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Nutritional Status of Nigerian Children from Urban Community Using Different Reference Cut-offs

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ABSTRACT

Few studies have used the 2007 WHO and International Obesity Task Force (IOTF)/International Survey (IS) references to assess nutritional status of Nigeria children. This study was undertaken to assess nutritional status of children from an urban community using the three reference cut-offs. This survey involved 1903 children, aged 1-10 years, recruited randomly from crèche, nursery and primary schools in Lagos, Nigeria. The estimation of the prevalence of thinness, overweight and obesity was based on age and sex-specific BMI cut-offs by 2007 WHO and IS/IOTF references. Thinness, stunting and underweight were defined as BMI-for-age, height-for-age and weight-for-age (Z-score), below 2SD (3SD for severe) from the relative median value of the 2007 WHO cut-offs, respectively. Boys (girls) had 75.6 % (74.4%) prevalence of stunting which increases with age and 1.4% (0.9%) severe stunting. 5% and 1.2% of children were underweight and severe underweight respectively. By IOTF/ IS cut-offs, 42.9%, 2.6% and 1.2% of children were thin, overweight and obese respectively. Using 2007 WHO cut-offs, 43.2%, 4.1% and 3.6% of children were thin, overweight and obese respectively. Obesity prevalence was high in ages 1-4 years in boys and girls. In ages 1-4 years, the 2007 WHO overestimated, while IOTF underestimated obesity prevalence. The prevalence of thinness and overweight compared fairly well in all cut-offs. This study suggests a high prevalence of malnutrition with emerging increase in overweight/obesity among urban children.

Key-words: Malnutrition, Obesity, Overweight, Thinness, Underweight, Stunting

INTRODUCTION

The epidemic nature of under nutrition and over nutrition has been reported in both developed and developing nations with the former being commonly reported in middle income and developing nations (Lobstein *et al*, 2004; Yngve *et al*, 2007). There is the

need to pay attention to these two extremes of malnutrition because of their health implications. The effects of malnutrition on children are not limited to physical health, but extend to mental, social and spiritual well-being (Taguri *et al*, 2008). Under nutrition is linked to growth faltering and is associated with increased morbidity and mortality (Bovet *et al*, 2011). Evidence that being overweight in childhood increases the risk of

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atherosclerosis; a risk that continues in to adulthood has been reported (Gielen and Hambrecht, 2004). Obesity in youth has serious medium- and long-term consequences including endocrine, cardiovascular, renal, pulmonary, orthopaedic and gastroenterological diseases (Field *et al*, 2005; Singhal *et al*, 2005).

In developing nations, there is double burden of under nutrition and over nutrition (Warraich *et al*, 2009; Corsi *et al*, 2011). These have been attributed to westernization and reduced level of physical activities in those nations. There is transition from predominantly under nutrition to over nutrition (Warraich *et al*, 2009). High prevalence of under nutrition (stunting, wasting, underweight and thinness) as well as over nutrition (overweight and obese) has been reported in the literature for developing nations. In Ethiopia, the prevalence of infant under nutrition was high at 6 months (21.7% underweight, 26.7% stunted and 16.7% wasted) and at 12 months of age (21.2% underweight, 48.1% stunted, and 8.4% wasted) (Medhin *et al*, 2010). Malnutrition and micronutrient deficiencies are also widely prevalent in school children in Burkina Faso with prevalence of stunting (8.8%) and that of thinness, 13.7% (Daboné *et al*, 2011). Stunting was found in 47.0% of the Kenya children; 11.8% were underweight, and 2.6% were wasted. Severe stunting was found in 23.4% of the children; severe underweight in 3.1%, and severe wasting in 0.6% (Olack *et al*, 2011). The prevalence of thinness was 21.4%, 6.4% and 2.0% based on the three International Survey (IS) cut-offs and 27.7%, 6.7% and 1.2% based on the WHO cut-offs among children and adolescents living in the Seychelles (Bovet *et al*, 2011).

Nutritional status is an integral component of the overall health of an individual, and provides an indicator of the well-being of children living in a particular region (Goon *et al*, 2011). Nutritional status data are central to improving the health of the children in the coming generation and also for the overall development of developing countries in near future. In Nigeria, prevalence ranges (stunting, 20.6-52.7%; wasting, 6.7-14.7%; underweight 23.3-43.3%; thinness, 7.3%) have also been reported for under nutrition and over nutrition (overweight, 1.3-9.8%; obese, 0-2.7%) respectively (Akinpelu *et al*, 2008; Ekpo *et al*, 2008; Ayoola *et al*, 2009; Goon *et al*, 2011). However, different reference cut- offs were used, making comparison difficult from study to study and nation to nation. The WHO, 2007 reference provides cut-offs ranging from thinness to overweight and obesity, the IOTF provides cut-offs ranging from overweight to obesity and IS provides cut-offs for only thinness. Few studies have used the new WHO, 2007 reference. This study was undertaken to

assess nutritional status of Nigeria children from urban community using the WHO, IS and IOTF reference cut-offs and see how they compared.

MATERIALS AND METHODS

This cross-sectional survey was conducted in a Nigerian urban community. It was approved by the University of Ibadan and University College Hospital Research Ethics Committee. The participants were selected from nine schools (5 private and 4 public) in Ojo Local Government Area (LGA) of Lagos State, Nigeria. The nine schools were selected from a list of 47 schools in Ojo Local Education District of Lagos State using a table of randomized numbers. Children ages 1-4 years were sourced from day care and play group classes of the 5 private schools. Only those children whose parents gave consent and without obvious deformities were included in the study. They were 1903 children between ages 1 and 10 years. The sex and age in years as at last birthday of each child were recorded.

Standard methods were used to assess body weight (kg) and body height (m) with electronic weighing scale (Kenwell Model EB600) and a plastic height meter (Invicta Plastic Limited, England) respectively. The measured weight and height were used to calculate body mass index. The estimation of the prevalence of overweight and obesity was based on age-, sex-specific BMI cut-off points developed by the World Health Organization (WHO 2007) (de Onis *et al*, 2007) and International Obesity Task Force (IOTF) (Cole *et al*, 2000) while grade 1-3 thinness was based on International Survey (IS) (Cole *et al*, 2007) references. Thinness, stunting and underweight were defined as BMI-for-age, height-for-age and weight-for-age (Z-score), below two standard deviations from the relative median value of the WHO growth reference (2007), respectively while the severe cases of these were defined below three standard deviations from the relative median value. Mild thinness was defined as below one standard deviation from the relative median value of the WHO growth reference (2007). Mild thinness and severe thinness on the WHO, 2007 reference correspond to grade 1-3 thinness on IS reference respectively.

Data Analysis: WHO AnthroPlus software was used to calculate Z scores of Height for Age (HA), Weight for Age (WA) and Body Mass Index for Age (BMIA). Data were summarised using mean and standard deviation. Percentage was used to estimate the prevalence of thinness, underweight, overweight, obesity, and stunting.

RESULTS

Table 1 presents anthropometric characteristics of the participants. The body mass index (BMI) was decreasing with age from ages 1-5 years and then slightly increased from ages 6-10 years. Weight for Age Z score (WAZ) was also decreasing with age for both sexes. Girls had consistently high values of WAZ with exception of age 10 years. Height for Age Z score (HAZ) followed the same pattern of decrease with age and girls having consistently high values of HAZ with exception of age 2 years. Body Mass Index for Age Z score (BMIAZ) was increasing with age, from ages 1-8 in boys and thereafter decreased with exception of age 2 years. In girls, BMIAZ decreased with age from ages 1-5 years with exception of age 2 years.

Table 2 shows the prevalence of stunting and underweight using WHO, 2007 cut-off. Pulling all age groups together, boys had 75.6% prevalence of stunting and 1.4% severe stunting; girls showed similar prevalence of stunting (74.4%) and severe stunting (0.9%).

The stunting prevalence increased with age with exception of age 9 years in boys and ages 3-4 and 9-10 years in girls. The prevalence of severe stunting increased with age from ages 1-4 years in boys and 1-3 years in girls but this was not observed in older ages with exception of age 10 years. Severe stunting prevalence was high in ages 4 and 10 years for boys and girls respectively. About 5.1% (5.3% in boys, 4.8% girls) and 1.2% of children were underweight and severe underweight respectively. Underweight prevalence decreased with age from age 1-5 years and increased thereafter in boys while in girls it increased with age from ages 5-10 years. Severe underweight prevalence was high in ages 3 and 10 years in boys and ages 4 and 10 years in girls.

Thinness, overweight and obesity prevalence using IS/ IOTF and WHO, 2007 cut-off was presented in tables 3 and 4. About 42.9%, 2.6% and 1.2% of children were thin, overweight and obese respectively with IS/ IOTF cut-offs.

Table 1:
Anthropometric Characteristics of Participants by Age and Sex

Age (yrs)	Number		Body mass index		WAZ		HAZ		BMIAZ	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1	43	58	15.13 ±2.66	15.66 ±2.72	1.84 ±1.79	2.00 ±1.19	5.50 ±2.49	4.88 ±2.34	-1.55 ±2.18	-0.72 ±2.03
2	94	106	15.52 ±3.98	15.24 ±3.03	0.73 ±1.11	0.89 ±1.14	2.71 ±2.65	2.22 ±2.03	-0.78 ±2.86	-0.59 ±2.07
3	108	94	14.68 ±2.60	14.74 ±2.64	0.49 ±1.30	0.81 ±1.06	1.90 ±2.66	2.25 ±2.42	-0.96 ±2.22	-0.73 ±2.00
4	100	100	14.59 ±3.84	14.06 ±2.19	0.37 ±1.40	0.44 ±1.18	1.70 ±2.35	2.00 ±1.37	-0.90 ±2.95	-1.09 ±1.83
5	108	92	14.24 ±2.10	13.93 ±2.03	-0.02 ±0.94	-0.02 ±0.80	1.02 ±2.49	1.26 ±2.05	-0.91 ±1.95	-1.10 ±1.60
6	103	96	14.50 ±1.81	14.25 ±1.47	-0.44 ±0.84	-0.32 ±0.82	0.06 ±1.41	0.33 ±0.96	-0.78 ±1.44	-0.81 ±1.12
7	88	113	14.57 ±1.06	14.24 ±1.51	-0.79 ±0.74	-0.55 ±0.81	-0.48 ±0.86	0.05 ±1.44	-0.76 ±0.87	-0.88 ±1.25
8	100	100	14.98 ±1.32	14.61 ±1.26	-0.90 ±0.91	-0.69 ±0.79	-0.76 ±0.89	-0.34 ±0.84	-0.64 ±0.97	-0.75 ±0.85
9	95	105	14.82 ±1.45	14.86 ±1.78	-1.19 ±0.80	-1.02 ±0.82	-0.93 ±0.86	-0.72 ±1.40	-0.97 ±1.03	-0.86 ±1.35
10	101	99	14.86 ±1.32	14.92 ±1.51	-1.42 ±0.79	-1.44 ±0.95	-1.12 ±0.82	-1.20 ±0.99	-1.16 ±1.06	-1.06 ±1.00

Table 2:
Stunting (HA) and Underweight (WA) Prevalence [% (n)] in Boys and Girls (WHO, 2007)

Age (yrs)	Boys				Girls			
	HA		WA		HA		WA	
	Stunting	severe	underweight	severe	Stunting	severe	Underweight	severe
1	4.7(2)	0(0)	2.3(1)	0(0)	10.3(6)	0(0)	0(0)	0(0)
2	39.4(37)	3.2(3)	0(0)	0(0)	49.1(52)	2.8(3)	0(0)	0(0)
3	47.2(51)	3.7(4)	1.9(2)	2.8(3)	37.2(35)	3.2(3)	1.1(1)	0(0)
4	52.0(52)	4.0(4)	1.0(1)	2.0(2)	48.0(48)	0(0)	0(0)	3.0(3)
5	82.4(89)	0(0)	0.9(1)	0(0)	85.9(79)	0(0)	1.1(1)	0(0)
6	94.2(97)	1.0(1)	2.9(3)	0(0)	91.7(88)	0(0)	1.0(1)	0(0)
7	100.0(88)	0(0)	4.5(4)	0(0)	96.5(109)	0(0)	1.8(2)	1.8(2)
8	100.0(100)	0(0)	7.0(7)	2.0(2)	100.0(100)	0(0)	6.0(6)	0(0)
9	98.9(94)	1.1(1)	16.5(16)	1.1(1)	98.1(103)	0(0)	14.3(15)	0(0)
10	100(101)	0(0)	14.9(15)	3.0(3)	96.0(96)	3.0(3)	20.2(20)	7.1(7)
All	75.6(711)	1.4(13)	5.3(50)	1.2(11)	74.4(716)	0.9(9)	4.8(46)	1.2(12)

Table 3:
Prevalence of thinness, overweight and obesity in boys

Age	IS			IOTF		WHO, 2007				
	thinness grade (% {n})			overweight	Obese	thinness (% {n})			overweight	obese
	1	2	3	%(n)	%(n)	mild	thinness	severe	% (n)	% (n)
1						20.9(9)	7.0(3)	30.2(13)	7.0(3)	4.7(2)
2	21.3(20)	8.5(8)	23.4(22)	4.3(4)	8.5(8)	14.9(14)	16.0(15)	16.0(15)	4.3(4)	12.8(12)
3	31.5(34)	7.4(8)	17.6(19)	8.3(9)	2.8(3)	32.4(35)	9.3(10)	9.3(10)	4.6(5)	9.3(10)
4	9.0(9)	7.0(7)	31.0(31)	6.0(6)	7.0(7)	12.0(12)	9.0(9)	23.0(23)	6.0(6)	12.0(12)
5	21.0(22)	9.5(10)	13.3(14)	3.8(4)	1.0(1)	17.6(19)	6.5(7)	6.5(7)	5.6(6)	1.9(2)
6	31.1(32)	6.8(7)	4.9(5)	1.0(1)	1.0(1)	32.0(33)	6.8(7)	3.9(4)	3.9(4)	1.0(1)
7	23.9(21)	1.1(1)	3.4(3)	1.1(1)	0(0)	28.4(25)	2.3(2)	2.3(2)	2.3(2)	0(0)
8	21.2(21)	4.0(4)	1.0(1)	2.0(2)	0(0)	27.0(27)	8.0(8)	1.0(1)	5.0(5)	0(0)
9	25.3(24)	8.4(8)	3.2(3)	2.1(2)	0(0)	32.6(31)	11.6(11)	3.2(3)	2.1(2)	1.1(1)
10	26.3(26)	9.1(9)	4.0(4)	0(0)	0(0)	34.7(35)	11.9(12)	5.9(6)	0(0)	0(0)
All	22.2(209)	6.6(62)	10.9(102)	3.1(29)	2.1(20)	25.5(240)	8.9(84)	8.9(84)	3.9(37)	4.3(40)

The prevalence of all types/grades of thinness increased with age from ages 8-10 years in both sexes with exception of grade 2 thinness which decreased with age in girls. Overweight and obesity was high in boys from ages 2-4 years while overweight was high from ages 2-3 years in girls. Using WHO 2007 cut-off, 43.2%, 4.1% and 3.6% of children were thin, overweight and obese respectively. Severe thinness was equal to thinness prevalence and was increasing with age from ages 8-10 years in boys. In girls, severe thinness was less than

thinness prevalence. Obesity prevalence was high in ages 1-4 years in boys and 1-3 years in girls. There was a higher prevalence of obesity by WHO, 2007 than IOTF cut-offs in ages 1-4 years. The prevalence of thinness and overweight compared fairly well in all cut-offs though, WHO cut off demonstrated high prevalence in all except severe thinness/grade 3 thinness where IS cut off showed high prevalence. Obesity rarely present in older ages in both (IOTF and WHO, 2007) cut-offs.

Table 4:
Prevalence of thinness, overweight and obesity in girls

Age yrs	IS			IOTF		WHO, 2007				
	thinness grade (% {n})			overweight	obese	thinness (% {n})			overweight	obese
	1	2	3	% (n)	% (n)	mild	thinness	severe	% (n)	% (n)
1						13.8(8)	17.2(10)	13.8(8)	17.2(10)	5.2(3)
2	0.0 (0)	0.0(0)	100.0(106)	0.0(0)	0.0(0)	21.7(23)	15.1(16)	7.5(8)	3.8(4)	11.3(12)
3	15.1(14)	11.8(11)	19.4(18)	9.7(9)	2.2(2)	22.3(21)	12.8(12)	7.4(7)	4.3(4)	9.6(9)
4	16.0(16)	7.0(7)	27.0(27)	5.0(5)	0.0(0)	17.0(17)	17.0(17)	11.0(11)	9.0(9)	2.0(2)
5	28.3(26)	16.3(15)	14.1(13)	2.2(2)	1.1(1)	38.0(35)	13.0(12)	4.3(4)	8.7(8)	1.1(1)
6	32.3(31)	6.2(6)	5.2(5)	2.1(2)	0.0(0)	34.4(33)	7.3(7)	2.1(2)	2.1(2)	0.0(0)
7	30.4(34)	4.5(5)	4.5(5)	0.0(0)	0.0(0)	31.0(35)	6.2(7)	2.7(3)	0.9(1)	0.0(0)
8	21.0(21)	7.0(7)	3.0(3)	1.0(1)	0.0(0)	27.0(27)	6.0(6)	1.0(1)	2.0(2)	0.0(0)
9	21.0(22)	5.7(6)	4.8(5)	0.0(0)	0.0(0)	23.8(25)	7.6(8)	2.9(3)	0.0(0)	0.0(0)
10	29.3(29)	4.0(4)	8.1(8)	0.0(0)	0.0(0)	35.4(35)	7.1(7)	5.1(5)	1.0(1)	0.0(0)
All	20.0(193)	6.3(61)	19.7(190)	2.0(19)	0.3(3)	26.9(259)	10.6(102)	5.4(52)	4.3(41)	2.8(27)

DISCUSSION

This study provides nutritional status of Nigerian children in Ojo LGA of Lagos State, Nigeria. Our findings indicate a high prevalence of stunting (76.2%) with 1.2% having severe stunting among the children living in Ojo, Lagos. Children from South-western Nigeria have been shown to exhibit substantially shorter height compared to reference means (Eze *et al*, 2005; Ekpo *et al*, 2008; Ayoola *et al*, 2009). The patterns of high prevalence of stunting observed in these urban children appear to be generalized phenomena in sub-Saharan Africa and have been reported among other population samples (Akinpelu *et al*, 2008; Ayoola *et al*, 2009; Goon *et al*, 2011). Consistent with other previous studies from Nigeria and sub-Saharan Africa (Ayoola *et al*, 2009; Warraich *et al*, 2009; Corsi *et al*, 2011; Fetuga *et al*, 2011), and elsewhere (El Mouzan *et al*, 2010), our study showed stunting to be higher in boys than in girls. Contrastingly, Ekpo *et al*, (2008) reported higher prevalence in girls (41.9) than in boys (38.7%). Stunting prevalence was also reported to be higher in girls than in boys in Chinese children (Li *et al*, 2009). Stunting increased with age among both boys and girls, and the trend was similar in the study by Mushtaq *et al*, (2011).

The prevalence of underweight (6.3%) in our study was lower than in previous studies from Nigeria which reported prevalence rate between 24.3% and 56.4% (Meremikwu *et al*, 2000; Eze *et al*, 2005; Ekpo *et al*, 2008; Fetuga *et al*, 2011; Goon *et al*, 2011). These studies reported higher prevalence in boys than in girls which was similar to ours. A ready explanation was not available to explain the disparity in the level of underweight between boys and girls seen in this study. It is likely that both sexes are subjected to different conditions of nutrition and dietary intake though; these were not assessed in the present study. The prevalence of moderate underweight in the present study (6.3%) was similar to that of Saudi children (6.9%) and closer to the 5.4% reported from Egypt (El Mouzan *et al*, 2010). An intermediate position of underweight in this study might reflect an improvement in nutritional status of children from urban area. The moderate prevalence of underweight observed in the present study is expected from an urban region. Lagos is a busy commercial city and children are not encouraged to walk to school thus, reducing their physical activity level. The low physical activity coupled with westernization may further explain the moderate prevalence of underweight among the children in the LGA. Also, most of the children attending primary school in the LGA are from middle socio-

economic backgrounds and this suggests that factors such as education, occupation and economic status of parents may also account for the moderate prevalence of under nutrition among our cohort.

Using IS and WHO 2007 BMI thinness classification, age variations exist in the different BMI thinness classifications. Majority of the children exhibited Grade 1 thinness in both IS (21.1%) and WHO 2007 (26.2%) reference. This observation was in tandem with previous studies (Bovet *et al*, 2011; Fetuga *et al*, 2011; Goon *et al*, 2011). These studies reported that boys were thinner as our study. The prevalence of thin children was low compared to previous studies from Nigeria (Fetuga *et al*, 2011; Goon *et al*, 2011) but higher than Pakistani children (Mushtaq *et al*, 2011). Again, this might reflect an improvement in Nutritional status of urban children. The prevalence of mild thinness and thinness with the WHO cut-offs was higher than grade 1 thinness and grade 2 thinness with IS cut-offs while the prevalence of thinness of “grade 3” (IS cut-offs) was higher than the prevalence of “severe thinness” (WHO cut-offs). This observation was similar to previous study (Bovet *et al*, 2011). Few population-based studies have compared the IS and WHO cut-offs and none in Nigeria. This is necessary because they provide a common denominator, both the IS and WHO thinness categories allow for comparisons of nutritional status across countries, follow trends, and look at global patterns.

Although malnutrition still appears as a priority problem in developing countries, overweight/obesity should not be overlooked right at pre-school age, as our study indicated a higher prevalence trend in the youngest group of children. The prevalence of overweight/obesity (7.7%) in this study is higher than what is reported in previous studies from Nigeria (Ben-Bassey *et al*, 2007; Fetuga *et al*, 2011). It is worrisome that overweight and obesity appeared to be increasing in Nigeria and our findings support this trend. These observations among Nigerian population were in tandem with reports of a prevalence of 6.2% for overweight/obesity among Chinese children using the WHO, 2007 standards. Though, physical activity was not assessed in the present study; the age-related rise in overweight and obesity in urban children might be associated with a parallel decline in physical activity, suggesting that alteration in the energy balance is one of the major contributing factors. The highest overweight and obesity prevalence was observed as defined by the WHO 2007 reference, while the lowest by the IOTF (4.1% vs. 2.6% and 3.6% vs.1.2% respectively). The two references, namely the WHO, and IOTF references, can be used to define overweight and obesity among Nigeria children 1-10 years.

In this study, the highest dual burden (stunting combined with overweight/obesity) at the individual level was seen in Nigeria children. Combined overweight/obesity and stunting is more likely to be associated with central obesity and its metabolic effects. A slight increase in the prevalence of overweight/obesity in Nigeria children accompanied by virtually no decrease in the prevalence of under nutrition seems to be the epidemiologic description of weight status for Nigeria. This demonstrates the degree of heterogeneity in health and nutrition problems in developing countries. A previous study has reported that a number of lower- and middle-income countries have experienced a transition from under- to over-nutrition problems or, quite frequently a double burden of both malnutrition and obesity (Wang and Lobstein, 2006).

In conclusion, malnutrition with emerging increase in overweight and obesity is prevalent among urban children in Ojo Local Government area of Lagos, Nigeria. Majority of the children exhibited Grade 1 thinness in both IS and 2007 WHO references. Both the WHO and IOTF references may be used to define overweight and obesity among Nigeria children

REFERENCES

- Akinpelu A.O, Oyewole O.O, Oritogun K.S (2008):** Overweight and Obesity: Does It Occur In Nigerian Adolescents in an Urban Community? *International Journal of Biomedical and Health Sciences* 4:11-17
- Ayoola O, Ebersole K, Omotade O.O, Tayo B.O, Brieger W.R, Salami K, Dugas L.R, Cooper R.S, Luke A (2009):** Relative Height and Weight among Children and Adolescents of Rural Southwestern Nigeria. *Ann Hum Biol.* 36: 388–399.
- Ben-Bassey U.P, Oduwale A.O, Ogundipe O.O (2007):** Prevalence of overweight and obesity in Eti-Osa LGA, Lagos, Nigeria. *Obesity Reviews* 8: 475–479.
- Bovet P, Kizirian N, Madeleine G, Blössner M, Chiolero A (2011):** Prevalence of thinness in children and adolescents in the Seychelles: comparison of two international growth references. *Nutr J.* 10: 65.
- Cole T.J, Bellizzi M.C, Flegal K.M, Dietz W.H (2000):** Establishing a standard definition for child overweight and obesity worldwide: international survey. *BMJ* 320:1240-1243.
- Cole T.J, Flegal K.M, Nicholls D, Jackson A.A (2007):** Body mass index cut offs to define thinness in children and adolescents: international survey. *BMJ* 335:194
- Corsi D.J, Finlay J.E, Subramanian S.V (2011):** Global Burden of Double Malnutrition: Has Anyone Seen It? *PLoS One* 6: e25120.
- Daboné C, Delisle H.F, Receveur O (2011):** Poor nutritional status of schoolchildren in urban and peri-urban areas of Ouagadougou (Burkina Faso). *Nutr J.* 10: 34
- de Onis M, Onyango W.A, Borghi E, Siyam A, Nishida C, Siekmann J (2007):** Development of a WHO growth

reference for school-aged children and adolescents. *Bulletin of the World Health Organization* 85: 660-667.

Ekpo U.F, Omotayo A.M, Dipeolu M.A (2008): Prevalence of malnutrition among settled pastoral Fulani children in Southwest Nigeria. *BMC Research Notes* 1:7 doi: 10.1186/1756-0500-1-7

El Mouzan M.I, Foster P.J, Al Herbish A.S, Al Salloum A.A, Al Omar A.A, Qurachi M.M (2010): Prevalence of malnutrition in Saudi children: a community-based study. *Ann Saudi Med.* 30: 381–385.

Eze U.L.H, Olowu A.A, Bamidele T.O, Adeyanju F.D (2005): Prevalence of malnutrition and effect of maternal age, education and occupation amongst preschool children attending health centres in a semi urban area of south-western Nigeria. *Nig. Qt. J. Hosp. Med.*15:179-183

Fetuga M.B, Ogunlesi T.A, Adekanmbi A.F, Alabi A.D (2011): Nutritional Status of Semi-Urban Nigerian School Children using the 2007 WHO Reference Population. *WAJM* 30: 331–336.

Field A.E, Cook N.R, Gillman M.W (2005): Weight status in childhood as a predictor of becoming overweight or hypertensive in early adulthood. *Obes Res.* 13:163–9.

Gielen S, Hambrecht R (2004): The childhood obesity epidemic: impact on endothelial function. *Circulation* 109: 1911–3.

Goon D.T, Toriola A.L, Shaw B.S, Amusa L.O, Monyeke M.A, Akinyemi O, Alabi O.A (2011): Anthropometrically determined nutritional status of urban primary schoolchildren in Makurdi, Nigeria. *BMC Public Health* 11: 769.

Kwena A.M, Terlouw D.J, Devlas S.J, Phillips-Howard P.A, Hawley W.A, Friedman J.F, Vulule J.M, Nahlen B.L, Sauerwein R.W, Terkuile F.O (2003): Prevalence and severity of malnutrition in pre-school children In a rural area of western Kenya. *Am. J. Trop. Med. Hyg.* 68(Suppl 4):94–99

Li Y, Hu X, Jing-zh A.O, Yang X, Guan-sheng M.A (2009): Application of the WHO Growth Reference (2007) to Assess the Nutritional Status of Children in China. *Biomedical and Environmental Sciences* 22: 130-135

Lobstein T, Baur L, Uauy R (2004): Obesity in children and young people: a crisis in public health. *Obes Rev* 5(suppl 1):4-85

Medhin G, Hanlon C, Dewey M, Alem A, Tesfaye F, Worku B, Tomlinson M, Prince M (2010): Prevalence and predictors of undernutrition among infants aged six and twelve months in Butajira, Ethiopia: The P-MaMiE Birth Cohort. *BMC Public Health* 10: 27

Meremikwu M.M, Antia-Obong O.E, Asindi A.A, Ejezie G.C (2000): Nutritional status of pre-school children in rural Nigeria: Relationship with intestinal heminthisiasis. *JOMIP* 1:18-20

Mushtaq M.U, Gull S, Khurshid U, Shahid U, Shad M.A, Siddiqui A.M (2011): Prevalence and socio-demographic correlates of stunting and thinness among Pakistani primary school children. *BMC Public Health* 11:790

Olack B, Burke H, Cosmas L, Bamrah S, Dooling K, Feikin D.R, Talley L.E, Breiman R.F (2011): Nutritional Status of Under-five Children Living in an Informal Urban Settlement in Nairobi, Kenya. *J Health Popul Nutr.* 29: 357–363.

Singhal A (2005): Endothelial dysfunction: role in obesity-related disorders and the early origins of CVD. *Proc Nutr Soc.* 64:15–22.

Taguri A.E, Rolland-Cachera M-F, Mahmud S.M, Elmrzougi N, Abdel M.A, Betimal I, Lenoir G (2008): Nutritional status of under-five children in Libya: a national population-based survey. *Libyan Journal of Medicine* 3: 6-10

Wang Y, Lobstein T (2006): Worldwide trends in childhood overweight and obesity. *International Journal of Pediatrics Obesity* 1:11-25.

Warraich H.J, Javed F, Faraz-ul-Haq M, Khawaja F.B, Saleem S (2009): Prevalence of Obesity in School-Going Children of Karachi. *PLoS One* 4: e4816.

Yngve A, De Bourdeaudhuij I, Wolf A, Grjibovski A, Brug J, Due P, Ehrenblad B, Elmadfa I, Franchini B, Klepp K-I, Poortvliet E, Rasmussen M, Thorsdottir I, Rodrigo C.P (2007): Differences in prevalence of overweight and stunting in 11-year olds across Europe: The Pro Children Study. *European Journal of Public Health* 18:126–130