness (-3 < Z < -2)	01(2,70)	0(0)	0(0)	0(0)	0(0)	0(0)	0,05	-	-
Slight thinness (-2 < Z < -1)	0(0)	01(2,70)	01(2,70)	01(2,70)	01(2,70)	0(0)	0,05	1	0,05
Normal nutritional status (-1 < Z < 1)	04(10,81)	08(21,62)	03(8,10)	02(5,40)	07(18,91)	02(5,40)	0,17	0,67	0,46
Overweight (1 < Z < 2)	0(0)	0(0)	0(0)	01(2,70)	02(5,40)	0(0)	0,05	0,006	-
Obesity grade 1 (2 < Z < 3)	0(0)	0(0)	01(2,70)	0(0)	01(2,70)	0(0)	0	0,05	0,05
Obesity grade 2 (≥ 3)	01(2,70)	0(0)	0(0)	0(0)	0(0)	0(0)	0,05	-	-

P1: p values for comparison of subjects proportions aged 9 years among canteen pre-adolescents by sex and pre pubertal age; P2: p values for comparison of subjects proportions aged 10 years among canteen pre-adolescents by sex and pre pubertal age; P3: p values for comparison of subjects proportions aged 11 years among canteen pre-adolescents by sex and pre pubertal age; BMI: Body Mass Index

## DISCUSSION

This study on the nutritional status of school children of Cocody (Abidjan) shows that most of children included in our study have a good nutritional status. This could be attributed in part to our study area. In Cocody of Abidjan, live most civil

servants, officials and an importance portion of well-educated population with a high standard of living. The impact of socio-economic and demographic conditions on nutritional status of children has been highlighted. [11] Furthermore, women are well educated and have access to quality

profession, which influences food supply, child health and feeding practices and impact children's nutritional status. [12] In this study we observed low prevalence of malnutrition in study population. Underweight with a prevalence of 2.23%, stunting (3.47%) and overweight (8.93%) and obesity (5.07%) within population. These findings are comparatively different from those obtained in Abidjan (Cote d'Ivoire) with prevalence of underweight, which were 26.5%, stunting (5.8%), and overweight (1.7%). [13] In their study no cases of obesity have been observed comparatively to our study. Our findings are lower than those obtained in Nigeria who during their study on nutritional status of children of 9-12 years observed underweight (43.4%) and delay growth was 52.7%. [14] These values were very high compared to our findings. Moreover in South Africa on a study in children aged 1-20 years, those authors observed high rate of underweight which was 20.4%, stunting was 12% and 11% of overweight and 5% of obesity among the children. [15]

In Guatemala a study concluded that children from families with a higher socioeconomic status had a good nutritional status compared to children from families with low socio-economic status who are more prone to protein-energy malnutrition. [16] Indeed, the low prevalence of malnutrition is partly due to socio-economic and demographic status of families, parents' living standards and family's social stability. [17] Moreover, all forms of malnutrition were moderate; this could be explained by the fact that our study population had access to three meals per day, although the nutritional quality of meals varies from one household to another. [18] The prevalence of overweight observed in our study is 8.93% (8.91% in children in canteen versus 8.94% of control population). These findings are different to those in Ouagadougou (Burkina Faso). [4] The prevalence of overweight was 2.3% in their study population and 8.8% of stunting and underweight was 13.3%. The high

prevalence of overweight 8.93 % in our study is upper to that obtained in Cote d'Ivoire, which was 4% in adolescents in high schools in Abidjan. [19] The high prevalence of overweight observed in children is caused by reduced physical activity, poor eating habits that tends to westernize (consumption of sodas and juices), high consumption of dense calories food, reduced consumption of fruits and the socioeconomic level of parents. Dietary factors involved in the occurrence of overweight is due by excess dense nutrient intake and eating disorders habits with excessive calories intake relative to needs, which therefore lead to a long-significant weight gain. [20] Children in canteen had good nutritional status compared to controls. That could explain the ameliorative impact of school feeding programs on nutritional status of children at school. Indeed, meals in canteens provide a balanced and varied diet in line with recommended dietary allowances for children population and by age. In addition, the menus are selected, based on nutritional needs of children and respecting the diet required for the child. Similar finding were in Nigeria. [21] After their study these authors concluded that school feeding programs have a positive impact on nutritional status of pupils. In the same ways, another investigation showed that school lunch has a positive impact on nutritional status of children aged from 6-12 years in a rural area of South Karnataka Region. [22] According to gender, boys with 1.99 % are stunted than girls (1.24%). However, these results didn't show any significant difference between gender and protein-energy malnutrition because before puberty boys and girls have the same nutritional needs. [23]

Concerning the thinness, the prevalence is 0.74% in our study population. The low rate of thinness can be explained by the fact that our study has been conducted in an environment with a high level of favorable socio-economic life. The lack of emaciation observed among school children in canteens was inherent to school feeding

program on improving nutritional status of children.

According to International Obesity Task Force (IOTF) references or the method that uses the body mass index (BMI kg/m<sup>2</sup>) different grades of thinness have been determined. [24] In the way of comparison with IOTF references, we use the new WHO standards that classify thinness in severe emaciation, moderate and mild, Z-scores for Body Mass Index for Age (BAZ) are determined in order to assess the thinness status. [25] The grade 3 thinness was dominant in our study with a prevalence of 3.90% among girls of 10-year old. Our results are different from those obtained other researchers in Côte d'Ivoire. [13] During their study that also took place in urban areas like ours, these authors reported grade 3 thinness with a prevalence of 30.8% in three municipalities in Abidjan. In contrast to our studies, investigations in Nigeria have reported a prevalence of 77.3% for grade 3 thinness that dominated throughout their study population. [14] However, with WHO reference (BMI for Age) thinness with 3.90% was moderate among girls of 10 years old and mild in 3% of boys of 10 years in control population. In Burkina Faso, some researchers observed that the prevalence of moderate thinness was 13.7% with no significant difference between gender and type of school (private or public). [4] Nevertheless, both forms of malnutrition (deficiency and excess weight) exist in our study population, which confirms nutritional transition experienced by developing countries causing de facto if nothing is done double burden of problem malnutrition. [7]

## CONCLUSION

On completion of this study, we noticed that nutritional status of school children for Rosiers (Cocody) was normal in most cases. During this study we observed very low prevalence of malnutrition with moderate form. In school canteen, the prevalence of malnutrition was very low, this made our study supports the idea that

school feeding programs improve nutritional status of pupils by reducing malnutrition. Depending on gender, malnutrition affects both sexes and special children 5-9 years. Furthermore, overweight and obesity were present in relatively high percentage raising fears of non-communicable disease in children. Although, nutritional deficiencies problems in macro and micronutrients remain, we must deal with overweight problems, synonym of nutritional transition. So it should be introduced and included in school curricula nutrition education to prevent malnutrition with its corollary of negative impacts on health and academic performance.

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