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308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

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Investigation of Body Composition of Normal and Malnourished Rural Children (3-11 Years) In the Niger – Delta Region of Nigeria

L.O. Eboh and T.E. Boye
Department of Health and Physical Education, Delta State University, Abraka, Delta State, Nigeria

Abstract: The main thrust of the study was to investigate the body composition of normal and malnourished children aged 3 to 11 years. A total of 2192 children aged 3 to 11 years, grouped into 2060 normal and 131 stunted, and 2062 normal and 129 wasted children using – 2SD of NHANES cut off point. Body composition was evaluated using anthropometric variables (weight, height, triceps, sub scapular, suprailiac, and biceps skinfolds). The anthropometric variables were measured according to the protocol of the international society for the Advancement of kinanthropometry. Children were categorized by the age groups as defined by Deitz (1994) for the development of obesity in children. Result revealed that percentage body fat was high for the stunted children in the infancy and adipose rebound period (16.8% and 15.3% of stunted children compared to 15.6 and 14.9% normal children respectively), which the normal children had high significant percentage body fat at the adolescence spurt (14.6% compared to 15.5%). Inversely, normal children had high percentage body fat compared to wasting children throughout the age category. The fact that stunted children exhibit high percentage body fat at an early stage may clearly depict that stunting at an early stage of this population may be associated with overweight.

Key words: Percentage body fat, malnutrition, obesity and skinfold

Introduction

For many decades, studies (Amuna 2000; He *et al*., 1999; Toriola, 1998) on body composition and health relationship, have shown evidence that extremes in body composition are hazardous on health. Information on body composition of population group is essential and body composition assessment is becoming a standard measurement in many clinical and nutritional related studies. There is a growing concern about the increasing prevalence of obesity nationwide and world wide (Bray *et al*., 1992).

Four sensitive periods has been linked with the development of obesity, intra-uterine life, infancy, the period of adipose rebound (5-7yrs) and adolescence (Money, 1983 and Money, 2001). The beginning of obesity during one or more of this period appears to increase the risk of persistent obesity during later life. Consequent upon this, obesity is associated with diseases such as diabetes mellitus, hypertension, coronary heart disease (CHD), cancer and many other health problems (WHO, 1997; Wabitsh *et al*., 1996). Money (1983) stated, excessive body fat has profound effects on health.

When body fat exceeds 25% for pubertal boys and 35% for pubertal Girls, is regarded as being too high (Westrate and Deaurenberg, 1989). According to Muoboghare (2003) national surveys in Nigeria indicated that children of all ages are fatter than they were 25 years ago. A study conducted by Ogbe (2004) revealed an alarming increase in prevalence of obesity in children and adolescents. During the past 30 years the prevalence of overweight, defined as weight –for-age >85th percentile, in children aged 6-11 years, has increased from 15.2 – 22.3% in the U.S.A. (Toriola, 1998). The prevalence of obesity in rural Nigeria children (3 – 10years) ranged from 0-4.3% for girls and 0-2.5% for boys (Ogbe, 2004).

Recently, the relationship between childhood body fat and adult obesity has led to the development of cut-off points for BM1 in children, designed to classify children as obese or overweight in terms of predicted future obesity in adulthood (Cole *et al*., 2000). The usage of these cut off point Afaire (2001) has found the prevalence of obesity among urban girls to be ranging from 0.9 to 21.4% and toy 0.9 to 12.9% aged 6 to 13 years. Paucity studies have applied this out off point on rural Nigeria youth. Ajiduah (2002) show that the prevalence of obesity among children aged 3 to 9 years in developing countries ranges between 7 and 10%. The underlying facts are that obesity is common among African Urban female adolescence and women but rare among African males.

Children in the neglected Niger-Delta region of Nigeria are facing diseases, some of which manifest from poor health, poor growth and malnutrition. It was reported in some Nigeria studies (Ogbe, 2004; Jeroh, 2003; Ajiduah 2002) that children appear to be progressively stunted during adolescent years and the children in the Niger-Delta area demonstrate little or no nutritional wasting for both males and females. Afaire (2001) also estimated that in Nigeria most children are underweight and stunted for their age. He stated that the sample in his

study exhibited a high prevalence of stunting rising from less than 10% at 7 years to more than 30% by 10 years of age. However, percentage body fats in acute and chronic malnourished children have received little attention. The main thrust of this study was to investigate the body composition of normal and malnourished rural children aged 3 to 11 years in the Niger-Delta region of Nigeria.

Materials and Methods

The Niger-Delta region in team of its geographical location is in the coastal area of the country. The unique physical terrain (swampy) and ecological problems makes it a special area. The region is made up of ten states namely; Anambra, Akwa Ibom, Abia, Bayelsa, Cross –Rivers, Delta, Edo Imo, Ondo and Rivers.

The participant for the study were 2192 children (1125 boys and 1067 girls), 3-11 years of age, from twelve rural villages in six of the ten states of the Niger-Delta region in Nigeria. The sample for the study was drawn from 4 schools (12 pre-schools and 12 primary schools) randomly selected from 214 schools in the Niger-Delta region. A total of 2192 children (1125 boys and 1067 girls), who were measured in September 2004 with their aged ranging between 3 and 11 years constituted the subjects for this study.

Anthropometric measurements: All the children under went a series of anthropometric measurements, which included height, weight, and four skinfolds (subscapular, triceps, biceps, suprailiac). The measurements were taken according to the standard protocols suggested by the international society for the Advancement of Kinanthropometry (ISAK) (Norton and Olds, 1996). The sum of four skinfold (SSF) measures were used to predict subcutaneous fatness (Van, 1997). Stature and body mass were used as indicators of body size while sum of skinfolds and BMI were used as indicators of body composition (Malina and Bouchard, 1991). The validity and reliability of the measurements for this sample have been documented elsewhere (Monyeki *et al*., 2001).

Body composition: Percentage body fat was obtained using the equation of (Brozek *et al*., 1963), % BF = 4.75/D - 4.142.

Subsequently, body density (D) was calculated according to the formula of Nagamine and Suzuki (1964).

Boys, D = 0.1879 – 0.00154 X

Girls, D = 1.0794 – 0.00142 X

Where X = sum of triceps and subscapular skinfold thicknesses.

Subjects were classified into three stages of development of obesity as following: infancy (3 to 4 years), adipose rebound (5 to 7 years), and the adolescence stage (8 to 11 years) (Dietz, 1994). To determine the stunting and wasting in the population, measurement of height for – age, weight for – age and weight for height were also expressed as Z-scores of the NHANNES III Sample (Frisancho, 1990). Z-score values of less than -2 for height for-age and weight for-age were used to determine the prevalence of stunting and wasting respectively (Gibson, 1990). Among the children stunting (low height –for-age) indicates a chronic poor nutrition, while wasting (low weight-for-height) is a reflection of an acute poor nutritional condition (Cameron, 1991).

Descriptive statistics were used to determine mean and standard deviation (SD) of the age and gender specific anthropometric indicators. The t-test was used to determine the significant difference between the normal and the malnourished group. The level of significant was set at $P<0.05$.

Table 1 present the Means and SD and t-ratios of absolute body mass and body composition of both the normal and malnourished group of children aged 3 to 11 years.

Absolute body size: Normal children exhibit higher mean stature compared with the stunted children in all age categories. The mean differences between the two groups for all age categories are 10.9, 13.3cm and 11.8cm for age groups 8-11, 5-7 and 3-4, respectively. However, the mean differences between the two groups were only significant at age 8-11years. Wasted children had low and non-significant mean stature than the normal children were heavier than stunted children by 2.4kg, 3.4kg and 4.7kg for age group 3-4, 5-7, and 8-11 years, respectively. The mean difference was significant only at 8-11 years. Normal children exhibit high and significant mean body mass during the adolescence group.

Body composition: Percentage body fat was insignificantly high in the stunted children by 0.9% at the age of 3-4 years and 0.4% in the adipose rebound age group than the normal children. Normal children exhibit high significant percentage body fat of 0.9% at adolescence. Stunted children exhibit high and significant BMI values compared to the normal children in age groups 3-4 years and 5-7 years (Table 1) which raises a concern in this population. Normal children exhibit high BMI values compared to wasted children in all age categories (Table 2). The difference is, however, significant only at the age group of 8-11 years.

Stunted children exhibit high, but non-significant sum of skinfolds than the normal children at ages 3-4 & 5-7 years. The normal group of children, however, exhibit high significant sum of skinfolds at age 8-11 years. The wasted group exhibit low significant mean values of the sum of skinfolds as compared to the normal children in all the age groups.

Table 1: Mean, Standard Deviation and t-values of % BF, stature, body mass, sum of skinfolds and BMI of normal & stunted children aged 3-11years

Age Range	Sample Size		% body fat			Stature			Body mass			Sum of skinfolds			BMI		
	Normal	stunted	Normal	stunted		Normal	stunted										
			Mean (sd)			Mean (sd)			Mean (sd)			Mean (sd)			Mean (sd)		
			Mean (sd)		t	Mean (sd)		t	Mean (sd)		t	Mean (sd)		t	Mean (sd)		t
3-4	1.56	13	15.9 (4.4)	16.8 (4.4)	0.69	103.6 (6.2)	91.8 (3.4)	10.33	14.6 12.2	(2.1) (2.2)	2.90	22.1 (4.4)	22.7 (6.0)	0.34	13.6 (1.6)	14.4 (3.8)	0.82
5-7	879	38	14.9 (3.5)	15.3 (3.7)	0.4	118.7 (6.9)	105.4 (5.3)	13.92	18.9 15.1	(2.9) (2.2)	9.71	20.2 (3.6)	21.4 (4.0)	1.83	13.3 (1.2)	13.5 (1.6)	0.70
8-11	1025	80	14.6 (3.9)	15.5 (3.9)	2.09	132.9 (6.4)	122.0 (5.1)	18.75	24.5 (3.9)	19.8 (2.9)	14.1	21.6 (5.6)	19.9 (4.2)	3.4	13.8 (1.4)	13.3 (1.4)	3.33

*Statistically significant at P< 0.05.

Table 2: Mean, Standard Deviation and of % BF, Body Mass, stature, sum of skin folds & BMI of normal and wasted children aged 3-11 years

Age Range	Sample Size		% body fat			Stature			Body mass			Sum of skinfolds			BMI		
	Normal		Normal (sd)		t	Normal		t	Normal		t	Normal		t	Normal		t
	Wasting		Wasting (sd)			wasting (sd)			wasting (sd)			wasting (sd)			wasting (sd)		
3-4	1.49 (3.5)	15 (5.5)	16.1 (6.6)	13.9 (5.2)	1.62	103 (2.2)	97.2 (1.1)	4.27	14.8 (4.6)	11.5 (2.6)	9.54	22.4 13.9	20.4 12.2	2.64	13.9	12.2	4.56
5-7	897 (3.4)	90 (3.4)	15.1 (6.9)	14.1 (7.3)	2.14	118.9 (2.7)	109.5 (2.5)	9.57	19.1 (3.7)	15.4 (3.1)	13.6	20.3 13.4	19.2 12.1	2.47	13.9	12.2	8.22
8-11	1016 (4.1)	25 (3.9)	15.2 (6.6)	14.0 (3.0)	2.7	132.5 (3.8)	123.5 (2.2)	8.0	24.5 (5.6)	16.7 (4.4)	24.3	21.5 13.9	19.5 11.1	3.30	(1.4)	(1.3)	12.20

* Statistically significant P<0.05

Discussion

The study showed that development of obesity was eminent in the infancy period while in the adipose tissue rebound and the adolescent period it was fairly stable (Table 1). This finding supports the theory that stunting was a chronic phenomenon as it was seen in this study that either body mass or stature of stunted children was higher than that of the normal children. Thus the very slight weight gain gives a substantial BMI for the stunted children as their heights have already been chronically affected.

Lower mean body composition was revealed for the wasted children than normal children (Table 2). Though not significant, the statures of wasted children were lower in all age groups compared to the normal children. This suggests that there is a possibility that these wasted children may progress into chronic malnutrition due to the fact that their body mass is considerably lower at all age categories compared with the normal children.

Higher mean percentage body fat was indicated in the stunted children in all age groups. The mean differences (0.9%, 0.4% and 0.9%) for the age categories were not significant. The normal children however showed slightly higher % body fat than their wasted counter parts in all age categories. The mean differences of 1.2, 1.0, and 1.2 noted for the age categories were however, not significant. A study by Money (2001) reported percentage body fat range between 16.55% - 17.15% for normal children of similar age. Both the normal and wasted children in this study had a percentage body fat lower than the values reported in the Adejumo and Money (2000). These authors reported percentage body fat which varied within 19.37% to 27.54% for 8 to 11 year age group. Even though the stunted, wasted and normal children in the present study differ in present body fat they were all within the optimal range (that is between 10% and 25%) for health as described by Lee (1995).

BMI was higher in the stunted children than in the normal children in all the age categories except age 8-11 years where the BMI values were similar (Table 1).

The higher BMI found in the stunted children has implications for development of obesity. The mean differences (0.8, 0.2 and 0.5), are however, not significant. BMI values for the normal children are higher than those of the wasted children in all age categories (Table 2). Gutin *et al.* (1996) in their study, indicated that BMI were 18.64kg/m^2±4.46 in children of ages 10.3±0.58 which was higher than the values for both the normal and malnourished children in the group 8 to 11 of this study. Normal, wasted and stunted children of this study had Lower BMI compared to those in other studies (Wabitsh *et al.*, 1996; Westrate and Deaurenberg, 1989; and Adejumo and Money, 2000).

The sums of skinfolds in this study are similar to those reported in other studies involving children to similar age groups. Mean values across age groups were 22.1±4.4mm (3-4 years), 20.2±3.6mm (5-7years) and 21.6±5.6mm (8-11years) for normal children as well as 22.7±6.0mm (3-4years), 21.4±4.000 (5-7years) and 19.9±4.2 (8-11years) for stunted children. The mean differences of the sum of skinfolds between the normal and stunted children in these age categories were not statistically significant. The mean sum of skinfolds values for the normal compared with the wasted children were 22.4mm vs 20.4mm (3-4years), 20.3mm vs 19.2mm (5-7years), 21.5mm vs 19.5mm (8-11 years). The sum of skinfolds (22.6±8.2mm - 19.38±8.2mm) reported by Schroeder and Martorell (1997), were similar to the one of this study especially in both the 3-4 and 5-7 years old categories.

The fact that stunted children show tendency towards obesity at the infancy period should raise a serious concern since it was indicated in several studies that children who are obese in childhood are likely to remain obese in adulthood (Dafe, 1997). The probable explanation for the development of this problem is that children at this stage are taken care of closely by their parents and food is readily available for them. The overall effect is that they tend to overeat. The problem is compounded if the level of physical activity is low, for example watching television and playing computes games for several hours daily.

Conclusion and recommendation: It was found, in this study, that percentage body fat was high in the stunted children at the age 3-4 years and in the adipose rebound age group than in the normal children. The normal children had high percentage body fat at the adolescent stage. The tendency towards obesity at in this age group raises serious concern regarding the health of the children, particularly during adulthood. More studies should focus on the dietary intake of the people in the area understudy and socio-economic status of these children, for a better understanding of growth status in this population - the Niger-Delta region people of Nigeria.

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