RELATIONSHIP OF ANTHROPOMETRIC VARIABLES WITH FASTING BLOOD SUGAR IN MODERATE AND SEDENTARY WORKERS

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ABSTRACT: Background: Failure to engage in physical activity constitutes the fourth most important risk factor leading to death in the entire world. Modernization has resulted in increased rates of diabetes, primarily because of a decrease in physical activity, and increasing prevalence of obesity. There is a close association between obesity and type 2 diabetes. The likelihood and severity of type 2 diabetes is closely linked with body mass index. Insulin resistance, which is the basis of type 2 diabetes mellitus, is associated with both visceral and subcutaneous fat content. **Objective of the Study:** To assess relationship of anthropometric variables with fasting blood glucose in moderate and sedentary workers in Jammu region. **Materials and Methods:** A total of 300 subjects, 150 each from Group-1 (moderate workers) and Group-2 (sedentary workers) consisting of 75 males and 75 females were selected for this study. Record of body weight, height, waist circumference and hip circumference was made as per WHO standards. The body mass index and waist hip ratio were calculated. Abdominal obesity was assessed by measuring waist hip ratio. Fasting blood glucose estimation was done by fully enzymatic glucose oxidase-peroxidase method. Mean and standard deviation were calculated and reported for quantitative variables. The statistical difference in mean value was tested using unpaired 't' test. Linear regression was used for unilateral comparison. A p-value of <0.05 was considered as statistically significant. All p-values reported are two-tailed. **Results:** The mean values of age, weight, body mass index, waist circumference, hip circumference, waist-hip ratio (males only), waist-height ratio and abdominal volume index in Group 1 (moderate workers) subjects were significantly less as compared to those of Group 2 (sedentary workers). Relationship of waist circumference with fasting blood sugar in Group 2 was found to be significant, while anthropometric parameters showed no significant relationship with fasting blood sugar. **Conclusion:** Anthropometric variables such as weight, waist circumference, hip circumference, waist-hip ratio, waist-height ratio and abdominal volume index are significantly affected in sedentary workers, showing that sedentary work profile affects the general body mass index and leads to both central and generalized obesity.

Key words: Anthropometric variables, Fasting blood sugar, Moderate workers, Sedentary workers.

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INTRODUCTION

Physical inactivity is a common problem and is becoming increasingly widespread.[1] In its 2010 report on the status of noncommunicable diseases, the World Health Organization estimated that 3.2 million people die each year due to failure to engage in physical activity, which constitutes the fourth most important risk factor leading to death in the entire world (6% of all deaths), surpassed only by tobacco use (9%) and hypertension (13%).[2]

Sedentary behavior is conventionally defined as activities that do not increase energy expenditure above the resting level of 1.0-1.5 METs (metabolic equivalents) or as reclining postures, which includes activities such as sitting, lying down, watching television, writing and reading.[3] Modernization has resulted in increased rates of diabetes, primarily because of a decrease in physical activity, an increasing prevalence of obesity, and an increasing consumption of high calorie diets.[4]

Obesity, as most commonly defined according to body mass index, substantially increases the risk of type-2 diabetes, hypertension,[5] cardiovascular disease[6] and all-cause mortality.[7] The central deposition of excess weight has been proven to be a stronger predictor of risk of morbidity and mortality in comparison with overall obesity, as defined by

BMI alone.[8] There are various terms of obesity such as abdominal obesity, abdominal adiposity, body fat percentage, and predictors for obesity. Body mass index is the most commonly used parameter to measure abdominal obesity for determining whether someone may be defined as obese, overweight, or normal weight.[9]

World Health Organization guidelines state that alternative measures that reflect abdominal obesity such as waist circumference (WC), waist-hip ratio (WHR), and waist-to-height ratio (WHtR) have been found to be superior to BMI.[10]

Waist circumference and waist-to-hip ratio have been used as proxies for central obesity. Waist-to-height ratio is a proxy for central (visceral) adipose tissue, which has received attention as a marker of 'early health risk'.[11]

Anthropometric measures of obesity contribute to the increased risk of atherogenic events. Distribution of fat during early adulthood is associated with increased metabolic disease risk in later adulthood.[12] Atherogenic index of plasma (AIP), a new marker of atherogenicity, has been shown to significantly increase with atherogenic risk.[13] Sedentary lifestyle and physical inactivity, either individually or in combination, are known precursors of atherogenic risks.[14]

Abdominal volume index is a reliable and easy-to-calculate anthropometric tool for estimation of overall abdominal volume, that is shown to be strongly related to impaired glucose tolerance and diabetes mellitus.[15]

There is a close association between obesity and type 2 diabetes. The likelihood and severity of type 2 diabetes are closely linked with body mass index (BMI).[16] Insulin resistance, which is the basis of type 2 diabetes mellitus, is associated with both visceral and subcutaneous fat content.[17]

The present study was carried out to assess relationship of anthropometric variables with fasting blood glucose in moderate and sedentary workers in Jammu region, so that lifestyle modifications like increase in physical activity, weight loss and low caloric intake can be adopted to prevent obesity, risk of diabetes mellitus and cardiovascular diseases.

MATERIALS AND METHODS

The present one year cross-sectional study was carried out in the Postgraduate Department of Physiology, Government Medical College, Jammu. The subjects included administrative and paramedical staff of Government Medical College, Jammu. Subjects willing to participate were allocated into two groups: Group 1 comprised of healthy moderate workers and Group 2 comprised of healthy sedentary workers.

After detailing the purpose and methodology of the study, all subjects found eligible were requested to participate in the study after obtaining approval from the Institutional Ethical Committee. Consent of the subjects was obtained before including them in the study. Eligibility criteria included moderate workers and sedentary workers in the age group of 20 to 60 years. All those subjects with history of diabetes mellitus, hypertension, any other illness known to effect fasting blood glucose and pregnant women were excluded from the study. A total of 300 subjects, 150 each from both the groups consisting of 75 males and 75 females were selected for this study.

Record of body weight, height, waist circumference and hip circumference was made as per WHO standards. The body mass index and waist hip ratio were calculated. The BMI interpretation used was: BMI < 25 kg/m^2 (normal), 25-30 kg.m^2 (overweight and > 30 kg/m^2 (obese).[18] Abdominal obesity was assessed by measuring waist hip ratio. WHR interpretation used was: > 0.9 for men and > 0.85 for women.

For biochemical parameters, subjects were asked to fast for 14 hours before the day of test. This was to avoid the influence of diet on blood sugar. 5 ml of venous blood was drawn from anticubital vein under all aseptic precautions for the estimation of biochemical parameters. The sample from disposable syringe was transferred immediately to plain vacutainers [which were pre-marked and kept in a rack] and allowed to clot at room temperature for more than 30 minutes. These samples were centrifuged in Remilab centrifuge at 3000 rpm for 15 minutes. Serums were separated and transferred to other dry test tubes, which were then capped with cotton plugs and taken to the Department of Biochemistry for analysis. Fasting blood glucose estimation was done by fully enzymatic glucose oxidase-peroxidase method (GOD-POD).

The blood glucose values were assessed as documented in Harrison's Principles of Internal Medicine, which classifies blood glucose values of 75-110 mg/dLas normal, values of 111- 125 mg/dL as impaired glucose tolerance and values > 125 mg/dL as diabetes mellitus.

The data was analyzed using computer software Microsoft Excel and IBM SPSS version 22.0 for Windows. Mean and standard deviation (SD) were calculated and reported for quantitative variables. The statistical difference in mean value was tested using unpaired 't' test. Linear regression was used for unilateral comparison. A p-value of <0.05 was considered as statistically significant. All p-values reported are two-tailed.

RESULTS

The mean age of Group-1 subjects (39.49 years) was less as compared to that of Group-2 subjects (43.33 years), the difference between the two groups being statistically significant (p=0.001) (Table 1). In Group-1, there were more subjects in their third decade of life, while in Group-2 more subjects were in their fourth decade of life. History of smoking and alcohol consumption was found to be negligible in both the groups. The mean weight of Group-1 subjects (63.35 kg) was less as compared to that of Group-2 subjects (71.98 kg), the difference being statistically significant (p < 0.0001). The mean height in Group-1 subjects (1.62 m) was found to be comparable with that of Group-2 subjects (1.61 m). The mean BMI of Group-1 subjects (24.35 kg/m^2) was less than that of Group-2 subjects (27.78 kg/m^2), the difference being statistically significant (p < 0.0001) (Table 1).

Table 1: Comparison of mean age, weight, height and body mass index of Group-1 and Group-2 subjects.

Parameter	Group-1 (n=150) Mean ± SD (Range	Group-2 (n=150) Mean ± SD (Range	p-value (Unpaired 't' test)
Age (in years)	39.49 ± 11.07 (20-60)	43.33 ± 9.51 (20-60)	t=3.22; p=0.001*
Weight (in kg)	63.35 ± 9.71 (40-86)	71.98 ± 10.13 (45-107.5)	t=7.53; p<0.0001*
Height (in m)	1.62 ± 0.09 (1.44-1.88)	1.61 ± 0.09 (1.42-1.86)	t=0.96; p=0.336**
BMI (in kg/m^2)	24.35 ± 3.91 (15.85-35.5)	27.78 ± 4.10 (17.9-40.91)	t=7.41; p<0.0001*

*Significant; **Not significant

The mean waist circumference of Group-1 subjects (75.96 cm) was less than that of Group-2 subjects (90.2 cm), the difference being statistically significant (p < 0.0001) (Table 2). In Group-1, no male subject had waist circumference ≥102 cm and no female subject had waist circumference ≥88 cm. However, in Group-2, 50 female subjects had waist circumference ≥ 88 cm. These respective ranges are associated with health problems such as type-2 diabetes mellitus, heart disease and high blood pressure. The mean hip circumference of Group-1 subjects (81.47 cm) was less than that of Group-2 subjects (94.88 cm), the difference being statistically significant (p < 0.0001) (Table 2).

Table 2: Comparison of mean waist circumference, hip circumference, waist-hip ratio, waist-height ratio and abdominal volume index of Group-1 and Group-2 subjects.

Parameter		Group-1 (n=150) Mean ± SD (Range	Group-2 (n=150) Mean ± SD (Range	p-value (Unpaired 't' test)
WC (in cm)		75.96 ± 5.90 (60-85)	90.2 ± 5.97 (61-109)	t=20.77; p<0.0001*
HC (in cm)		81.47 ± 7.06 (64-100)	94.88 ± 6.77 (63-120)	t=16.79; p<0.0001*
WHR	Males	0.93 ± 0.03 (0.82-1.03)	0.95 ± 0.02 (0.89-1.11)	t=4.80; p<0.0001*
	Females	0.92 ± 0.03 (0.8-0.98)	0.93 ± 0.04 (0.85-1.06)	t=1.73; p=0.085**
WHtR		0.46 ± 0.05 (0.34-0.64)	0.56 ± 0.11 (0.38-1.75)	t=0.13; p<0.0001*
AVI		11.62 ± 1.75 (7.21-14.45)	16.44 ± 1.91 (14.12-23.78)	t=22.78; p<0.0001*

*Significant; **Not significant

In Group-1, abdominal obesity (WHR > 0.9) was present in 61 (81.33%) male subjects, while in Group-2, abdominal obesity was present in 74 (98.67%) male subjects. The mean WHR of Group-1 male subjects (0.93) was less than that of Group-2 male subjects (0.95), the difference being statistically significant (p < 0.0001). In Group-1, abdominal obesity (WHR > 0.85) was present in 70 (93.33%) female subjects, while in Group-2, abdominal obesity was present in 72 (96%) female subjects. The mean WHR of Group-1 female subjects (0.92) was comparable with that of Group-2 female subjects (0.93). The mean WHtR (0.46) of Group-1 subjects was less than that of Group-2 subjects (0.56), the difference being statistically significant (p < 0.0001). The mean AVI (11.62) of Group-1 subjects was less than that of Group-2 subjects (16.44), the difference again being statistically significant (p < 0.0001) (Table 2). Distribution of subjects in two groups according to fasting blood sugar is given in Table 3. The mean values of fasting blood sugar in both the groups were comparable.

Table 3: Distribution of subjects according to fasting blood sugar.

Fasting blood glucose (mg%)	Group-1 (n=150)		Group-2 (n=150)	
	No.	%age	No.	%age
<75	20	13.34	19	12.67
75 – 110	110	73.33	113	75.33
111 – 125	5	3.33	6	4.00
>125	15	10.00	12	8.00
Total	150	100.00	150	100.00
Mean FBG ± Standard deviation (Range)	103.06 ± 51.86 (56-327)		97.10 ± 33.58 (61-310)	
p-value (Unpaired 't' test)	t=1.18; p=0.238 (Not significant)			

Using linear regression for unilateral comparison, the present study observed that in Group-1 (moderate workers) relationship of body mass index, waist circumference, waist-hip ratio, waist-height ratio and abdominal volume index, with fasting blood sugar, was not significant. However, in Group-2 (sedentary workers) relationship of waist circumference with fasting blood sugar was observed to be significant (p = 0.007), while with other parameters it was not significant.

DISCUSSION

There is evidence that higher levels of sedentary time are associated with several adverse functional and clinical health outcomes in the general adult population. These include the presence of risk factors for chronic disease such as large waist circumferences, unhealthy levels of blood glucose, insulin and blood fat, lower measures of physical functioning, and increased risk for mortality from all-causes, cardiovascular disease and some cancers. WHO guidelines state that measures that reflect abdominal obesity such as WC, WHR and WHtR have been found to be superior to BMI. A study among Chinese population demonstrated that while BMI and WC were found to be the important indices for obesity, WC was found to be the best measurement of obesity, whereas WHR could be used as an alternative indicator for obesity. WC was also found to be a simple and more accurate predictor for type-2 diabetes mellitus than other indices such as BMI and WHR.[9]

In the present study, subjects from 20 to 60 years age were selected in both the groups. The mean age of Group-1 (moderate workers) subjects (39.49 years) was less as compared to that of Group-2 (sedentary workers) subjects (43.33 years), the difference between the two groups being statistically significant (p = 0.001). There were more subjects in the age group of 31 to 40 years in Group-1, while there were more subjects in the age group of 41 to 50 years in Group-2. Similar results were given by Jayalakshmi MK et al., who conducted a study in 105 healthy female subjects and found that anthropometric and cardiovascular parameters were increased in sedentary subjects and there was statistically significant increase after the age of 35 years.[20]

In the present study, mean weight of moderate workers (63.35 kg) was less as compared to that of sedentary workers (71.98 kg), the difference being statistically significant (p <0.0001). This is in agreement with that of Ahluwalia N, who found that people from the middle and higher income groups were prone to develop obesity and its related complications due to a sedentary life style.[21]

In the present study, mean BMI of moderate workers (24.35 kg/m^2) was less than that of sedentary workers (27.78 kg/m^2), the difference being statistically significant (p < 0.0001). This is in agreement with the study conducted by Jayalakshmi et al., who found that BMI was increased in sedentary subjects when compared to non-sedentary subjects and it was statistically significant.[20]

In the present study, mean waist circumference and mean hip circumference of sedentary workers was significantly higher than that of moderate workers and the difference was statistically significant. The present study result is in agreement with that of Ahmad N et al., who found that the prevalence of abdominal obesity using WC was higher than using WHR. The WC shows strong and positive correlation with BMI as compared to WHR. Using both Caucasian and Asian cutoff points, the prevalence of abdominal obesity using WC was found to be higher than with using WHR,because the WHR cutoffs detected more underweight and normal respondents as being abdominally obese.[9]

In the present study, mean WHtR of moderate workers (0.46) was less than that of sedentary workers (0.56), the difference being statistically significant (p < 0.0001). The present study is also in agreement with that of Li WC et al., who concluded that WHtR is a simple and effective index of cardiometabolic risk among Taiwanese men and women, which may be superior to BMI and WC. A WHtR > 0.5 was shown to clearly identify men and women at an elevated risk of diabetes, hypertension, metabolic syndrome and dyslipidemia.[22]

In the present study, mean AVI of moderate workers was less than that of sedentary workers, the mean difference between the two being statistically significant (p < 0.0001). This result is in agreement with Patil VC et al., who found that high WHtR was present in 699 males and 103 females. Age ≥ 45 years, high SBP, high DBP, low HDL, high triglyceride and diabetes mellitus were positively correlated with high BMI, high WC, high WHR, high WHtR and high AVI.[23]

In the present study, mean fasting blood glucose of moderate workers was comparable with that of sedentary workers, the difference not statistically significant (p= 0.238). Obesity plays a major role in development of type-2 diabetes mellitus. The reason for comparable result for fasting blood glucose in our study could be due to selection of a small sample size. Secondly, only the paramedical staff was enrolled as a representative of whole sample. In addition, we did not consider lifestyle, dietary habits and socioeconomic status of the subjects.

There were certain limitations in the study. First, the cross-sectional design of the study did not allow any inference to be drawn with respect to the causal relationship among variables. Secondly, the study sample was a select group of healthy paramedical professionals and the findings may not be generalized to the whole population.

CONCLUSION

The present study was conducted to assess the relationship of anthropometric variables with lipid profile and fasting blood sugar in moderate and sedentary workers. The findings of the present study indicate that anthropometric variables such as weight, waist circumference, hip circumference, waist-hip ratio, waist-height ratio and abdominal volume index are significantly affected in sedentary workers showing that sedentary work profile affects the general BMI and leads to both central obesity and generalized obesity. However the difference in fasting blood sugar amongst sedentary and moderate workers was not statistically significant, maybe due to the sample group selected. Further studies with a more diverse sample group may help in reaching a definite conclusion.

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