Original Research Article

Study of effects of total and visceral fat on cardiovascular sympathetic functions

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Abstract

Background : Obesity is characterized by an excessive deposition and storage of fat in the body, which alters the cardiovascular autonomic functions. Autonomic nervous system through its Sympathetic and Parasympathetic division regulates and modulates most of the visceral functions of the body. **Methods :**This was a cross sectional study with the primary data that includes 200 healthy volunteer male subjects between 20 to 35 years of age, in and around Shivpuri. For all the subjects anthropometric data was collected by Karada scan and cardiovascular sympathetic functions were assessed by sphygmomanometry and electrocardiogram. **Observation and results:** Descriptive statistics was done by using SPSS software version 16 for windows with descriptive analysis done by ANOVA analysis test which suggested increase in sympathetic and decrease in parasympathetic activity as visceral fat% increases. **Conclusion:** Study concludes that with increase in visceral fat% cardiovascular morbidity and mortality increases as compared to increase in total body fat %.

Keywords: Cardiovascular, Sympathetic Function, Total Body Fat %, Visceral Fat %

Introduction

Obesity is an important and independent risk factor for cardiovascular morbidity and mortality and is increasing at an alarming rate in underdeveloped countries.Obesity is characterized by an excessive deposition and storage of fat in the body[1]. Adipose tissue is now recognized as a highly active metabolic and endocrine organ. Its functions are regulated by multiple external influences, such as autonomic nervous system activity, the rate of blood flow and delivery of a complex mix of substrates and hormones in plasma[1].

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Body fat is distributed in total body fat and visceral fat but the visceral fat is considered to be more dangerous than total body fat because the visceral fat has been shown to secrete certain cytokines (interleukins-6, tumour necrosis factor- alfa) and chemicals (leptin, angiotensinogen and non-esterified fatty acids) that are involved in atherogenesis and development of hypertension and alterations in the autonomic balance[2]. The balance between the sympathetic and Parasympathetic activities is required to maintain the anabolic state of the different vital organs for example-cardiovascular and pulmonary system etc[1].

Autonomic nervous system (ANS) plays key role in maintaining homeostasis.

It directs involuntary physiological processes like digestion, Blood Pressure (BP), Hormonal regulation, energy metabolism and regulation of cardiovascular system. It is considered an important regulator of internal environment of body[4].

ANS plays an important role in regulating energy expenditure and body fat content. ANS through its sympathetic and Parasympathetic division regulates and modulates most of visceral functions through a number of visceral reflexes.

Material and methods

This cross-sectional study was conducted over a period of one year in department of Physiology, at Govt Medical College Shivpuri (MP).

Inclusion criteria – 200 young healthy adult male volunteers, between 20 to 35 years of age, in and around Shivpuri district (not having any major illness or chronic addiction) were selected for the study.

Exclusion criteria – Female subjects, children and male subjects more than 35 years of age, having major illnesses and addictions were excluded.

The tests were performed at the same time of the day in all the subjects and at a comfortable environment. Anthropometric data like body weight (kg), Body Mass Index (BMI), Body age (yrs), total body fat(%), visceral fat (%) was obtained from all the subjects with the help of Karada scan (Omeron HBF 375 IN) after taking the written informed consent.

Fig 1: Collecting anthropometric parameters by Karada Scan

Cardiovascular sympathetic functions were assessed in all the subjects by recording the Resting Heart Rate (RHR), Resting Systolic Blood Pressure (RSBP), Resting Diastolic Blood Pressure (RDBP), Orthostatic Systolic Blood Pressure (Orthostatic-SBP) with help of Stethoscope,Sphygmomanometer,Electro-cardiogram in lead II.

Statistics

Statistical analysis was done using SPSS software version 16 for windows. The descriptive analysis was done by ANOVA analysis test.

Results

Table 1: Subject distribution depending on total body fat (%)

Total Body Fat %	No. of Subjects	Groups
< 20	58	Normal
20 - 25	46	Overweight
>25	96	Obese

All the subjects were categorized as Normal, overweight and obese depending on their total body fat (%) as < 20, 20 to 25 and >25 respectively [Table 1]

Table 2: Subject distribution depending of visceral fat (%)

Visceral Fat %	No. of Subjects	Groups
<10	100	Normal
10- 15	86	Overweight
>15	14	Obese

Similarly all the subjects were categorized as Normal, overweight and obese depending on their visceral fat (%) as < 10, 10 to 15 and >15 respectively [Table 2]

Table 3: Descriptive statistical analysis of cardiovascular sympathetic parameters in respect to total body fat (%)

Sympathetic parameters	Total Body Fat %	No. of Subjects	Mean Value	P-Value
RHR	<20	58	79.758	0.00 Highly significant
	20- 25	46	81.695	
	>25	96	89.416	
RSBP	<20	58	114.97	0.019 Significant
	20- 25	46	117.91	
	>25	96	121.83	
RDBP	<20	58	75.103	0.022 Significant
	20- 25	46	78.782	
	>25	96	79.708	
ORTHOSTATIC SBP	<20	58	108.34	0.022 Significant
	20- 25	46	110.61	
	>25	96	114.92	

Descriptive statistical analysis of Cardiovascular sympathetic parameters in respect to total body fat (%) were found to be highly significant for RHR, significant for RSBP, RDBP and Orthostatic SBP[Table 3]

Table 4: Descriptive Statistics Analysis of Cardiovascular sympathetic parameters in respect to Visceral Fat (%)

Sympathetic parameters	Visceral Fat %	No. Of Subjects	Mean Value	P-Value
RHR	<10	100	80.9600	0.00 Highly significant
	10- 15	86	87.9535	
	>15	14	93.4286	
RSBP	<10	100	1006.48	0.01 Highly significant
	10- 15	86	119.72	
	>15	14	131.71	
RDBP	<10	100	77.3200	0.02 Significant
	10- 15	86	77.6744	
	>15	14	87.1429	
ORTHOSTATICS BP	<10	100	109.68	0.01 Highly significant
	10- 15	86	112.65	
	>15	14	124.86	

Descriptive statistical analysis of cardiovascular sympathetic parameters in respect to visceral fat (%) were found to be highly significant for RHR, RSBP, Orthostatic and significant for RDBP [Table 4]

Discussion

In the present study subjects were categorized into normal, overweight and obese depending on their total body fat % and visceral fat % as shown in table 1 and 2.In this study the considering % Total Body Fat mean value of RHR in obese subjects (89.4) is higher as compare to overweight (81.6) and in normal person (79.7) and this difference is highly significant (p 0.000) (Table-3).

Our findings are similar with the Rajalakshmi R et al [3], Kanavi et al[5], Urs Scherrer et al [6], Stefanie Hillebrand et al [10],Camila Oliveira et al [11], Vishrutha K V et al[12], Renata Claudino Rossia et al [13]. In our study the considering % Visceral Fat mean value of RHR in obese subjects (93.4) is higher as compare to overweight (87.9) and in normal person (80.9) and this difference is highly significant(p 0.000) (Table 4).Our findings are similar with the Rajalakshmi R et al [3], Kanavi et al[5], Urs Scherrer et al [6], Neeru Garge et al [14], Ram Lochan Yadav et al [15], Mohamed F Lutfi et al[16]. We observed significantly higher RHR in obese group than overweight and normal group indicating sympathetic over-activity and low parasympathetic activity. By considering Total Body Fay % the mean value of RSBP in obese subjects (121.8) is higher as compare to overweight (117.9) and in normal person(114.9) statistically this difference is highly significant (p 0.019) but with RDBP in obese subjects (79.7)) is higher as compare to overweight (78.7) and in normal person (75.1) this difference is highly significant (p 0.002). The findings of present study are similar with the other studies[7,2,5,10,11]. By considering Visceral Fat % the mean value of RSBP in obese subjects (131.7) is higher as compare to overweight (119.7) and in normal person(116.4) statistically this difference is highly significant (p 0.019) but with RSBP in obese subjects (87.1) is higher as compare to overweight (77.6) and in normal person(77.32) this difference is highly significant(p 0.002). The findings of present study are similar with the other studies (Shahin Akhter et al[7], Talay Yar[2], Kanavi et al[5]. We observed significantly higher resting systolic and diastolic blood pressure in obese group than overweight and normal group indicating sympathetic over-activity and low parasympathetic activity. By considering total body fat % the mean value of orthostatic SBP in obese subjects (114.9) was higher as compare to overweight (110.6) and in normal person(108.3) this difference is highly significant(p-0.022)(Table-3).

Our results are inaccordance with Simran Grewal et al[8], Shahin Akhter et al [7], Renata Claudino Rossia et. al[13],Paul Poirier et al[17]. By considering visceral Fat % the mean value of orthostatic SBP in obese subjects (124.8) as compare to overweight (112.6) and in normal person (109.68) this difference is highly significant(p-0.022) (Table-4), Our results are in accordance with Simran Grewal et al [8], Shahin Akhter et al [7].We observed significantly higher orthostatic SBP in obese group than overweight and normal group indicating sympathetic over-activity and low parasympathetic activity.

Conclusion

The study concludes that high visceral fat % is giving significantly high value for most of the sympathetic tests, which suggested increased sympathetic activity as the deposition of visceral fat increases in the body as compare to total body fat. Thus there is overriding of sympathetic activity on the parasympathetic activity which predispose highly for the cardiovascular morbidity and mortality.

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