ANTHROPOMETRICAL PROFILE, SKINFOLD THICKNESS AND SUBCUTANEOUS FAT DEPOSITIONS IN ADOLESCENTS OF SOUTHEASTERN NIGERIA

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Abstract

The threatening health problems resulting from excess subcutaneous fat depositions have been reported by the World Health Organization. Also noteworthy is that childhood obesity is a pointer to adult obesity. This necessitated a study on the anthropometrical profiles of adolescents of Southeast Nigeria using different methods of determination of adiposity patterns. Subcutaneous fat depositions in adolescents of Southeastern Nigeria were studied from anthropometrical data generated between 1998 and 2000 on 857 adolescents. The methods used were the Body Mass Index (BM1), the Triceps Skinfold Thickness (TST) and Subscapular Skinfold Thickness (SST). Results in the three methods were positively correlated (r = 0.81) in establishing adiposity patterns of subjects. However, the TST and SST showed more accuracy in reliability of data related to fat content of body while the BM1 relates to total body weight. The paper establishes the fact that for measurements of growth for adolescents of Southeast Nigeria, the BM1 provides enough information on growth of subjects but for quick anthropometrical fat content determinations in clinical examinations, the TST and SST appear to provide more accuracy.

Introduction

Anibeze. Akpa and Eteudo (2003) reported the adiposity patterns of adolescents in schools in the Southeast of Nigeria using their body mass index as recommended by WHO (1995). However. Carter (1980) showed that although weight loss or gain (adiposity patterns) could be ascertained by the use of body mass index, skinfold thickness is a more satisfactory method of making a direct measurement of change in the amount of fat. This is so because as the thickness of the skin itself is more or less constant, variations in skin fold thickness are essentially due to differences in the amount of subcutaneous fat.

Measurement patterns in particular areas of the body are also known to affect the accuracy of results (Marshall, 1977). Auxological studies are therefore dependent on the accuracy and choice of measurement areas with respect to body anatomy. Carter (1980) mentioned that during growth, the amount of subcutaneous fat deposited on the limbs is often different from that of the trunk. For this reason, it is advisable to take fat measurements on both limbs and trunk sites. 'This is preferably at triceps (limb) and sub scapular (trunk) sites. Generally, for clinical purposes, the direct measurement of subcutaneous fat has effectively correlated with measuring skinfold thickness (WHO, 1995). Anthropometric measurements of body mass index (BMI) have been known to be superior over other methods of assessing nutritional status (Forse and Shizgal, 1980; Anibeze et al, 2003). However, clinical examinations have relied on measurement of subcutaneous fat depositions for quick assessment (Marshall, 1977).

The aim of this study is to correlate the various anthropometrical patterns of measurement of growth for clinical examinations and growth study. It also seeks to examine and provide mean baseline growth data for adolescents of Southeastern Nigeria.

Materials and Methods

The data collection was carried out between 1998 and 2000 on 857 adolescents from the Southeastern region of Nigeria. The detailed sampling frame included live senior secondary schools in Enugu metropolis and first and second year students in Ebonyi State University, Abakaliki and Abia State University, Uturu within the stipulated year of sampling. 'Fable I presents the categories of adolescents in the study sample. The criteria for selection of sample include individuals within the age category of adolescents.

Height-Weight Profiles

The measurement of Body fatness adopted in the present study is the Body Mass Index (BMI = $kg.m^2$) recommended by WHO[4]. Height (m) and weight (g) were generated by direct measurement of adolescents using a meter rule and weighing scale. BMI were calculated from generated data and subjects were allocated to groups on the basis of their BMI following Bray[5] as follows:

- Those of normal weight with BMI < $25kg/m^2$
- Those of overweight with BMI> $25kg/m^2$
- Those obsessed with BMI > $30kg/m^2$

Triceps Skinfold

A total of 320 adolescents were randomly picked from the 857 total sample size. Their triceps skin fold thickness measured using a skin fold caliper (Holtain Skin fold Caliper). In each of the adolescent, the skin fold was measured by picking up a fold of skin and subcutaneous tissue between the observer's forefinger and thumb, which are initially placed about 2cm apart on the skin and then brought together to pinch the fold away from the underlying muscle. The jaws of the caliper are applied to the skin fold about 2cm between the lingers. The right hand then relaxes its grip on the handle so that the jaws of the caliper can exert their full pressure and the readings then taken.

The triceps skin fold was measured over the posterior surface of the left triceps muscle on a vertical line passing upwards from the olecranon with the arm hanging relaxed at the side.

Sub-Scapular Skinfold

The sub scapular skin fold was measured by picking up the fold just below the angle of the left scapula by the thumb and forefinger which are brought down the lateral and medial borders of the bone, until they meet. The skin fold is calculated following Edwards (1995) as follows:

Skin fold transform = 100 x log 10 (Reading in mm - 1.8).

Results

Table 1 presents the average weight, height and age of adolescents according to sex and pooled sample, flic classification of BMI in terms of body fatness is presented in Table 2. Although the mean height of males showed a higher value, the BMI was higher in females.

The obtained values in the skinfold thickness showed that the folds at the triceps region are higher than the values obtained from the subscapular region. However, the correlation of 0.89 obtained was high. Females had higher mean values in the tw-o regions when compared with males (Females TS = 16.33mm, SS = 8.5; Males TS = 12.5, SS = 8.2). The profile of skinfold thickness in both males and females (Figs 1 &2) showed that there was an increase in the skinfold as age of subjects increased. The graph of the female group tended to flatten into a plateau towards the end of adolescence. In the males the graph appear to continue in steepness even at the peak of the age of subjects studied.

Discussion

'Fhe result obtained for the skinfold thickness in the Triceps and Subscapular regions corroborate the data for the Body Mass Index in total values (Tables 2 and 3). The correlation obtained was high and positive (r = 0.81). However, the coefficient of variations from the data showed that the triceps and subscapular folds show more accuracy. This agrees with Tanner and White[7] who mentioned that measurement of skinfold thickness reflect changes in total fat and allows the relative fat of individuals to be compared with accuracy sufficient for clinical examinations.

The BMI measurements are related to total weight (Brooks, Lloyd and Wolff, 1972), which is related to three biological factors; increase in fat, increase in water content and increase in growth. The skinfold measurements are directly related to the estimation of subcutaneous fat (Edward, 1995). Hence it would then appear that although the BMI and skinfold measurements are related to estimation of growth parameters, their estimated values reflect different aspects of growth. Thus for standard growth measurements related to increase in general gross anatomy, the BMI suffices to give adequate data but for fat content measurements in clinical examinations the skinfold thickness would appear to give a better estimation. The results obtained for the subjects under study corroborate this fact.

The higher mean value of the BMI in females is indicative of the fact that the females possess more subcutaneous fat than the males for the age range of subjects under study. The reasons for higher fat content in females have been varied. However, there is agreement that generally an increase of fat in the body may be due to an increase in fat containing cells or the enlargement of existing cells. Brook et al (1972) estimated the number of cells with fat in the bodies of 64 children who were not obese and 52 who were obese and found that the number of fat-containing cells apparently increased five times between the ages of one and 13 years. Although girls are fatter in the study, they do not appear to have more number of cells and must therefore have more fat in each cell. Following from this, it would appear that in the present study, the subjects have been adolescents and hence increases in fat would be due to increases in individual fat cells than in the number of fat cells.

The accuracy of the skin fold measurements in estimating fat as observed in this study corroborates the idea that the BMI is related to total weight which is related to three factors: increase ill fat, increase in water content and increase in growth. The skin fold measurements are directly more related to subcutaneous fat. Thus, for standard growth measurements, the BMI suffices to give adequate data but for fat content measurements in clinical examinations the skin fold measurements appear to be more accurate.

Conclusion

This paper establishes the fact that for measurements of growth for adolescents of Southeastern Nigeria, the BMI provides enough information on general growth of subjects and nutritional status. Although this compares favourably with the TST and SST, the later methods demonstrate more accuracy and hence adequately suffice for quick clinical examinations of fat content.

References

1. Anibeze, C.I.P.; Akpa, A.O.C.; and Etudo A (2003). Adiposity Patterns in Adolescent Populations of Southeastern Nigeria Based on Their Body Mass Index. J. *Expt. & Clin. Anal.* 2(1): 40-42.
2. Bray, G.A (1989). Classification and Evaluation of Obesities. *Med. Clin. North Am.* 73: 161- 184.
3. Brook, C.D.E.; Lloyd S.K.; and Wolff, OTI. (1972). Weight Profiles in Adolescents. *British Medical Journal 2:25-28.*
4. Carter, N.D (1980). *Development. Growth and Ageing.* London: Croom Helm Ltd.
5. Edwards et al, (1995). Quoted in WHO (1995).
6. Forse R A and Shizgal H M (1980). The Assessment of Malnutrition. *Survey* 88: 17 - 24.
7. Marshall, W.A. (1977). *Human Growth and its Disorders.* London & New York: Academic Press.
8. Tanner, J.M and Whitehouse, R.II. (1975). Genetic Diseases of Childhood and Adolescence *Archs. Dis. Child* 51:170-179.
9. WHO (World Health Organization) (1995). Physical Status: The Use and Interpretation of Anthropometry. WHO Technical Report Series, 854 WHO Geneva.

Table 1: Adolescents in the Study Sample

Sample Characteristics	N	Per.(%)
Males		
12 - 14 yrs	92	10.7
15 - 16 yrs	130	15.2
17 - 18 yrs	156	18.2
19 - 21 yrs	104	21.1
Sub-total	**392**	**45.7**
Females		
12 - 14 yrs	54	6.3
15 - 16 yrs	169	19.7
17 - 18 yrs	183	21.4
19 - 21 yrs	59	6.9
Sub-total	**465**	**54.3**
Total Sample size:	**857**	**100**

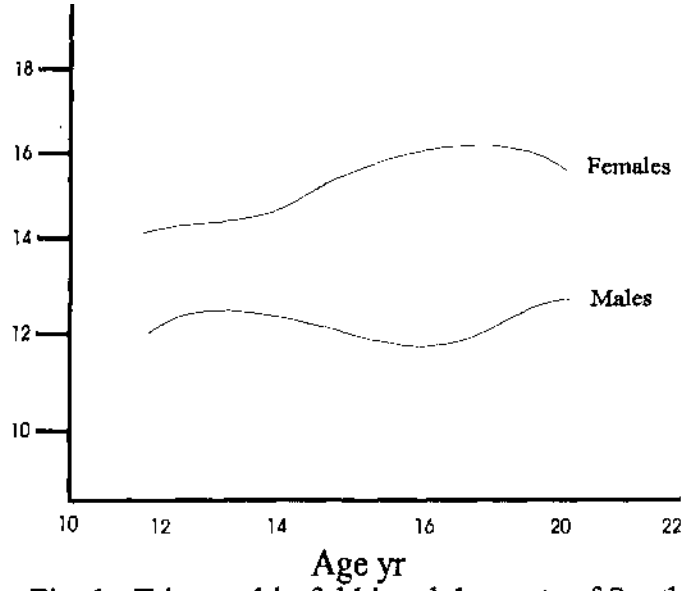
Table 2: Anthropometrical Data of Adolescents in the Sample Study

	Mean Weight	Mean Height	Mean Age	Mean BMI
Males	52.19 ± 14.33	1.58 ± 0.14	16.07 ± 3.61	20.50 ± 3.45
Females	55.73 ± 10.99	1.56 ± 0.9	16.79 ± 2.69	22.55 ± 3.45
Pooled Sample	54.61 ± 12.24	1.57 ± 0.11	16.56 ± 3.30	21.90 ± 3.56

Table 3: Skin Fold Thickness in Adolescents in the Study Sample

	Triceps Skin Fold	Subcutaneous Skin Fold
Males	12.5mm	8.2mm
Females	16.3mm	8.5mm
Pooled Sample	14.4mm	8.4mm

Fig. 1: Triceps skin fold in adolescents of Southern Nigeria.



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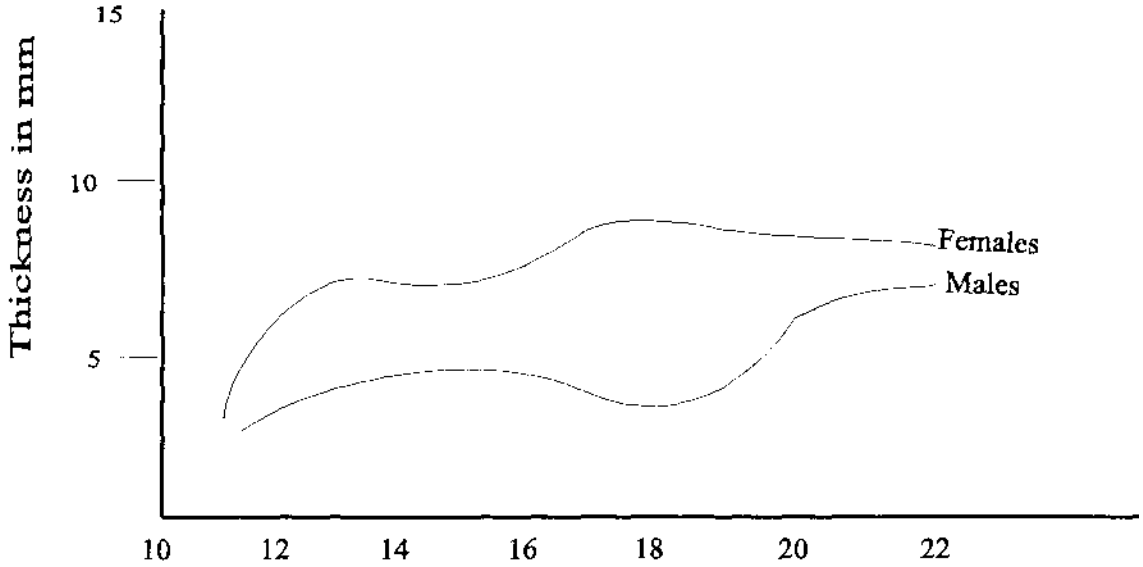

Fig. 2. Subscapula skinfold in adolescents of Southeastern Nigeria.