Association of Body Composition With Serum Cholesterol and Body Mass Index in Healthy Pakistani Adults

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ABSTRACT

Objective: To determine the association of serum cholesterol and body mass index with body composition in the healthy Pakistani adults.

Study Design: Cross sectional study.

Place and Duration of Study: Physiology Department, Army Medical College Rawalpindi/National University of Medical Sciences (NUMS), in collaboration with Armed Forces Institute of Rehabilitation Medicine (AFIRM) Rawalpindi and Clinical Pathology Laboratory (CPL), Pak-Emirates Military Hospital, Rawalpindi. (Duration to be asked form the authors).

Methodology: The total study sample of 100 participants was taken, that comprised of two groups. Group-1 included male participants (n=50) while group-2 included female participants (n=50). The participants were healthy adults of ages 18-60 years having same physical activity background. Body composition of the participants was evaluated by bioelectric impedance analysis machine. Measurement of serum cholesterol was carried out by the Bosh Diagnostic Kit. Body Mass Index (BMI) was determined by the formula.

Results: Serum cholesterol was found to be significantly correlated with body fat mass and percent body fat in males (r-value = 0.90 and 0.82, *p*-value <0.001 and 0.002 respectively) and in females there was significantly positive correlation with the body fat mass (r-value=0.51, *p*-value 0.007), skeletal muscle mass (r-value = 0.59, *p*-value 0.005), total body water (r-value=0.67, *p*-value 0.006) and fat free mass (r-value=0.47, *p*-value 0.008).

Conclusion: Serum cholesterol and BMI were associated with the body composition in females but with only fat parameters in the males.

Keywords: Body fat mass, Body mass index, Fat free mass, Percent body fat, Serum cholesterol.

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INTRODUCTION

Body composition stands for body fat mass, skeletal muscle mass, total body water and percent body fat. Body fat increases the risk of cardiovascular diseases and raises the chances of developing diabetes mellitus.[1] There is an inverse association between excess body fat mass and occupational physical performance. This is because excess body fat does not contribute to the force production.[2] Muscle mass on the other hand is associated with capacity of physical performance, normal functioning, weight bearing and body strength. [3] Body composition can be determined by bioelectric impedance analysis machine. It is based on the measurement of electrical resistance in the body to an imperceptible amount of electric current for a brief period of time.[4]

In the recent past, anthropometric indices have been employed for the assessment of nutritional deficiencies and cardiovascular risk.[5,6] Body mass index soon became the standard method of determining physical fitness and obesity level as it was cost effective and quick. This was even used as a fitness criterion for recruitment of the Armed Forces and law enforcement agencies.

Research has shown that South East Asian have higher prevalence of sarcopenia and are more prone to visceral and central obesity.[7] Due to a higher levels of percent body fat and a more centralized pattern of fat distribution, elevated disease risks and rise in functional disability have been observed in Asian populations at BMI scores well below the World Health Organization (WHO) thresholds defining overweight and obesity.[8] There is documented equivocal association of body composition with serum cholesterol.[9,10]

Although many studies have been conducted on body composition and the anthropometric indices in the West and a few in South Asia as well but most of them have been conducted on participants suffering from cardiovascular, metabolic or oncological

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disorders. However, in this study, we focused on the healthy, disease free individuals. Study regarding body composition of healthy Pakistani adults has not been done so far, therefore, it will add to the pool of knowledge. This study also investigated the association of body composition with serum cholesterol in healthy Pakistani adults. Outcome of our study will contribute to provision of non-pharmacological measures and dietary advice for the improvement of health of the community.

METHODOLOGY

This cross sectional study was conducted at the Physiology Department, Army Medical College Rawalpindi in collaboration with Armed Forces Institute of Rehabilitation Medicine (AFIRM) Rawalpindi and Clinical Pathology Laboratory (CPL), Pak-Emirates Military Hospital, Rawalpindi. The sample size was calculated using sample size calculator clincalc.com where the power of study was kept at 80% and alpha value was taken at 5%. Population means were taken from a similar study conducted in Kerala India by Chithira and Joseph.[10]

Inclusion Criteria: Healthy adults of age 18-60 years having same physical activity background were included in the study.

Exclusion Criteria: Participants having any musculoskeletal, cardiovascular or metabolic disorders were excluded from the study. Pregnant or lactating women were also excluded from the study.

The study was conducted after getting formal permission from Ethics Review Committee of Army Medical College, Rawalpindi (ERC/ID/28). Written informed consent was obtained from all the participants of the study. Brief history about any medication intake was taken. The participants filled the consent form after the clear elaboration of the whole study procedure. Participants were given identification numbers and their identity were kept in full confidentiality. Demographic details like their native area, age and gender were recorded. Hundred participants were recruited in the current study which included 50 males and 50 females.

Body composition of the participants was evaluated by bioelectric impedance analysis machine (InBody 370S) in the Armed Forces Institute of Rehabilitation Medicine, Rawalpindi. The body composition was determined by parameters such as skeletal muscle mass (SMM), percent body fat mass (PFM), total body water, body fat mass and fat free mass.

Blood sample of 3 ml was taken by antecubital venipuncture, under aseptic conditions. The samples were processed within 2 hours of collection at room temperature. Measurement of the serum cholesterol was done by the Bosh diagnostic kit in the Clinical Pathology Laboratory (CPL), Pak-Emirates Military Hospital, Rawalpindi.

Weight of all the participants was recorded, after standing on weighing machine bare-footed and removing extra clothing. Height was found with the use of Harpenden stadiometer. Body mass index was calculated as weight divided by height squared (Kg/m^2).

Data was analyzed using Statistical Package for Social Sciences (SPSS) version 25.0. Mean and standard deviation were calculated for numerical variables. Comparison between the groups was done by using independent sample t test. Pearson correlation test was applied. The *p*-value ≤0.05 was considered significant.

RESULTS

Hundred participants were recruited in the current study which included 50 males and 50 females. The mean age of participants was 31.33 ± 6.26 years (range: 19-50 years). In the male-group, the mean age was 32.74 ± 6.86 years (range: 20-50 years). Whereas, in the female-group the mean age was 29.92 ± 5.31 years (range: 19-44 years). The difference between mean age of males and females was statistically not significant.

Correlation of body composition with serum cholesterol in males has been presented in Table-I. The data revealed significant positive correlation of the serum cholesterol with body fat mass and percent body fat. Table-II showed that in females, the serum cholesterol had positive correlation with body fat mass, skeletal muscle mass, total body water and fat free mass. Percent body fat had negative correlation. Table-III showed the positive association of BMI with body fat mass and percent body fat in males.

Table-I: Correlation of body composition with serum cholesterol in males (n=50).

Parameters		Body Fat Mass (Kg)	Skeletal Muscle Mass (Kg)	Total Body Water (Kg)	Fat Free Mass (Kg)	Percent Body Fat
Serum Cholesterol (mmol/L)	r-value	0.90	0.04	0.08	0.05	0.82
	p-value	<0.001*	0.80	0.58	0.71	0.002*

While, Table-IV showed the positive correlation of BMI with body fat mass, skeletal muscle mass, total body water and fat free mass in females. However, there was significant and negative correlation with percent body fat.

Table-II: Correlation of body composition with serum cholesterol in females (n=50).

Parameters		Body Fat Mass (Kg)	Skeletal Muscle Mass (Kg)	Total Body Water (Kg)	Fat Free Mass (Kg)	Percent Body Fat
Serum Cholesterol (mmol/L)	r-value	0.51	0.59	0.67	0.47	-0.19
	p-value	0.007*	0.005*	0.006*	0.008*	0.19

Table-III: Correlation of body composition with body mass index, in males (n=50).

Parameters		Body Fat Mass (Kg)	Skeletal Muscle Mass (Kg)	Total Body Water (Kg)	Fat Free Mass (Kg)	Percent Body Fat
Body mass index (Kg/m^2)	r-value	0.92	0.14	0.17	0.12	0.81
	p-value	<0.001*	0.33	0.23	0.42	0.002*

Table-IV: Correlation of body composition with body mass index, in females (n=50).

Parameters		Body Fat Mass (Kg)	Skeletal Muscle Mass (Kg)	Total Body Water (Kg)	Fat Free Mass (Kg)	Percent Body Fat
Body mass index (Kg/m^2)	r-value	0.44	0.76	0.89	0.85	-0.56
	p-value	0.008*	0.004*	0.001*	0.001*	0.006*

DISCUSSION

Serum Cholesterol is an indicator of hepatobiliary function, intestinal absorption, propensity of coronary artery disease and hyper-lipoproteinaemias. Our study indicated that serum cholesterol level was significantly associated with the body fat mass and percent body fat in males, which was in accordance with the current practice of monitoring serum cholesterol of high risk patients, to keep an eye on their cardiovascular status. However, in females, there was significant and positive correlation of cholesterol with both fat mass and fat free mass parameters. Previous researches also suggested that its levels are affected by stress, age, gender and hormonal balance.[11]

Body mass index is also used in making public health policies. It is widely used for screening and categorization purposes because of convenient and rapid calculation which is also very cost effective and does not require an expert operator.[8] We found that serum cholesterol was positively correlated with body fat mass (r= 0.90, p<0.001) and percent body fat (r=0.82, p<0.002) in males while in females, the serum cholesterol levels had positive correlation with body fat mass (r=0.51, p<0.007), skeletal muscle mass (r=0.59, p <0.005), total body water (r=0.67, p<0.006) and fat free mass (r=0.47, p<0.008). From our study we can infer that in males, serum cholesterol may be considered as a proxy of total fat mass and percent body fat or simply the tendency of obesity. However, in case of females serum cholesterol is not indicative of obesity specifically. Siervogel *et al*, did a study to find the correlation between serum cholesterol and components of body composition on Caucasian population. Their sample size was 507. Their study found that there was positive correlation of total cholesterol and total body fat and percent body fat. However, the correlation with fat free mass was significant but negative in females.[12] The results of the two studies were similar for fat mass and percent body fat but contrasting for fat free mass. The reason may be racial variations, as in Siervogel *et al*, study population was Caucasians (USA). In addition, there is difference in dietary pattern and physical activity of the two populations.

Data analysis of male participants in our study, showed significantly positive correlation of body fat mass (r=0.92, p<0.001) and percent body fat with BMI, suggesting that in males, BMI is an indicator of body fat and obesity. While data analysis of female participants depicted significantly positive correlation of BMI with body fat mass (r=0.44, p=0.008), skeletal muscle mass, total body water and fat free mass. Body mass index and percent body fat were negatively associated to each other owing to the fact that other components of body composition were also increasing with increasing BMI; therefore, BMI is not a true depicter of body fat or obesity in females. The study carried out by Ranasinghe *et al*, in Colombo, Sri Lanka showed that there was a significant positive correlation between BMI and body fat mass in both males (r=0.75, p<0.01) and in females (r=0.82, p<0.01).[13] The results of the two studies were analogous for males because of racial similarity but not so in females because females of our population lead comparatively restricted life because

of social norms. In addition to that there is stark differences in dietary habits as their population was strict vegetarian whereas, no participant of our study avoided meat in their diet.

The study conducted by Chithira and Joseph, in Kerala, India demonstrates highly significant association of BMI with total body water (r=0.26), skeletal muscle mass (r=0.25), body fat mass (r=0.91) and percent body fat (r=0.65).[10] These results, were in agreement to the results of our study and reason may be racial similarities and usage of comparable machines.

Another study was conducted by Lietz *et al*, to find the association of body fat with metabolic disturbances. That study was conducted on 72 women and 34 men with the mean age of 39.0 ± 5.9 years. Their study showed significant association of body fat with serum cholesterol in both the genders. This similarity in the two studies may be because of similar study population with respect to physical activity level.[14]

Adipose tissue is not only a reservoir of fuel in the form of triglycerides but also exerts an active endocrine function as it produces many bioactive factors, which regulate systemic metabolism and inflammation.[16] When accumulation of triglycerides in adipocytes increases as in obesity then there is increase in the lipid droplet size and dysregulation in production and secretion of adipokines which are implicated in obesity -induced inflammation and insulin resistance.[17] Both inflammation and insulin resistance result in the development of metabolic syndrome.[18] Metabolic syndrome is the major cause of mortality and morbidity.[18,19]

CONCLUSION

Serum cholesterol and BMI are associated with body composition in females but with only fat parameters in the males.

Conflict of Interest: None.

Authors' Contribution

UA: Writing the manuscript referencing, BR: proof reading the manuscript, MSN; Proof reading the manuscript, AA: Conceived idea Adm, MAK: Designed methodology.

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