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Body mass index of children aged 2 to 15 years in Enugu Nigeria

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Abstract: *Background:* Body Mass Index (BMI) is a measure of adiposity and has been used in many countries for assessment of overweight and obesity. The prevalence of obesity in children is increasing and is recognized as risk indicator of cardiovascular disease in adulthood. The study aimed was to document the Body Mass Index of school children aged 2-15 years. The study also determined the prevalence of overweight and obesity.
Methods: This is a descriptive study of obesity prevalence in Nigerian Children. The weight and heights of the sampled children were measured and their BMI was calculated as weight/height (m^2). Overweight and obese children were identified using charts from pooled internationally accepted data age and sex specific cut -off points for BMI .
Results: The BMI ranged from 10.8kg / m^2 to24.7Kg/m^2 with a mean BMI of 16.28 $\pm$ 2.32 kg/m^2. The mean BMI for males was 16.09 $\pm$ 2.07 and the females 16.47 $\pm$ 2.52. ($P \geq 0.05$). The prevalence of overweight and obesity were 6.4% and 1.7% respectively. More females were significantly overweight than males ($p<0.05$). Prevalence of overweight and obesity were highest in the highest socioeconomic class.
Conclusion: Most children had BMI within the normal range. The prevalence of overweight and obesity though predominantly low should be taken seriously especially as it appears to be associated with improving socioeconomic status. School health education (physical activity and nutritional education) is recommended as preventive measures.

Key words: Body mass index, overweight, obesity, Nigerian children.

Introduction

Billewicz et al[1] in 1962 described for the first time in detail the use of the body mass index as an index of adiposity and is defined as weight (Kg) adjusted for height (m) squared (weight/height^2) in Kg/m^2. It is a measure of adiposity , an index of weight corrected for height. Body mass index correlates well with subcutaneous and total body fatness and has achieved international acceptance as a standard for the assessment of obesity in both children and adults[3]. BMI has been used in Nigeria and many countries for assessment of overweight and obesity[4,5,6]. Overweight and obesity are considered an epidemic in many countries of the world including developed and developing countries and its health implications has become a matter of growing concern[7]. The complications of childhood obesity include medical (mechanical or metabolic complications) and psychosocial consequences. Mechanical complications include obstructive sleep apnoea syndrome and orthopaedic problems. The metabolic consequences of childhood and adolescent obesity include glucose intolerance, hypolipidaemia, hypertension, gallstones and pseudotumour cerebri. Childhood obesity has significant impact on the emotional development of the child or adolescent, who suffers discrimination and stigmatization. They may have fewer opportunities in school, at work and social circles. Individuals who were obese in childhood are more likely to have poor body image, and low self esteem and confidence[8].

However there are different views on the criteria for determining cut - offs for overweight and obesity . The confusion over the use of different reference curves led to the establishment of cut- offs based on pooled data collected from international surveys. Cole et al[9] used pooled international data to develop age and sex specific cut-off points for BMI to classify overweight and obese children and this method can be conveniently applied to different populations and is simple to use. The aim of this cross-sectional study was to document the body mass index of school children aged 2-15

years and to determine the prevalence of overweight and obesity using the international cut-off thresholds proposed by Cole et al[9]

Subjects and Methods

This study was conducted in Enugu, the capital city of Enugu state of Nigeria

The study was a prospective cross-sectional observational study in which a two stage systematic sampling method was used. In the first stage, the schools were selected while the students were selected in the second stage.

Eighteen schools were selected from the sampling frame using a sampling interval of 10. Every third child received a questionnaire, letter of introduction and consent form. The parents filled the questionnaires, answering questions concerning the child's age and medical history, occupation and educational status of the parents. Two thousand questionnaires were distributed among the students using a sample interval of three (the 18 schools had a population of 5250 students). Each school was visited between 10 am and 1.30 pm each day. The head teacher in each school and the investigator explained the study to the student before physical examination and anthropometry were done. Apparently healthy school children (male and female) aged 2-15 years (both years inclusive) who obtained the consent of their parents were included in the study and children with chronic diseases were excluded by medical history (parental questioning) and by physical examination.

Anthropometric measurements

Standing height was measured once without shoes to the nearest 0.5cm. He or she was asked or helped to stand erect. The child's heels were together; the buttocks, the back of the heels, the upper back and the head touched the wooden measuring tape. The movable horizontal head-board was lowered until it rested firmly on the crown of the head. The vertical tape measure was read opposite the highest point of the head with the child looking straight ahead. Weight was measured to the nearest 0.1 kg using a bath room scale. The students wore school uniforms (light clothing) without outer garments, sweaters and shoes. The scale was calibrated to zero prior to the beginning of each session and checked with a standard weight at the beginning of each day. The investigator was assisted by a nurse who had been previously been trained on how to measure a child properly. Two measurements were made per subject and the mean was utilized in data analysis.

Body mass index

The body mass index (quetelets' index) was calculated using the formulae [3]

$$\text{BMI (Kg/m}^2\text{)} = \frac{\text{Weight (Kg)}}{\text{Height}^2\text{ (m)}}$$

Overweight and obese subjects were identified using age and sex specific cut off points for body mass index in children and adolescents.[9]

Table 1: Age and sex specific international cut off points for BMI [9] BMI (kg/m^2)

Age (years)	Overweight		Obese	
	Boys	Girls	Boys	Girls
2	18.4	18.0	20.1	20.1
3	17.9	17	19.6	19.4
4	17.8	17.3	19.3	19.1
5	17.4	17.1	19.3	19.2
6.	17.6	17.3	19.8	19.7
9.	19.1	19.1	22.8	22.8
10.	19.8	19.9	24.0	24.1
11.	20.0	20.7	25.7	20.4
12.	21.2	21.7	26.0	26.7
13.	21.9	22.6	26.8	27.8
14.	22.8	23.3	27.8	26.6
15.	23.3	23.9	28.3	29.1
16.	23.9	24.4	28.9	29.4
17.	24.5	24.7	29.4	29.7
18.	25.0	25.0	30.0	30.0

Social class determination for the subjects was done using the socio-economic index scores designed by Oyedeji[13] .The data was analyzed using the statistical package for social science (SPSS); windows version 10.0, Microsoft Excel 2000.Distributions were described as mean and standard deviation. Approval for the study was granted by the post primary schools management board (permanent secretary's office), Enugu State Primary Education Board, and the Education Secretaries of the three local Government Education, Authorities. Ethical clearance was obtained from the Ethical committee of the University of Nigeria Teaching Hospital Enugu.

Results

The subjects in the study comprised four hundred and six apparently healthy Nigerian school children. There were 197 males and 209 females (male: female ratio of 1: 1.06.).

The age distribution of the subjects is illustrated in figure 1. The ages ranged from 2 to 15 years with a mean of 8.18$\pm$ 2.98 years. The mean age for males was 8.18 $\pm$ 2.71 years while that of females was 8.71 $\pm$ 3.20 years. The difference between the mean age for males and that for females was not statistically significant. ($P > 0.05$).

Fig 1: Age distribution of Subjects

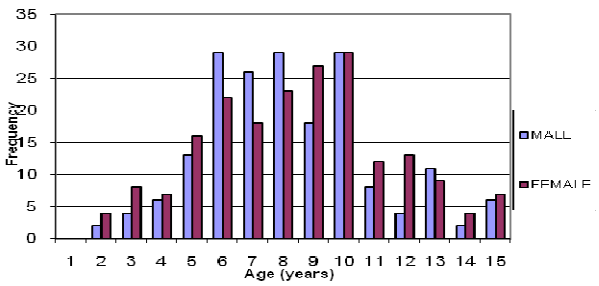

Fig 2 illustrates the mean body mass index in various ages. The body mass index had a range of 10.84kg / m^2 to24.70Kg/m^2. The mean body mass index was 16.28 ± 2.32 kg/m^2. The mean body mass index for males was 16.09 ± 2.07 and the females 16.47 ± 2.52. The difference in the mean body mass index for males and females was not statistically significant (P ≥ 0.05).

Fig 2: Mean BMI in various ages

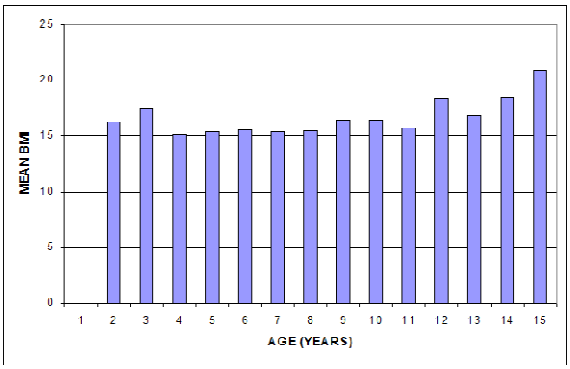

Table 2: Mean BMI at various ages by sex

Age (years)	Males	Females	P-value		
	No.		No.		
2	2	20.9±0.00	4	17.20±0.44	0.000*
3	4	18.75±3.16	8	16.16±2.76	0.29
4	6	14.00±1.04	7	16.16±2.57	0.07
5	13	14.89±1.91	16	15.76±2.83	0.35
6	29	15.96±1.92	22	14.95±1.45	0.04*
7	36	15.73±1.13	18	14.77±0.93	0.00*
8	29	15.65±1.49	23	15.19±0.71	0.30
9	18	16.10±1.44	27	16.72±2.53	0.35
10	29	16.38±1.39	29	16.61±1.57	0.55
11	8	14.89±0.98	12	16.45±1.24	0.03
12	4	15.78±1.44	13	19.16±2.83	0.04*
13	11	15.05±1.88	9	18.01±3.58	0.10
14	2	18.00±0.28	14	18.56±2.14	0.72
15	6	22.55±0.12	7	20.06±2.25	0.02*

*Statistically Significant

In various ages, there was a statistically significant difference in the mean body mass index with the males having a higher body mass index at ages 2,6,7 and 15 years while the females had a higher body mass index of age 12 years. The mean body mass index increased from 16.33kg/m^2 at two years to 17.43kg/m^2 at three years. It subsequently decreased to 15.13kg/m^2 at 4 years and remained stable at 15kg/m^2 until 9years when it increased to 16.4kg/m^2 and 20.86kg/m^2 at 15 years. The older age groups had the highest body mass index values.

Prevalence of overweight and obesity

Using Cole et al's international cut off points , the prevalence of overweight was 6.4% (twenty six children consisting of five males and twenty one females) and 1.7% of the subjects were obese. (Seven children consisting of five males and two females)
The prevalence of overweight and obesity in the subjects by gender is presented in table 3 while the prevalence of overweight and obesity in the different social is presented in table 4.
The number of overweight females was greater than the number of overweight males, while obesity was commoner amongst males. The difference was statistically significant (P<0.05). The highest prevalence of overweight was in the 10years age groups while the highest prevalence of obesity in the 3years age group. Seventeen (65%) of overweight individuals and five (71%) of the obese children belong to social class I. None of the obese children belongs to social class V.

Table 3: Prevalence of obesity and overweight in study population by gender

Status	Male (N=197)	Female (N=209)	Total (N=406)
	No.(%)	No.(%)	No(%)
Overweight	5(1.2)	21(5.2)	26(6.4)
Obese	5(1.2)	2(0.9)	7(1.7)

c^2 for Overweight = 9.54, df =1, P=0.002
c^2 for total overweight and obese 9.85,df =1,P =0.002

Table 4: Prevalence of overweight and obesity in the different social classes.

Social class	Overweight	Obese
	No.(%)	No.(%)
I	17(65.4)	5(71.4)
II	1(3.60)	-
III	5(19.20)	1(14.3
IV	3(11.50)	1(14.3)
V	-	-
Total	26(100)	17(100)

Discussion

The present cross-sectional study established the body mass index of predominantly urban children and adolescent boys and girls from all social classes in the 2-15 years age group. The body mass index was found to increase with age. After an initial decrease between 3 and 4 years, it remained relatively stable from 5- 8 years and then increased with age beginning from 9 years. The older subjects had the highest body mass index values. The rapid rate of increase in body mass index corresponds to the adolescent spurt growth which was has been reported to occur in the 11-13 years age interval[14].
The mean values of body mass index in this present study (16.28 ± 2.52kg/m^2) are similar to the values documented by Ansa et al[16] (16.10 ±2.10kg/m^2). They are lower than values from another study[17] (18.25kg/m^2). These could be due to differences in body stature in the different populations and the different age groups studied. Gender differences and other factors such as ethnicity and genetics affect anthropometric data in childhood populations[18].

Females had a higher mean body mass index and similar findings have been reported in Nigerian children in other parts of the country[19,20,21]

Using international cut off points proposed by Cole et al [9], this study documented a prevalence rate of 6.4% and 1.7% for overweight and obesity respectively. This prevalence of obesity is much lower than the prevalence of obesity among United States of America[22] and Saudi Arabia[23]. Previous studies in Nigeria[16,21] did not distinguish between overweight and obesity and different cut off points for obesity were used. These could have caused the differences observed in the prevalence of obesity documented.

Socioeconomic status is also important. A difference in standard of living is stated as one of the factors that caused differences in body mass index among different populations[24]. In this study 65.4% of overweight and 71.4% of obese children were of the highest socio economic class. Since parents of children from higher socio economic groups also have better incomes, higher educational levels and therefore access to western lifestyles , it is presumed that this could affect the diet and paediatric care that that these children received in their infancy and early childhood and thus they have higher body mass index values. With improvement in socioeconomic conditions, obesity may become a public health problem in Nigeria. Management of overweight in children should not be delayed until adulthood when the pathophysiological changes associated with overweight and obesity are more likely to be established. The best approach is prevention which should be targeted at pre school and school children including physical activity (cardiovascular fitness), nutritional education (teaching children critical aspect of quality nutrition, to reduce intake of high caloric low nutrition foods) and behavior modification (change eating habits and increase habitual physical activity). These preventive measures have previously been found to be effective[8].

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