Assessment of the Nutritional Status of Children Living in Orphanages in the City of Douala, Cameroon

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Abstract: *Introduction*: Malnutrition is characterised by metabolic disturbances identified by measurement of anthropometric and biological parameters. The purpose of this study was to determine the nutritional profile of children living in orphanages and to investigate the factors associated with malnutrition in these institutions.

Methods: A cross-sectional study was conducted on subjects aged 0 to 18, living in 13 orphanages in Douala. Socio-demographic data, anthropometric and biological parameters were collected. The diagnosis of malnutrition at the clinical level was based on Z score <-2 for the different index and >2 for Weight-for-Height and Body Mass Index for Age. A blood sample permits the photometric assay of albumin, pre-albumin, and C Reactive Protein. The results were interpreted according to reference values for age.

Results: Among the 176 children included, the average age was 10±4 years with a male predominance. The majority of children (51.1%) were placed in orphanages for lack of financial resources, and one or both parents orphaned were 42.1%. The wasting, underweight and stunting rates were 5.6%, 4.7%, and 18.2%, respectively. Hypo-pre-albuminemia and hypo-albuminemia were observed in 42.6% and 34.7% of children respectively. CRP was increased in 5.1% of cases. Stunting and orphanages with one caregiver for more than 5 children were predictive factors for hypo-albuminemia and Hypo-pre-albuminemia.

Conclusion: Rates of wasting, stunting and underweight were high. Several children had sub-clinical malnutrition despite normal anthropometric index. These results recall the importance of biology for screening, in order to prevent the occurrence of clinical malnutrition.

Keywords: Albumin, C Reactive Protein, Malnutrition, Orphanage, Pre-albumin.

INTRODUCTION

The World Health Organization (WHO) defines malnutrition as a cellular imbalance between the source of nutrients, energy and body requirements for growth, maintenance and specific functions [1]. Malnutrition is a public health problem by its magnitude; it was estimated that about 171 million pre-school children were stunted in 2010, with 95% (167 million) in developing countries [2]. Malnutrition occurs most commonly in sub-Saharan Africa with very high rates of stunting in many countries [3]. In Cameroon in 2012, the rate of moderate chronic malnutrition among children under 5 was estimated at 33%; this rate varied according to the Regions and is higher in the North and the Far North [4]. An orphan is any child under the age of 18 whose mother or father or both parents have died, their number was estimated at about 140 million worldwide in 2014, with 90% in sub-Saharan Africa [5]. Conflicts, natural disasters, endemic diseases such as malaria, HIV/AIDS and tuberculosis, and increasing poverty have claimed the health and lives of millions of productive adults in Africa leaving their children orphaned and vulnerable [5]. Orphanages are shelters providing protection, nutrition, care, education and an environment conducive to the development of these vulnerable children, but young institutionalized children did not register weight gain, unlike other children of their age; they have complex medical status and frequent growth and development delays [6]. In this context, we proposed to study the nutritional and

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inflammatory status of children and adolescents living in the orphanages of the city of Douala (Cameroon).

METHODOLOGY

Location and Period

This cross-sectional study was conducted from December 1st, 2015 to May 31st, 2016, on children from 13 orphanages in the city of Douala, Capital of the Littoral Region (Cameroon).

The study population consisted of subjects' aged 0 to 18 years in apparent good health, permanent residents, and semi-boarders who returned to the family homes at the end of the day and whose tutor consented to participate in the study. Recruitment was consecutive. The analysis of the samples took place in the biology laboratory at the General Hospital of Douala, in the biochemistry unit.

Data Collection

A questionnaire was administered to caregivers or children in the presence of a caregiver. Socio-demographic data (date of birth, gender, level of education), personal history (reason for placement, age at admission, length of stay at the orphanage, person who placed, orphaned or abandoned child, reason for abandonment, number of rooms and children in the orphanage, number of subjects per room, number of children per caregiver, sources of funding) were collected. For the anthropometric parameters, the measurement of the size was made immediately after the weighing, while the child was undressed. Depending on age and ability to stand, the height was measured in lying position, or in a standing position. For children under 2 years old, the measurement was performed while lying down; for children 2 years or older and able to stand, it was done in a standing position. A horizontal board placed on a flat, stable surface such as a table has been used. The measurement of the standing height was done with the help of a wall-mounted fence installed at a right angle on a flat ground and against a straight, vertical surface.

Anthropometric Index [7]

- Height-for-age: it reflects the growth achieved in size lying or standing at the child's age during a given visit. This indicator is used to identify growth retardation (stunting).

- Weight-for-age: It reflects body weight in relation to the age of the child at a specific date. This indicator is used to determine if a child is underweight or severely underweight.

- Weight-for-height: it is an indicator of growth that relates weight and height on a lying or standing position, and indicates wasting.

- Body mass index (BMI) - for age: is a useful indicator for detecting overweight and obesity. BMI-for-age and weight-for-height lying/standing tend to give very similar results.

The parameters obtained were recorded in the Anthro™ software, which calculated the Z score values according to each anthropometric index. This allowed children to be classified according to their state of growth and weight.

Biology

All children had a specimen for the determination of pre-albumin, albumin and C Reactive Protein (CRP). The collection of venous blood was done in a tube without anticoagulant, previously labelled. All the samples were then transported to the Clinical Biology laboratory of the General Hospital of Douala in a cooler, containing cold accumulators. After centrifugation, the albumin and pre-albumin assay were performed by photometry on the COBAS C311™ (ROCHE) analyser. The C Reactive Protein (CRP) assay was performed by immuno-turbidimetry on latex particles. Samples that could not be processed immediately were frozen at -20°C for later analysis. The results were interpreted according to the reference values for age.

Data Analysis

The data was recorded and processed using the Epi Info 7, EPIDATA 3.1 and Excel 2007 software; then analysed using the XLstat 7.5.2 software. The growth curves were plotted using the Anthro™ and Anthro plus™ software. The quantitative variables were presented on the average ± standard deviation and the qualitative variables in numbers, the percentages were presented (in a bivariate analysis), the comparison between the qualitative variables was carried out using the chi2 test; the exact probability of Fisher has been determined for dichotomous variables. The differences were considered significant for $p < 0.05$.

RESULTS

Of the 23 orphanages listed by the Regional Delegation of Social Affairs in the city of Douala, 17

accepted to participate in the study, four of which included only external children were excluded. A total of 176 subjects were recruited with a male predominance (52.8%). Their average age was 10 ± 4 years, with extremes of 10 months and 18 years. The most represented age group in the study population was 10 to 18 years old, and the average age at arrival in orphanages was 5 ± 4 years (0-14 years). The majority of participants, 98 (55.7%), attended primary school and 35 children (19.9%) were out of school (Table **1**). In this study, we noted a predominance of placement cases for low financial resources, i.e. 90 children (51.1%) (Table **1**). The majority of children living in orphanages (43.2%) were not really orphans, 73 children were placed there by their biological parents (41.5%), and the placement modalities of 11 of them (6.3%) were unspecified (Table **1**). Concerning the number of subjects, each of these institutions had on average 17 children (6 to 28), four rooms (2 to 9), and five caregivers (2 to 23). All the orphanages were mostly provided by donations, none were subsidized.

A total of 145 subjects (82.4%) were of normal height for age and 140 (79.5%) were of normal weight for age. Seven children (4%) had wasting and 9 (5.1%) severe wasting, while 17 (9.7%) were at risk of overweight, 2 (1.1%) were overweight and 1 (0.6%) was obese (Tables **2**, **3**). According to the Height-for-Age index and gender, some children of both genders were stunted, with female predominance for stunting and male overweight (Figure **1**).

Table 1: Socio-Demographic Characteristics of Study Population

Characteristics		Frequency N =176	Percentage %
Gender (Sex ratio 1.12)	Male	93	52.8
	Female	83	47.2
Age groups (years) Mean = 10±4	0-5	17	9.7
	5-10	69	39.2
	10-18	90	51.1
School level	None	35	19.8
	Nursery school	17	9.7
	Primary school	98	55.7
	Secondary school	26	14.8
Reason for placement	Lack of financial resources	90	51.1
	Social security	20	11.4
	Street child	16	9.1
	Mother's mental disorders	9	5.1
	Abuse	7	4
	Parental conflict	2	1.1
	Not determined	32	18.2
Person who placed the child	Biological parents	73	41.5
	Social services	32	18.2
	Uncle/Aunt	22	12.5
	Grandparents	17	9.7
	Other	21	11.9
	Not determined	11	6.3
Deceased parents	Father and mother	42	23.8
	Father	16	9.1
	Mother	16	9.1
	None	76	43.2
	Do not know	26	14.8

Table 2: Anthropometric Index According to Age Groups

		Anthropometric index								
		W/A*			H/A			W/H** and BMI/A		
Age group (year)		0-5	5-10	Total n (%)	0-5	5-18	Total n (%)	0-5	5-18	Total n (%)
Z scores	< -3	0	2	2 (1.9)	0	12	12 (6.8)	0	7	7 (4.0)
	< -2	1	3	4 (3.8)	0	19	19 (10.8)	1	6	7 (4.0)
	< -1	1	24	25 (23.6)	7	33	40 (22.7)	3	32	35 (19.9)
	0	13	56	69 (65.1)	5	71	76 (43.2)	8	98	106 (60.2)
	>1	3	3	6 (5.7)	5	20	25 (14.2)	4	14	18 (10.2)
	>2	0	0	0 (0)	1	2	3 (1.7)	2	0	2 (1.1)
	>3	0	0	0 (0)	0	1	1 (0.6)	0	1	1 (0.6)
Total		18	88	106 (100)	18	158	176 (100)	18	158	176 (100)

W/A = Weight-for-Age.
H/A = Height-for-Age.
W/H = Weight-for-Height.
BMI/A = Body Mass Index for Age.
*0 to 10 years.
**0 to 5 years.

Table 3: Biological Parameters

		Pre-albumin n (%)			Albumin n (%)		
		Normal	Low rate	P value	Normal	Low rate	P value
Age groups (Years)	< 5	8 (4.5)	9 (5.1)	0.5	11 (6.3)	6 (3.4)	0.98
	5 - 10	50 (28.4)	38 (21.6)		57 (32.4)	31 (17.6)	
	> 10	43 (24.4)	28 (15.9)		47 (26.7)	24 (13.6)	
H/A	Important stunting (n =12)	4 (2.3)	8 (4.5)	0.024	8 (4.5)	4 (2.3)	0.001
	Stunting (n = 19)	7 (4.0)	12 (6.8)		5 (2.8)	14 (8.0)	
	Normal height (n= 145)	90 (51.1)	55 (31.3)		102 (58)	43 (24.4)	
W/A	Important underweight (n=1)	0 (0)	1 (0.9)	0.2	0 (0)	1 (0.9)	0.35
	Underweight (n=4)	1 (0.9)	3 (2.8)		3 (2.8)	1 (0.9)	
	Normal weight (n=101)	58 (54.7)	43 (40.6)		68 (64.2)	33 (31.1)	
W/H and BMI/A	Important wasting (n=9)	4 (2.3)	5 (2.8)	0.44	5 (2.8)	4 (2.3)	0.48
	Wasting (n=7)	2 (1.1)	5 (2.8)		4 (2.3)	3 (1.7)	
	Normal weight (n=140)	84 (47.7)	56 (31.8)		96 (54.5)	44 (25.0)	
	Risk of overweight (n=17)	10 (5.7)	7 (4.0)		9 (5.1)	8 (4.5)	
	Overweight (n=2)	1 (0.6)	1 (0.6)		1 (0.9)	1 (0.6)	
	Obesity (n=1)	0 (0)	1 (0.6)		0 (0)	1 (0.6)	
Length of stay (year)	<1	12 (6.8)	5 (2.8)	0.1	12 (6.8)	5 (2.8)	0.044
	1-5	50 (28.4)	49 (27.8)		57 (32.4)	42 (23.9)	
	>5	39 (22.2)	21 (11.9)		46 (26.1)	14 (8.0)	
Children/Caregiver	1	23 (13.1)	1 (0.6)	0.0002	22 (12.5)	2 (1.1)	0.008
	2-5	33 (18.8)	29 (16.5)		35 (19.9)	27 (15.3)	
	>5	45 (25.6)	45 (25.6)		58 (33.0)	32 (18.2)	
Meals/ Day	<3	19 (10.8)	1 (0.6)	<0.0001	20 (11.4)	0 (0)	<0.0001
	3	57 (32.4)	72 (40.9)		71 (40.3)	58 (33.3)	
	>3	25 (14.2)	2 (1.1)		24 (13.6)	3 (1.7)	

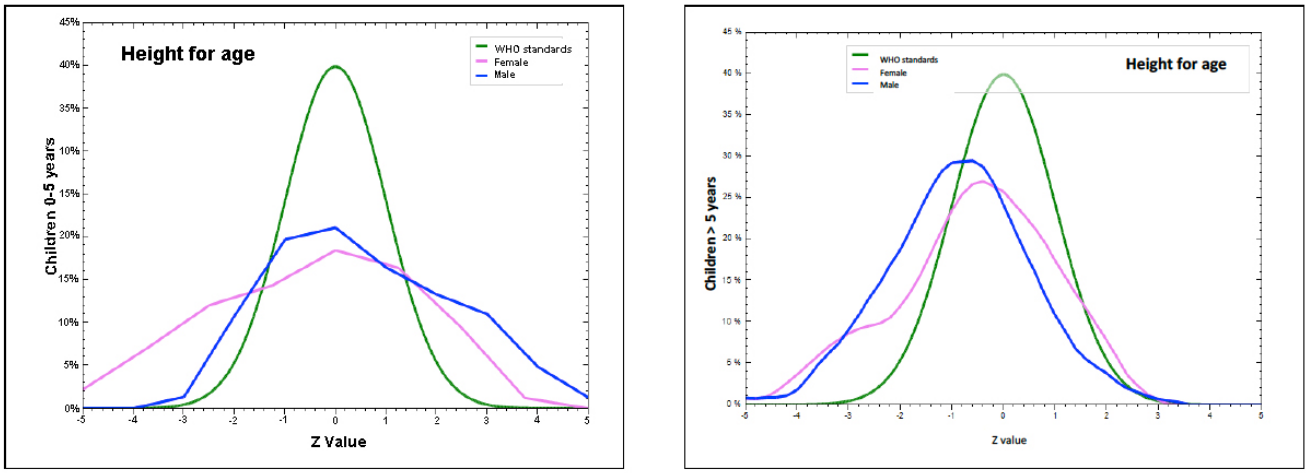

Figure 1: Height for Age according to gender.

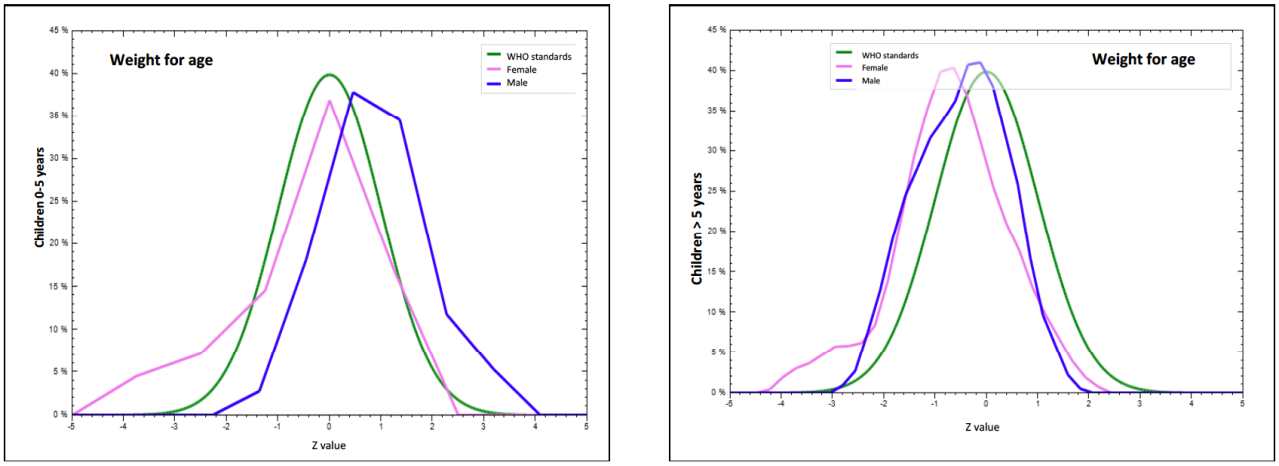

Figure 2: Weight for Age according to gender.

According to the Weight-for-Age index and gender, for children aged 0 to 5 years, wasting was more prevalent among girls than boys. For children over 5 years, girls were underweight, while boys had a higher weight for their age (Figure **2**).

For Weight-for-Height index and gender in children from 0 to 5 years, there were overweight cases in both genders and wasting cases only in girls (Figure **3**).

Concerning BMI for Age and gender, children were wasted, and there were also cases of overweight (11.1%) (Figure **3**).

Concerning the biological parameters, inflammation resulting from the elevation of CRP was found in 9 children (5.1%).

In this study, 75 subjects (42.6%) had a low pre-albumin level, and hypo-albuminemia was found in 61 (34.7%) of them.

The population most affected by malnutrition according to the levels of albumin and pre-albumin was that of children under 5 years (Table **3**). Hypo-albuminemia was found in 75% of children with moderate underweight, and in 100% of those with the severe form. There was a decrease in the level of pre-albumin and albumin with normal anthropometric indices. This decrease in biological parameters was more marked in the presence of a disturbance of the anthropometric parameters and statistically significant for the Height-for-Age index ($p = 0.024$ and 0.001). The decline in albumin level was 71.4% in cases of wasting. The children most affected by stunting and wasting were older than or equal to 10 years; the risk of stunting and wasting was statistically significant ($p = 0.03$ and 0.02 respectively). The children most affected by malnutrition were those who had stayed between 1 and 5 years in the orphanage as well by anthropometric indices as by biological data. The risk

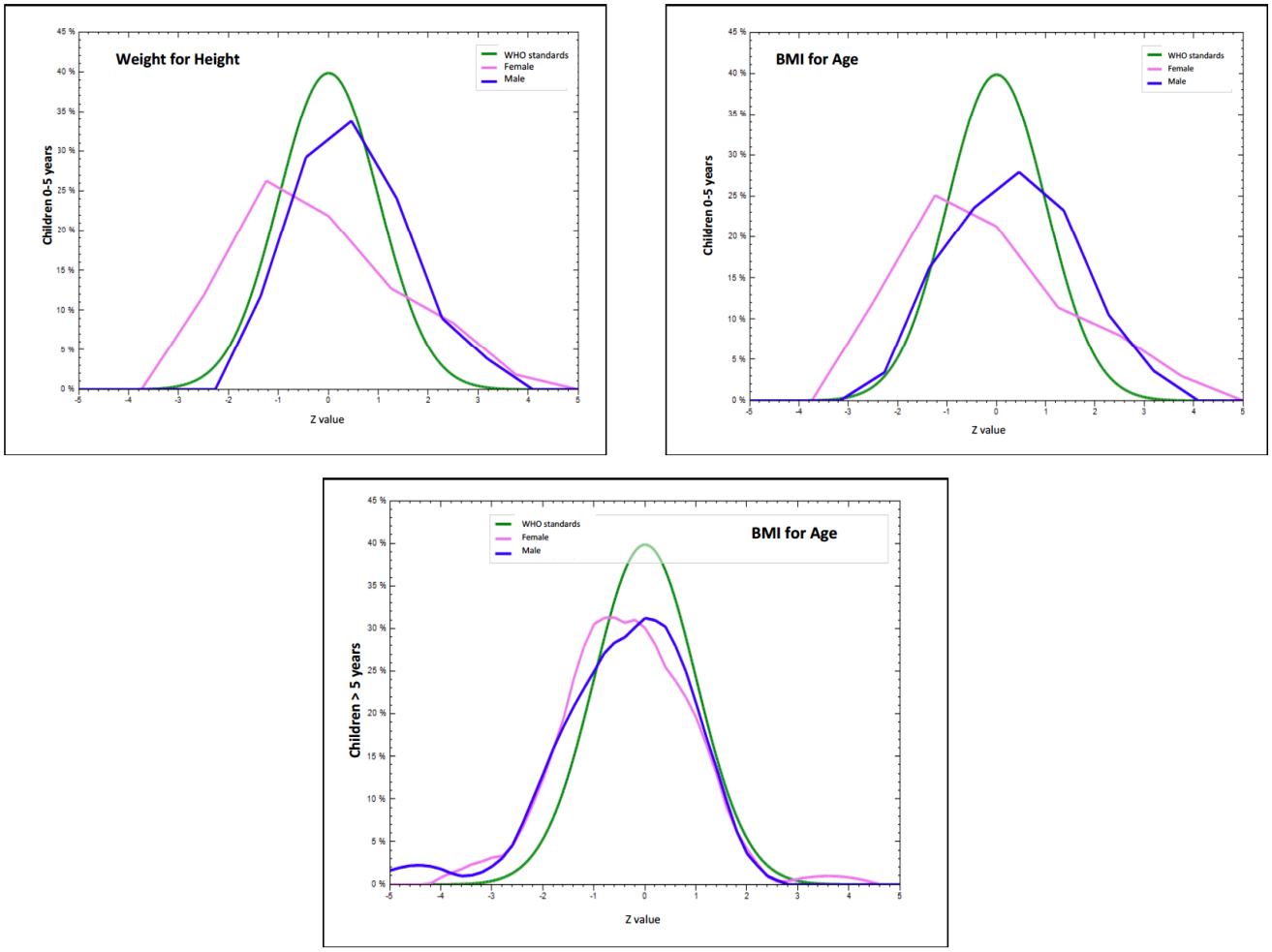

Figure 3: Weight for Height and Body Mass Index for Age according to gender.

of malnutrition was statistically significant for the duration and decrease of albumin (p = 0.044).

Hypo-albuminemia and hypo pre-albuminemia were most common in orphanages with one caregiver for more than 5 children. The children most affected by malnutrition were those who had less than three meals a day. The risk of occurrence of malnutrition and the number of meals was statistically significant for pre-albumin and albumin. The Table **4** presents the factors associated with biological malnutrition (defined as albumin and pre-albumin). The presence of stunting and the number of children per caregiver increase the risk of hypo-albuminemia. Increased age and more than 3 meals/day reduced the risk of malnutrition.

DISCUSSION

This study aimed to evaluate the nutritional and inflammatory profile of children living in orphanages in the city of Douala. The observed male dominance was similar to that found by Sadik *et al.* in Ghana in 2010 and Sinha *et al.* in 2016 in India [8, 9]. In Cameroon according to ESDC 2011, boys are the most represented in the 0-19 age group [10]. In this study, the average age was 10 years ± 4 similar to those of Ayuku *et al.* in 2014 in Kenya who reported 10 years [11]. The majority of children, 55.7% were in primary school, the delay in schooling can be explained by the fact that most children were unschooled on arrival at the orphanage, at the age of 5 years. The low socio-economic level was the main reason for placement (51.1%). This rate was lower than those found in 2013 in Ghana, which was 80 to 90% [8]. In many areas where poverty is widespread, institutionalization by parents is the only way to meet the basic needs of children such as food, access to education and health [6, 9]. Poverty is often cited as the reason for placing children in orphanages in Africa. The majority (63.7%) of children were placed in an orphanage by family members i.e. direct, ascending and collateral parents. The number of orphans was 74 (42.1%), of whom 23.8% had both parents who died; Ayuku *et al.* in Kenya, found 21.9% of children who lost both parents,

Table 4: Factors Associated with Malnutrition

Variables		OR	95%inf	95%sup	P value
Pre-albumin	Age (years)	0.88	0.80	0.97	0.013
	Length of stay > 5 years	2.16	0.89	5.28	0.090
	> 3 meals/day	0.037	0.001	0.15	< 0.0001
	> 5 children/Caregiver	1.45	0.64	3.28	0.38
	Growth retardation	2.53	1.02	6.26	0.044
Albumin	Age (years)	0.98	0.89	1.08	0.71
	Length of stay > 5 years	0.75	0.32	1.72	0.50
	> 3 meals/day	0.044	0.012	0.168	< 0.0001
	> 5 children/Caregiver	3.18	1.45	6.96	0.004
	Growth retardation	2.67	1.13	6.35	0.026

OR: odd ratio.

Sinha *et al.* in India obtained 6.8% of double orphan and 31.7% of no deceased parents, in Russia, Miller *et al.* found only 4 true orphans in 193 young children [6, 9, 11].

Height for Age Index

Studies in orphanages in rural areas have shown a high rate of stunting, 56% and 42.7% in Bangladesh and Ethiopia respectively [12, 13]. In the Douala orphanages, this rate is much lower, i.e. 18.2%; this difference could be explained by the higher global hunger index in these countries [14].

Weight for Age Index

In total, 5.7% of children were underweight; these results are lower than those of ESDC 2011 (15% nationally), Bangladesh in 2011 (22% mildly underweight and 10% severely underweight) and in Ghana (33.2%), especially among children under 5 [10, 12, 8]. However, the Weight-for-Age index for the under-5 was shifted to both bounds compared to the WHO standards, and boys were more affected than girls. Miller *et al.* found that the proportion of children with the Z scores <-2, especially for weight, decreased as children get older; many children who were growth delayed at entry accelerate their growth during baby home residence [6].

Weight for Height Index

Moderate wasting was present in 5.6% of children (Z score <-2). These results are similar to those reported by ESDC 2011 (6%), lower than Gultie *et al.* (9.9%) [10, 15]. Ferdoushi *et al.* found a higher prevalence in a previous study in Bangladesh; they reported 46.5% wasting in a population of 200 children [12]. These high rates could be explained by the fact that these studies were conducted only in vulnerable children (0 to 5 years).

Body Mass Index for Age

In the population, the overweight rate was 1.7%, while wasting was 8%. Ferdoushi *et al.* in children aged 6 to 15 years had 21.74% overweight children and 10.87% emaciated children; Sadik *et al.* in children aged 2-18 years found 5% overweight and 15% wasting [8, 12].

Biological Data

We obtained 42.6% hypo pre-albuminemia and 34.7% hypo-albuminemia. The 2014 study by Musimwa *et al.* in Congo found a 27.3% decrease in albumin in a population of 124 children, with 18.3%, 24% and 30.4%, chronic malnutrition, wasting and underweight respectively [16]. This decrease is generally all the more marked as the protein has a short half-life. Pre-albumin and albumin were diminished despite a normal clinic; this decrease is even more marked when there is malnutrition at the clinical level. The incidence of disturbances in the protein profile and associated infections is much greater in severe malnutrition, in which a very high inflammatory and nutritional prognostic index has been noted [16]. Pre-albumin is a feasible and reliable tool in the evaluation of malnutrition, particularly in settings where it is difficult to perform a more detailed nutritional assessment [17]. It has been noted an elevation of CRP in both forms of malnutrition. This study has shown that minor and

moderate malnutrition in children is always accompanied by the inflammatory process and protein consumption including albumin.

Associated Factors

In our study, children older than or equal to 10 years were the most affected by stunting (26.7%, p = 0.03) corresponding to chronic malnutrition; those under 5 years of age were underweight and decreased albumin levels, both acute and chronic malnutrition. Stunting is the anthropometric measure most strongly associated with poverty and is an indicator of choice to reveal a correlation between chronic poverty and malnutrition in stable situations [18]. Eating fewer than 3 meals per day and low caregiver involvement were associated with malnutrition, Thielman *et al.* found that the same factors contribute to poorer child health outcomes [19].

LIMITATIONS

Our study could not be carried out in all orphanages of Cameroon, so it is impossible to generalize the results at the national level.

CONCLUSION

The rates of wasting, stunting and underweight were high among children living in orphanages in the city of Douala. Several children had sub-clinical malnutrition despite normal anthropometric indices. The decline in albumin was not associated with inflammation. Stunting and orphanages with a supervisor for more than 5 children were predictive factors for hypo-albuminemia and hypo-pre-albuminemia. These results point to the importance of using biological parameters for screening, in order to prevent the occurrence of clinical malnutrition.

ETHICAL

The research authorizations were obtained from the Director of the General Hospital of Douala, the Regional and Departmental Delegates of social affairs and health; promoters of orphanages; as well as the clearance of the Institutional Committee of Ethics of the University of Douala.

COMPETING INTERESTS

None.

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