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Relationship between height, weight, BMI, waist circumference, hip circumferences, waist-to-hip ratio and waist-to-height ratio among male school children

Nariti Roy and Dr. Rajkumar Sharma

Abstract
The purpose of the present study was to establish the relationship between height, weight, BMI, waist circumference, hip circumferences, waist-to-hip ratio and waist-to-height ratio among school children. A total of one hundred male children belonging to middle and high schools in northern tribal region of West Bengal in age of thirteen years were randomly selected for the present investigation. Mean, SD and Pearson Moment Correlation coefficient were computed to analyse the collected data. BMI was calculated as the ratio of body weight to the square of height (kg/m2), WHR was calculated as the ratio of waist to hip circumference and WHtR as the ratio of waist circumference to height. The results of the study revealed the normal values in all the anthropometric measures among male school children in age of 13 years. The obesity symptom was not observed them in age of 13 years male school children. Significant correlations were also observed between anthropometric indices among them.

Keywords: Male, Children, Tribal Region, Adolescence, Anthropometric indices

1. Introduction
Anthropometric indices includes waist circumference, hip circumference, waist-to-hip ratio and waist-to-height ratio. waist circumference is a eminently sensitive and precise measure of upper body fat in young adolescents. it is also valuable to identify the overweight and obese adolescents at risk of developing metabolic complications and additionally denotes the risk factors of cardiovascular disease in children and adolescents, The waist circumference and waist-to-height ratio are the better predictors than BMI (McCarthy and, Ashwell M, 2006) [13].
Numerous investigations have informed that body composition varies with race/ethnicity (Deurenberg, Deurenberg-Yap, Wang, Lin & Schmidt, 1999; Gurrici *et al*., 1998; Kupper *et al*., 1998) [5, 7, 11], age (Baumgartner, 2005; Heyward & Wagner, 2004; Shephard, 2005) [1, 8, 15], gender (Wells, 2007 and Malina, 2005) [15, 1] and disease state (Chen, 2005; Janssen and Roubenoff, 2005; Kotler and Engelson, 2005) [3, 9, 10]. It is also confessed that few anthropometric measures are well correlated with body composition, commonly body fat percentage. These measures include certain length, breadth, and depth measures, abdominal and limb circumferences, and some skin-fold thickness measures (Bellisari and Roche, 2005) [2].
BMI cannot differentiate the lean mass and fat in body composition and an increasing number of studies are reporting that the correlation between BMI and body fat percentage is different among different populations (Deurenberg, Deurenberg-Yap and Guricci, 2002; Deurenberg, Van Staveren and Yap, 1998) [6, 4]. Moreover, assessment of body composition is a better approach in the evaluation of nutritional and health status.
Few anthropometric indices such as waist circumference (WC), waist-to-hieght ratio (WHtR), and waist-to-hip ratio (WHR) are also suggested as better indicators of obesity compared with BMI.
The purpose of the present study was to establish the relationship between height, weight, BMI, waist circumference, hip circumferences, waist-to-hip ratio and waist-to-height ratio among school children.

2. Methodology

2.1 Selection of Subjects

A total of one hundred male children belonging to middle, high and higher secondary schools in northern tribal region of West Bengal ranging between twelve to thirteen years of age were randomly selected for the present investigation. The age record of subjects were collected from school records and the subjects were tested within one month of their birthdays. The selection of sample was made by applying purposive random sampling technique. Sample of male children was taken from the different schools of Jalpaiguri, Darjilling and Alipur Duar Districts established in northern tribal region of West Bengal.

2.2 Instrumentation

2.2.1 Weight

Purpose: Assessment of weight. Equipment: Calibrated Digital scale Procedure: the topic can stand on the platform of the balance with foot parallel. Weight are equally distributed on the foot. Minimum material are wear by the respondent, likes vest and short (See Figure 4 and 13). Scoring: Weight of the topic is recorded in metric weight unit by scientist. Sit and reach take a look at.

2.2.2 Height

Purpose: Measuring of standing height. Equipment: Height measurement Stand (Stadiometer). Procedure: the topic stands erect bare-footed with heels and back of the pinnacle touching the stands. The flat card-board is place informed the highest of the pinnacle for measuring of height of the respondent. Scoring: The measuring is taken to the closest cm. Administrative Suggestions: After all outer clothing and shoes were removed, body weight and height were measured to the nearest 0.1 kg and 0.1 cm, respectively, using standardized equipment.

2.2.3 Body Mass Index

Purpose: Measurement of body size. Health relation: A higher BMI is associated with a worse cardiovascular profile. Equipment: An electronic scale and measuring tape fixed on the wall to measure weight and height respectively. BMI was calculated using the formulae BMI = kg/m². Scoring: A BMI greater than 25 may indicate that you are overweight, while a BMI greater than 30 generally indicates obesity.

2.2.4 Waist Circumference

Purpose: A non-elastic tape was used to measure central body fat. Health relation: A higher waist circumference is a risk factor for cardiovascular disease. Performance: The participants were asked to remove their t-shirt so that the tape could be correctly positioned. They stood erect with the abdomen relaxed, the arms at the sides and the feet together. The tester faced the participant and placed an inelastic tape around him, in a horizontal plane, at the level of the natural waist, which is the narrowest part of the torso, as seen from the anterior aspect. The measurement was taken at the end of a normal expiration. Practice and number of test trials: Two measurements were performed, not consecutively, and the mean was used in the analyses. Scoring: It was measured to the nearest 0.1 cm at the level of the iliac crest while the subjects were at minimal respiration.

2.2.5 Hip circumference

Hip circumference (HC) was measured to the nearest 0.1 cm at the level of the maximum extension of the buttocks in a horizontal plane. Both measurements were performed using non-stretchable tape.

2.2.6 Waist to hip ratio (WHR)

Purpose: To determine the ratio of waist circumference to the hip circumference. Equipment: Tape measure. Procedure: A simple calculation of the measurements of the waist girth divided by the hip girth. waist to hip ratio = Gw / Gh, where Gw = Waist girth, Gh = Hip girth. Scoring: The measurements for the hip to waist ratio can be taken in cm or inches.

2.2.7 Waist to height ratio (WHtR)

Purpose: To determine the ratio of waist circumference to height. Equipment: Tape measure. Procedure: A simple calculation of the measurements of the waist girth divided by the height. waist to height ratio = Gw / Ht, where Gw = Waist girth, Ht = Height. Scoring: The measurements for hip to height ratio can be taken in cm or inches.

2.3 Statistical analysis

Mean values were calculated for BW, Ht, BMI, WC, HC, WHR and WHtR. BMI was calculated as the ratio of body weight to the square of height (kg/m2), WHR was calculated as the ratio of waist to hip circumference and WHtR as the ratio of waist circumference to height.

3. Results

To assess the various anthropometric measures, mean and standard deviation were computed. To find out the relationship between BW, Ht, BMI, WC, HC, WHR and WHtR, Pearson Moment Coefficient Correlation was computed and data pertaining to this has been presented in Table 1 and 2

Table 1: Descriptive Statistics of Anthropometric Measures for Male Children Aged Thirteen Years

S.No	Components	Mean	SD
1	Height	152.63	3.08
2	Weight	43.52	2.38
3.	Waist Circumference	62.77	1.59
4.	Hip Circumference	85.46	2.12
5.	BMI	18.69	1.17
6.	Waist-Hip ratio	0.73	.026
7.	Waist-Height ratio	0.41	.014

The mean scores on anthropometric measure of male children aged thirteen years have been depicted in figure 1.

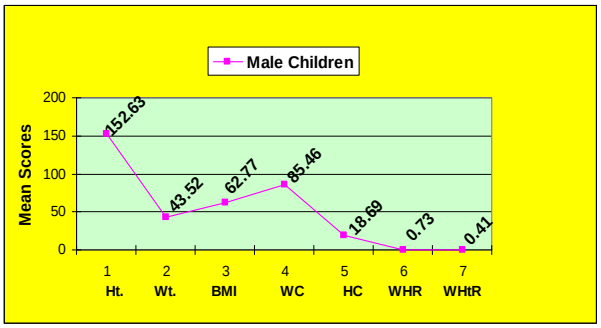

Fig 1: Mean Score of Various Anthropometric Measures of thirteen Years Male Children.

Table 2: Correlation/Matrix of Anthropometric Measures of Male Children Belog to Northern Tribal Region of West Bengal

S.N0.	Variables	Ht	Wt	BMI	WC	HC	WHR	WHtR
1.	Height	-	.126	-.505*	-.168*	.122	-.200*	-.636*
2.	Weight		-	.791*	.026	.137	-.070	-.027
3.	BMI			-	.130	.048	.060	.371*
4.	WC				-	-.036	.720*	.844*
5.	HC					-	.712*	.092
6.	WHR						-	.653*
7.	WHtR							-

* Significant at the 0.05 level, r.05. (198)=.138

Table 2 clearly reveals that statistically significant correlations were found between height - BMI followed by WC, WHR and WHtR negatively, as the obtained r-values of -.505, -.168, -.200 and -.636 respectively were higher than the r.05 (198)=.138. But the relationships between height-weight and between height- hip circumference were statistically insignificant, as obtained r-values of .126 and .122 respectively were lesser than the r.05 (198)=.138.

Statistically significant Correlation was observed between weight –Body Mass Index (BMI) posively, as the obtained r-value of 0.791 was high than the r.05 (198)=.138. But the insignificant correlations were observed between weight-WC followed by HC, WHR and WHtR, as the obtained r values of .026, .137, -.070 and -.027 respectively were lower than the required value to be significant.

Statistically significant correlation was found between BMI-WHtR positively, as the obtained r-value of .371 was high than the r.05 (198)=.138. But the relationships between BMI-WC followed by HC and WHR were statistically insignificant, as obtained r-values of .130, .048 and .060 respectively were lesser than the r.05 (198)=.138.

Statistically significant correlations were found between WC-WHR followed by WHtR positively, as the obtained r-values of .720 and .844 were higher than the r.05 (198)=.138. But the relationships between WC-HC was statistically insignificant negatively, as obtained r-value of -.036 was less than the required value to be significant.

Statistically significant correlation was found between HC-WHR positively, as the obtained r-value of .712 was high than the r.05 (198)=.138. But the relationships between HC-WHtR was statistically insignificant, as obtained r-value of .092 was lower than the r.05 (198)=.138.

Statistically significant correlation was observed between WHR-WHtR positively, as the obtained r-value of .653 was high than the r.05 (198)=.138.

4. Discussion

The sample for study consisted of 100 male school children between 12 to 13 years of age. Descriptive statistics for Height (Ht), Weight (Wt.), Body Mass Index (BMI), Waist Circumference (WC), Hip Circumference (HC), Waist-to-Hip Ratio (WHR) and Waist-to-Height Ratio (WHtR) were computed for male school children. The results of the study indicated the normal values in all the anthropometric measures of among thirteen years male children. Researcher did not seen any obesity symptoms them in age of 13 years.

When the inter-relationship was establish between Height (Ht), Weight (Wt.), Body Mass Index (BMI), Waist Circumference(WC), Hip Circumference (HC), Waist-to-Hip Ratio (WHR) and Waist-to-Height Ratio (WHtR) of male school children, statistically significant correlations were found between height - BMI followed by WC, WHR and WHtR negatively; Positive relationship was found between BMI- WHtR; WC-WHR followed by WHtR; WC-WHR followed by WHtR ; HC- WHR and between WHR-WHtR. But the insignificant correlations were observed between between weight-WC followed by HC, WHR and WHtR; between BMI-WC followed by HC and WHR; between WC-HC; and between HC-WHtR.

5. Conclusions

1. Normal values of all the anthropometric measures were found among male school children in age of 13 years. The obesity symptom was not observed them in age of 13 years.
2. A positive relationship was found between BMI- WHtR; WC-WHR followed by WHtR; WC-WHR followed by WHtR; HC- WHR and between WHR-WHtR.
3. Similar correlations were observed between between weight-WC followed by HC, WHR and WHtR; between BMI-WC followed by HC and WHR; between WC-HC; and between HC-WHtR among male school children.

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