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Role of Fatness in Predicting the Cardiovascular Disease Risk Factors

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Abstract: The aim of this paper is to find out the role of fatness variables in predicting the cardiovascular disease risk factors among healthy man. A total of 120 healthy army soldiers with mean age 34.6±6.6 years, were selected as a subject for the study from 90 Armored Regiment, Gwalior, India. All subjects were examined for Percentage of Fat, Waist Hip Ratio, Body Mass Index, Waist to Height Ratio, Blood Pressure (Systolic and Diastolic), Triglycerides, Total Cholesterol, High-Density Lipoprotein Cholesterol and Low-Density Lipoprotein Cholesterol. Pearson's correlation coefficients results revealed that Body Mass Index was significantly related to Systolic Blood Pressure, Diastolic Blood Pressure and HDL-cholesterol ($p<.05$), Waist Hip Ratio and Waist to Height Ratio both were also significantly related to Systolic Blood Pressure, Diastolic Blood Pressure, HDL-Cholesterol and Triglycerides ($p<.05$). Likewise, Percentage of Fat had significant relationship with Systolic Blood Pressure, Diastolic Blood Pressure and LDL-Cholesterol ($p<.05$). Multiple linear regression showed that waist circumference and percentage of fat were associated with most of the cardiovascular disease risk factors ($p<.05$). Hence, it can be concluded that fatness variables especially waist circumference and percentage of fat played an important role and would be the good predictor for the cardiovascular disease risk. However, the error associated with level of cardiovascular disease is not negligible and requires further investigation.

Key words: Fatness · Cardiovascular · Disease · Risk · Lipid Profile

INTRODUCTION

The health care needs of the world's population are likely to undergo dramatic changes due to the ongoing demographic transition. Non-communicable diseases (NCDs), such as diabetes, cancer, depression and heart disease, are rapidly replacing infectious diseases and malnutrition as the leading causes of disability and premature death [1]. Cardiovascular diseases account for high morbidity and mortality all over the world. Countries where the epidemic began early are showing a decline due to major public health interventions. On the other hand, cardiovascular diseases are contributing towards an ever-increasing proportion of the non-communicable diseases in the developing countries [2, 3]. Cardiovascular diseases (CVD) have assumed epidemic proportions in India as well. The Global Burden of Diseases (GBD) study reported the estimated mortality from coronary heart disease (CHD) in India at 1.6 million in the year 2000 [4]. A total of nearly 64 million cases of CVD are likely in the year 2015, of which nearly 61 million would be CHD cases (the remaining would include stroke, rheumatic heart disease and congenital heart diseases). Deaths from this group of diseases are likely to amount to be a staggering 3.4 million [5]. In Indian urban middle-socioeconomic status subjects there is high prevalence of cardiovascular risk factors [6]. There is a strong positive correlation of increase in coronary heart disease in India with primordial risk factors of urbanization, excessive fat intake, faulty diet, tobacco consumption and sedentary lifestyle [7]. According to the 2001 census, the total aged (60 years and above) population of India is approximately 110 million, or approximately 11% of the total population. This percentage will be increased to 14.8% by the year 2020 [8].

Subjects who gained percent body fat had 27, 71 and 48% higher risk of incident hypertension, metabolic syndrome and hypercholesterolemia, respectively, compared with those who lost percent body fat [9]. Obesity and associated CVD risk factors are becoming an important public health issue for children and adolescents

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[10], however, there have been few population based studies to investigate obesity and its association with CVD risk factors in youth. The risk of death during exercise is low; death in individuals over 35 years of age is usually the result of atherosclerotic CAD, whereas younger individuals are more likely to suffer from congenital cardiac malformations [11]. Hence, the aim of this paper is to find out the role of fatness variables in predicting the CVD risk factors among healthy man.

MATERIALS AND METHODS

In order to justify the purpose of this study, one hundred and twenty (N=120) healthy army soldiers with mean age 34.6±6.6 years, were selected for the study from 90 Armored Regiment, Gwalior, India. Body fatness variables included Percentage of Fat (FAT%), Waist Hip Ratio (WHR), Body Mass Index (BMI), Waist to Height Ratio (WHtR) while CVD risk factors included Blood Pressure (Systolic and Diastolic), Triglycerides (TG), Total Cholesterol (TC), High-Density Lipoprotein Cholesterol (HDL-C) and Low-Density Lipoprotein Cholesterol (LDL-C). All body fatness measurements were taken from each subject using standard procedure, Blood Pressure by Sphygmomanometer and Lipid Profile by Semi-Automatic Analyzer. All the blood samples from the subjects were collected by phlebotomist and analyzed by an expert pathologist. Written consent was taken from each subject willing to participate before the start of study. Subjects were free to withdraw their names from study at any time without asking for any reason. Measurements were made on a consecutive days between 06:30-10:00 AM. Subjects were not allowed to eat up to eight hours before testing, refrained from exercise for at least the previous twelve hours.

Measurements: *Standing height* of the subjects was measured with the help of height scale marked on the wall in centimeter. Subjects were asked to stand erect without shoes, keeping the legs and head together touching the wall. The height was recorded to the nearest 0.1 centimeters. *Body weight* of the subjects was measured with as little and lightest clothing as practicable to the nearest 0.1 kg by a calibrated weighting scale. *Waist Hip Ratio* was calculated by dividing subjects' waist measurement by hip measurement. (Hips are the widest part of the butt). WC was measured midway between the lowest rib and the superior border of the iliac crest with an inelastic measuring tape at the end of normal expiration to the nearest 0.1 cm. Hip circumference was measured at the widest point around the greater trochanter to the nearest 0.1 cm. The *Waist-to-Height ratio* was determined by dividing the waist circumference by the height to the nearest 0.1 centimeter. BMI of the subjects was determined by dividing the weight with a height of squared (kg/m^2) [12]. *Body density* was assessed from Hydrostatic Weighing with correction for residual volume. Residual volume was estimated by measuring vital capacity (VC) and multiplying it by 0.24 [13]. Underwater weight was measured to the nearest 0.025 kg in a portable water tank in which an underwater chair was suspended from a calibrated 15-kg autopsy scale. The best out of the 3 highest values was used as the representative underwater weight. Finally, with the help of obtained value of body density, percentage of fat was then determined using the equation given by Siri [14]. *Arterial Blood Pressure* was measured with a mercury sphygmomanometer after 5 min rest in the sitting position with the right forearm placed horizontal on the table. For *Lipid Profile* which includes HDL-cholesterol, LDL-cholesterol, triglycerides and total cholesterol a fasting 2ml venous blood sample was drawn from a superficial vein in plane vial after sterilizing the arm of the subject by using Dispo Van Disposable 24 G needle with 2ml syringe and enzymatically analyzed by Semi Automated Biochemistry Analyzer.

Statistical Analyses: The whole data was analyzed with the help of SPSS (Statistical Package for Social Sciences, Version- 20, SPSS Inc., USA). Mean, standard deviation, Pearson's correlation coefficient and multivariate linear regression analysis were used to investigate the relationship between selected Fatness and CVD Risk factors. The probability value less than or equal to 0.05 was considered to be significant.

RESULTS

Characteristics of the subject are described in Table 1 with the help of descriptive statistics (mean and standard deviation). The scores of each of the independent selected variables of fatness were correlated with dependent/criterion variable, the cardiovascular disease risk factors (CVD), in order to find out the relationship between the dependent and independent variables, which are depicted in Table 2. Multiple linear regression analysis was performed to estimate the significance of selected predictors (Fat%, WHR, BMI and WHTR) on CVD risk factors (Systolic Blood Pressure [SBP], Diastolic Blood Pressure [DBP], HDL-C, LDL-C, TC and TRIG) as shown in Table 3.

Table 1: Subject Characteristics

Characteristic	N	Mean	Stan. Dev.
Age	120	34.55	6.5
Height	120	174.08	5.3
Body Weight	120	71.85	8.9
B M I	120	23.70	2.7
W HR	120	.89	.04
FAT%	120	16.10	6.2
W HtR	120	.47	.04
SBP	120	119.69	8.3
DBP	120	78.25	6.8
HDL	120	35.47	7.9
LDL	120	107.99	32.3
TRIG	120	128.09	59.4
TC	120	169.82	30.9

Table 1 revealed that for age, height and body weight mean and standard deviation of subjects were 34.55±6.5, 174.08±5.3 and 71.85±8.9 respectively. For body mass index, waist hip ratio and waist to height ratio mean and standard deviation of subjects were 23.70±2.7, 0.89±0.04 and 0.47±0.04 respectively. For total percent body fat, mean and standard deviation of subjects was 16.10±6.2. For systolic and diastolic blood pressure mean and standard deviation of subjects were 119.69±8.3 and 78.25±6.8 respectively.

For fasting blood sugar, HDL and LDL cholesterol mean and standard deviation of subjects were 59.00±13.5, 35.46±7.9 and 107.99±32.3 respectively. For triglyceride and total cholesterol, mean and standard deviation of subjects were 128.09±59.4 and 169.82±30.9 respectively.

Table 2: Relationship of Fatness Variables to Cardiovascular Disease Risk Factors

	SBP	DBP	HDL	LDL	TRIG	T C
B M I	.496*	.509*	-.202*	.063	.161	.130
W H R	.481*	.460*	-.195*	-.002	.361*	.160
FAT%	.240*	.285*	.039	-.212*	.102	-.112
WHtR	.563*	.539*	-.224*	.059	.204*	.159

*Significant at.05 level; r_{05} (118) =.195

Table 2 revealed that the Body mass index (BMI) was significantly related to SBP, DBP and HDL, whereas insignificant relationship was obtained between other risk factors. Waist hip ratio (WHR) was not significantly related to LDL and TC, whereas significant relationship was obtained between other risk factors. Fat% was insignificantly related to HDL, TRIG and TC, whereas significant relationship was obtained between other risk factors. Waist to height ratio (WHtR) was not significantly related to LDL and TC, whereas significant relationship was obtained between other risk factors. Therefore these significant fatness variables appear to be more contributing to CVD risk factors.

Table 3 revealed the various regression models, predictor with value of R and percent variance (R^2) accounted by regression for CVD risk factors on the basis of selected fatness variables. Only one model was extracted for SBP and HDL respectively, which included only Waist circumference (WC) accounted for 36.5% variance (Adjusted R^2=0.365) and 6.4% variance (Adjusted R^2=0.064) respectively and both these models were also significant as the p-value was less than.05.

Further, one model was extracted for FBS, which included only Waist to Height Ratio (WHtR) accounted for 8.2% of the variance (Adjusted R^2=0.082) and this model was also significant as the p-value was less than.05. Additional, one model was extracted for TRIG, which included only cardio-respiratory waist hip ratio (WHR) accounted for 12.3% of the variance (Adjusted R^2=0.123) and this model was also significant as the p-value was less than.05.

Likewise, two models were extracted for DBP, we can see that model 1, which included only Waist Circumference (WC) accounted for 37.3% of the variance (Adjusted R^2=0.373). The inclusion of Body Weight (WT) into model 2 resulted in an additional 2.7% of the variance being explained (R^2change = 0.027) and this model accounted for 39.5% of the variance (Adjusted R2=0.395)

Table 3: Multiple Linear Regression Analysis between Fatness Variables and Selected Cardiovascular Disease Risk Factors (CVD)

CVD Risk Factors	Predictor	R	R^2	Adjusted R^2	Std. Error of The Estimate	F-Ratio	p-value
SBP	W C	.608	.370	.365	6.62	69.255	.000*
DBP	W C	.615	.378	.373	5.30	71.800	.000*
	WC, WT	.637	.406	.395	5.21	39.914	.000*
HDL	W C	.268	.072	.064	7.60	9.148	.003*
LDL	FAT %	.212	.045	.037	31.79	5.568	.020*
	FAT %, H C	.311	.097	.081	31.04	6.270	.003*
TRIG	WHR	.361	.130	.123	55.64	17.703	.000*
TC	WC	.198	.039	.031	30.50	4.830	030*
	WC, FAT%	.285	.081	.065	29.95	5.160	.007*

Waist Circumference (WC), Body Weight (WT), Hip Circumference (HC), Waist Hip Ratio (WHR), Fat Percentage (FAT %), *p <.05

and both these models were also significant as the p-value was less than.05. Moreover, two models were also extracted for LDL, we can see that model 1, which included only Fat Percentage (FAT %) accounted for 3.7% of the variance (Adjusted R2=0.037). The inclusion of Hip Circumference (HC) into model 2 resulted in an additional 5.2% of the variance being explained (R^2 change = 0.052) and this model accounted for 8.1% of the variance (Adjusted R2=0.081) and both these models were also significant as the p-value was less than.05.

Also, two models were also extracted for TC, we can see that model 1, which included only Waist Circumference (WC) accounted for 3.1% of the variance (Adjusted R2=0.031). The inclusion of Fat Percentage (FAT %) into model 2 resulted in an additional 4.2% of the variance being explained (R^2 change = 0.042) and this model accounted for 6.5% of the variance (Adjusted R2=0.065) and both these models were also significant as the p-value was less than.05.

DISCUSSION AND CONCLUSIONS

Considering the rising amount of individuals who are experiencing CVD throughout their life [15], it's crucial to implement healthy lifestyle practices at an early age. In middle-age, obesity and physical inactivity is associated with diabetes risk, increased blood pressure, dyslipidemia and insulin resistance. The present study was undertaken to investigate the role of body fatness in predicting the CVD risk factors among healthy man. The results of the study revealed that, all the selected fatness variables were significantly related to most of the CVD risk factors. In line, Waist Hip Ratio and Body Mass Index were significantly related to SBP and DBP, which agrees with results from previous studies done by Badaruddoza and B. Barna [16], Sanya *et al*. [17], Jia *et al*. [18], Martins *et al*. [19] and Thomas *et al*. [20]. The results of these studies indicated that WHR and BMI would be the good predictors for the chronic disease like hypertension.

Krauss *et. al*. [21] mentioned in their study that weight gain during young adult life may be one of the most important determinants of cardiovascular risk factors and increased intra-abdominal fat, or waist circumference, is probably related to a constellation of risk factors. They also pointed out that obesity had a strong effect on lipoprotein metabolism, regardless of ethnic group. Increased weight is a determinant of higher levels of triglycerides, elevated LDL-C and low HDL-C. Similarly, Thomas *et al.* [20] also found in their study that fatness was the only independent predictor of SBP, DBP and TG. They have identified strong, independent relationship between fatness and BP in young people and suggested that fatness could play a part in the etiology of primary hypertension.

Likewise, waist hip ratio and waist to height ratio were also significantly related to SBP, DBP, HDL-C and TG. These findings are also in partial agreement with findings of Chehrei *et al*. [22] and Liu *et al*. [23]. They investigated the relationships between some anthropometric indices (BMI, WC and W/Ht) and dyslipidemia and their results exhibited that there is correlation between these indices and dyslipidemia. Among the anthropometric indices, just waist circumference had a correlation with HDL-C level. Finally they concluded that waist to height ratio (W/Ht) and waist circumference (WC) could be used as simple and non-invasive methods for detection of dyslipidemia as an important cardiovascular risk factor. Therefore, as we concentrate on body fatness variables (BMI, WHR, WHTR and FAT%) of the individual, reduction in the risk of CVD in healthy men will be achievable.

Furthermore, the results of the present study showed that FAT % was significantly related to systolic & diastolic blood pressure and LDL-cholesterol, which agrees with study done by Fukui [24] which suggested that measurement of percent body fat is useful in preventing adult diseases and those who are considered to be obese according to their BMI or percentage of body fat have a high risk of adult diseases. This indicated that fatness variables namely BMI, WHR, WHTR and FAT % can be used as a screening test for predicting the cardiovascular disease risk.

Multiple linear regression analysis employed on selected fatness variables and CVD risk factors revealed distinctively different combinations of variables among various models. The findings of multiple linear regression analysis indicated that WC and FAT% play a dominant role in determining CVD risk factors, as these variables were associated with most of the CVD risk factors that's why a significant contribution has been made by these variables towards determining CVD risk factors. These findings are partial consonant of the studies done by Thomas *et al*. [20] which suggested fatness is independently related to CHD risk factors and Christou *et al*. [25] who also submitted that elevated body fatness is associated with an adverse CVD risk factor profile independently of aerobic fitness. Hence, the results from this study may be a good indicator that the sedentary lifestyle of individuals might have contributed to their CVD risk factors. Early identification, can lead to

successful prevention and treatment of obesity in childhood and thus reduce the adult incidence of CVD [26]. Moreover, the risks of cardiovascular disease, hypertension and myocardial infarction occur together and are all linked with obesity. Therefore, controlling waist circumference during childhood and adolescence will help in preventing and reducing the risk of CVD risk in the future.

From regression analysis results, it might be concluded that as we concentrate on managing the waist circumference and fat %, reduction in the risk of CVD in healthy man will be attainable. Sports scientist and physical educationist must designed the programs in such a manner that give more emphasis on to manage the fatness variables through lifestyle modification, diet and involvement in physical activity, which play an important role in reducing the incidence of CVD risk in these populations.

Longitudinal studies are necessary to elucidate more clearly the relation of body fatness with future CVD risk factors that would be useful in formulating policies to improve CVD risk factors among the youth. Adolescents should make extra effort to remain trim throughout their lives. Since there is clear evidence that selected CVD risk factors are associated with the body fatness [27]. Hopefully, with early intervention and successful prevention in childhood and adolescence can reduce the occurrence of CVD during adulthood.

Several limitations of the present study warrant further discussion. Self-selection bias is a concern because participants volunteered for the study. Future investigations aimed at confirmation of finding from the present study should incorporate random sampling. A single sample of blood pressure and blood lipids/glucose was obtained for each participant due to time and resource considerations. Duplicate measures of these parameters would have strengthened our findings.

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