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# Arm Muscle and Fat Components in Adolescent Boys of Punjab

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**ABSTRACT** The objective of the present study is to evaluate the association between Arm Fat and Muscle components in adolescent boys of Punjab. A cluster sampling of 829 boys from 12 to 18 years was drawn from various schools of Moga, Ludhiana, Bathinda and Ferozpur districts in Punjab during October 2000.Each subject was measured for two skinfolds, viz., Biceps and Triceps and one circumference of the Upper Arm employing standard techniques of Tanner et al. (1969). Areas of Arm Muscle and Arm Fat were calculated with the help of Upper Arm Circumference and respective skin folds assuming the limb to be a cylindrical entity. Arm Muscle Area shows high correlation with Upper Arm Circumference whereas Arm Fat Area is highly correlated with Triceps skin fold during the period under study. It may be concluded from the present study that the circumference of the Upper Arm is a good indicator of the Arm Muscle Area and hence later can be calculated from the former with lots of accuracy. Similarly the Arm Fat Area is better predicted with the help of Triceps skin folds. The associations and predictions of Arm Fat Area and Arm Muscle Area are generally stronger at the late adolescent years.

## INTRODUCTION

During the prenatal life the gamut of somatic changes is vast which includes replication and blot out of cells, emanation and resorption of tissues, repositioning and modification of organs, emergence and submergence of external features, and varied trends of alteration in size and form of the head, trunk and limbs. Later on during postnatal life, cells elongate, flatten, invaginate and migrate. They have specific life span as skin cells for a few weeks, blood cells for a few months, nerve cells from when they appear into postnatal life (Meredith, 1978). Various changes in the reproductive organs and secondary sex characters in body size and shape, in the relative proportions of muscle, fat and bone and in variety of physiological functions take place during adolescence (Tanner, 1962; Marshall, 1970). At the 24 weeks of gestation number of fibers in each human muscle is probably fixed so that growth follows hypertrophy without hyperplasia. Reliable measurements of muscle strength can be made from the age of about 5 years and is found to increase steadily up to puberty. Muscles in the upper body grow less rapidly in proportion to height squared. They maintain the same proportions as the long bones increase in length. The relationship between the strength of the biceps and height differs from that seen in young boys. This additional muscle growth probably represents the direct action of testosterone on muscle (Jones and Round, 1998). Fat is one of the most labile tissues in the body and change according to both genetic and environmental factors. Trends of reduced velocities is much better seen in case of the limb fat folds which represent the classical pattern of fat deposition. Much of the fat deposited at the suprailiac fat fold site as compared to the limbs where the velocities remain negative due to relatively greater expansion of the underlying lean tissue (Parkash and Pathmanathan, 2000).

The following study has been conducted with a view to evaluating the association between fat and muscle components in adolescent boys of Punjab.

## MATERIAL AND METHODS

A crossectional sample of 829 school boys in the age range of 12 to 18 years were measured for Upper Arm Circumference, Triceps and Biceps skin fold thickness using standard techniques given by Tanner et al. (1969). The data has been collected from various areas of Punjab during October 2000.Crossectional areas of muscle and adipose tissue were calculated using the formulae given by Vague et al. (1971).

Brachial Adipo Muscular Ratio (BAMR) is calculated as follows:

BAMR =Arm Fat Area/Arm Muscle Area

Data has been put to descriptive statistical analysis for the calculation of Mean and Standard Deviation. Correlation and Regression analysis is also done.

**Table 1: Descriptive statistic of observed variables (Mean ±SD)**

| *Age (Yrs)* | *UAC (cm)* | *Biceps (mm)* | *Triceps (mm)* | *Arm Muscle Area (cm)* | *Arm Fat Area (cm)* | *Brachial Adipo Muscular Ratio (BAMR)* |
|---|---|---|---|---|---|---|
| 12 | 17.73±1.01 | 5.50±2.42 | 8.03±2.59 | 19.50±2.68 | 5.62±1.93 | 0.29±0.12 |
| 13 | 19.21±1.77 | 5.03±1.64 | 8.27±2.01 | 23.59±4.77 | 6.04±1.64 | 0.26±0.07 |
| 14 | 20.21±2.12 | 5.04±1.90 | 8.63±2.14 | 26.34±6.29 | 6.54±1.86 | 0.25±0.08 |
| 15 | 20.99±2.20 | 5.56±2.24 | 8.87±2.32 | 28.30±6.59 | 7.16±2.27 | 0.26±0.09 |
| 16 | 22.37±2.26 | 5.79±1.91 | 8.50±1.83 | 32.69±7.53 | 7.56±1.92 | 0.24±0.07 |
| 17 | 23.48±1.71 | 6.46±2.62 | 9.75±3.00 | 35.21±6.70 | 8.92±2.74 | 0.26±0.11 |
| 18 | 24.01±2.07 | 9.31±2.75 | 11.79±2.12 | 34.54±7.81 | 11.71±2.45 | 0.35±0.11 |

UAC: Upper Arm Circumference

**Table 2: Correlation analysis (r)**

| *Age* | *Arm Muscle Area* | | | *Arm Fat Area* | | |
|---|---|---|---|---|---|---|
| *(Yrs)* | *Upper Arm Circumference* | *Biceps* | *Triceps* | *Upper Arm Circumference* | *Biceps* | *Triceps* |
| 12 | 0.75 | 0.47 | 0.40 | 0.39 | 0.90 | 0.94 |
| 13 | 0.95 | 0.15 | 0.05 | 0.51 | 0.80 | 0.87 |
| 14 | 0.96 | 0.16 | 0.11 | 0.48 | 0.79 | 0.84 |
| 15 | 0.95 | 0.15 | 0.14 | 0.47 | 0.87 | 0.87 |
| 16 | 0.97 | 0.24 | 0.25 | 0.39 | 0.85 | 0.83 |
| 17 | 0.90 | 0.45 | 0.52 | 0.11 | 0.92 | 0.90 |
| 18 | 0.95 | 0.44 | 0.40 | 0.28 | 0.85 | 0.85 |

## OBSERVATIONS AND RESULTS

Table 1 represents the descriptive statistics of the observed variables. Mean values of Upper Arm Circumference, Biceps and Triceps increase with advancing age. At the age of 12 years mean value for Upper Arm Circumference is 17.73±1.01cm, Biceps 5.50±2.42mm and Triceps 8.03±2.59mm which attains the values of 24.01±2.07cm, 9.31±2.75 mm and 11.79±2.12 mm at the age of 18 years respectively. Arm Muscle Area and Arm Fat Area follow similar trend of increase with age. Their mean values are more at each successive age group except at 18 years for Arm Muscle Area and 16 years for Arm Fat Area where it shows decrease in value, although increase in both the parameters is not uniform. Brachial Adipo Muscular Ratio (BAMR) also shows increasing trend with the age advancement except at the age of 16 years.

Correlation Analysis was attempted for Arm Muscle Area and Arm Fat Area with respect to Upper Arm Circumference, Biceps and Triceps skin folds. Results given in the Table 2 depict that Arm Muscle Area (Fig.1) is highly correlated with Upper Arm Circumference as compared to Biceps and Triceps skin fold. Whereas Arm Fat Area (Fig.2) shows good correlation with both the skin folds i.e. Biceps and Triceps but it is more highly correlated with

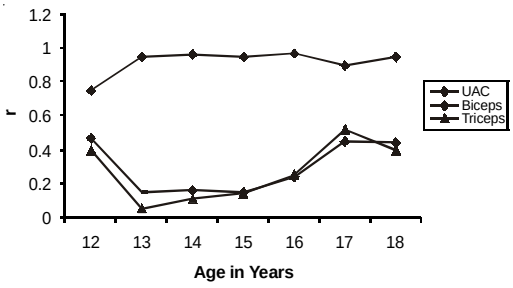


**Fig. 1. Correlation Analysis between Arm Muscle Area w.r.t. UAC and Skinfolds**

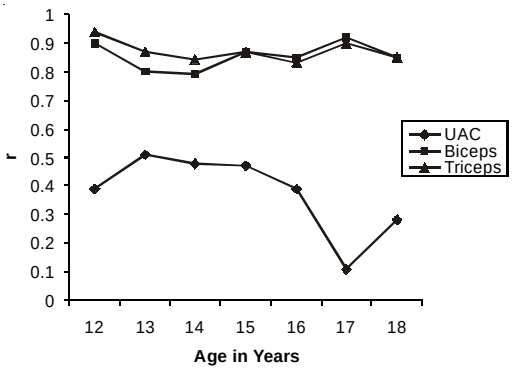


**Fig. 2. Correlation Analysis between Arm Fat Area w.r.t. UAC and Skinfolds**

Triceps skin fold thick nesses. So Upper Arm Circumference can be a good indicator for the prediction of Arm Muscle Area whereas Triceps skin fold for the prediction of Arm Fat Area. The regression equations for the calculation of both Arm Muscle Area and Arm Fat Area are given in the Table 3.

**Table 3: Regression equations for the prediction of Arm Muscle Area and Arm Fat Area.**

| *Age (yrs)* | *Arm Muscle Area* | *Arm Fat Area* |
|---|---|---|
| 12 | Y= -16.065+2.005X | Y*= -0.004+0.701X* |
| 13 | Y= -25.750+2.568X | Y*= 0.128+0.715X* |
| 14 | Y= -31.225+2.848X | Y*= 0.176+0.736X* |
| 15 | Y= -31.443+2.846X | Y*= -0.463+0.859X* |
| 16 | Y= -39.401+3.222X | Y*= 0.127+0.875X* |
| 17 | Y= -48.349+3.558X | Y*= 0.841+0.828X* |
| 18 | Y= -51.770+3.594X | Y*= 0.002+0.991X* |

Y= Arm Muscle Area
Y*= Arm Fat Area
X= Mean Value of Upper Arm Circumference at that age level.
X*= Mean Value of Triceps at that age level.

## DISCUSSION

The Brachial Adipo Muscular Ratio (BAMR) indicates proportional areas of adipose tissue versus that of muscular tissue. A higher value of this ratio reflects a relatively greater development of the adipose tissue with respect to the muscular tissue and vice versa. The Brachial Adiopo Muscular Ratio decreases from 12 years until 16 years and increases there after. It indicates that redistribution between the adipose and muscular tissue takes place during this period, the trend of which is that the crossection area of adipose tissue viz a viz that of muscular tissue decreases. In other words the relative area of lean tissue increases. This is the adolescent period during which the production of sex hormone increases many fold. The general outcome of increased muscles in the upper arm seems to be the result of the anabolic activities initiated through the hypothalamus pituitary gonadal axis. Both arm fat area and arm muscle areas are the soft tissue masses and are said to assess the calorie and protein reserve in the body (Frisancho, 1981; Gunay et al., 1990; Macias-Tomei et al., 2001). Children having proportionately more muscle than fat areas indicate that energy rather than protein is the main nutritional problem in them (Martorell et al., 1976).

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