CORRELATION OF RESTING HEART RATE WITH GENERAL AND VISCERAL OBESITY INDICES IN YOUNG MALE ADULT OF WESTERN RAJASTHAN

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Abstract: Background: Abdominal adiposity is suggested to be more closely associated with CVD risk and has been highlighted as a growing problem particularly in countries of Asia-Pacific region where individuals may exhibit a relatively normal BMI (<25 kg/m2) but have a disproportionately large waist circumference. Our objective is to compare body mass index(BMI), waist circumference (WC), waist hip ratio (WHR), waist stature ratio(WSR) and Body Fat% (BF%) as indices of obesity and assess the respective association with Resting Heart Rate (RHR). **Method:** A cross sectional descriptive study was made on 200 individual. Anthropometric measure was obtained and indices of general obesity BMI and indices of visceral obesity WC, WHR, WSR, BF %, Fat Free Mass (FFM) were calculated. RHR in standing and supine position were obtained by ECG. Pearson's correlation (r) between obesity indices and resting heart rate in normal weight and obese were calculated. **Result:** Multiple regression method was applied to find the effect of BMI, WC, WHR, WSR and FFM on RHR. Result shows that in obese group only WC is significant contributor for RHR (supine and standing), while FFM also significantly contribute for RHR (supine) **Conclusion:** It is worthwhile to mention that the stronger correlation of WC, compared to that with BMI has led to the suggestion that WC should be used as an index of abdominal obesity and may be more sensitive in the assessment of disease risk than BMI alone in the population of Western Rajasthan adult males.

Key Words: Body Fat Percentage, Body Mass Index, Resting Heart Rate, Waist Circumference, Waist Hip ratio, Waist Stature ratio.

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Introduction:

The worldwide prevalence of overweight and obesity has been increasing at an alarming rate, indiscriminately affecting populations of both higher and lower middle income countries [1]. Obesity has reached epidemic proportion in India in 21st Century, with morbid obesity affecting 5% of the country's population. Obesity is associated with an increased risk of morbidity and mortality as well as reduced life expectancy. Excess adiposity has been shown to be an independent risk factor for cardiovascular diseases (CVD) like Type II diabetes, dyslipidemia and hypertension.

Several studies [2] in literature suggest that autonomic nervous system (ANS) of obese (OB) individuals is chronically altered. Since ANS is involved in energy metabolism and regulation of cardiovascular system, It is conceivable that one or more sub groups of obesity have an alteration in their autonomic nervous system that may promote obesity and account for several clinical consequences of obesity [3]. Several major prospective studies [4-5] have found high heart rates in men at rest to be predictive of the future manifestation of cardiovascular disease (CVD). The association between tachycardia and cardiovascular disease may be explained by the fact that tachycardia is associated with obesity, sympathetic activation, and hypertension. Obese people tend to have increased RHR as autonomic responsiveness has been shown to be diminished in these individuals [6]. In adults, the use of resting heart rate (RHR) as screening index for cardiovascular risk has been postulated and supported by studies that reported its relationship to mortality [7].

The autonomic dysfunction associated with obesity could lead to changes in RHR and arterial blood pressure. Though the RHR is influenced by several constitutional and environmental factors, the most important determinants are parasympathetic and sympathetic influences [8]. Quantifying RHR can give an index of the load imposed on the heart and the state of imbalance between sympathetic and parasympathetic activity. Recently, *Fernandes et al* [9], Identified that a higher RHR was associated with elevated blood pressure, in obese male children and adolescents, independent of age and

ethnicity; however, it is not clear if RHR can also be applied as a screening for other risk factors, such as general and abdominal obesity. Since there is dearth of literature for comprehensive studies which focus on the association between obesity, body composition and RHR among young adults in Western Rajasthan of India, the present study was aimed to investigate the effect of body composition and adiposity on RHR in Adult Males and finding correlation of RHR with indices of general obesity namely body mass index (BMI) and abdominal obesity viz. waist circumference, waist-hip ratio and waist stature ratio (WC, WHR and WSR respectively).

Material and Method:

The current study is of a cross sectional design to determine the relationship between resting heart rate in general and visceral obesity. Study was carried out in Physiology Department of Dr. S.N. Medical College, Jodhpur. About two hundred individuals were included in the study, which were divided into 2 groups. Control Subject (N=104) who were having body mass index between 18.5-24.99 .Obese individual (N=96) who were having body mass index >25. All the subject of study was males between the age group of 21-40 years. We had selected the subject randomly fulfilling the above criteria & they voluntarily participated in the study. A prior informed consent was also obtained from each subject for participation in the study and was briefed about the procedure to achieve full cooperation. Detailed history including name, age, gender, demographic, anthropometric feature was taken.

Inclusion Criteria: Age between 21-40 years, physically and mentally fit, Co-operative and & capable of understanding the procedure. Not suffering from any known medical problem.

Exclusion Criteria: Age < 21 years > 40 years, Uncooperative, Not physically fit. Hypertensive, Diabetic or suffering from any long term systemic illness. Smoker, Tobacco and alcohol users were also excluded from this study.

Subject was examined for their weight, height, waist circumference & hip circumference. Weight was measured nearest to 0.1 Kg. by weighing balance after removal of shoes with light clothing only. Height was measured to the nearest 0.5 cm. against the wall without shoes using a stadio meter. Waist circumference was measured using a measuring tape in standing position at the level midway between the lower rib margin and the iliac crest in a horizontal plane. Hip circumference was measured in standing position at the widest point over the buttocks. For each of the waist & hip circumference, two measurements to the nearest 0.5 cm were recorded. If the variation between the measurements was more than 2 cm, a third measurement was taken. The mean of the two closes measurement was calculated.

BMI was calculated by dividing the weight taken in Kg by the square of height taken in meters. WHR was calculated by dividing waist measurement by the hip measurement. WSR was calculated by dividing the waist measurement (cm) by height measurement (cm). We have used the cut-off point of 25 for BMI and 85 cm for WC, .85 for WHR and WSR .50 in our study according to the WHO criteria for South Asian population recommendations (10).

BF% is another parameter for defining obesity. This was also used in present study because of its sensitivity and specificity. Cut of value of BF% for normal and obese person is >25% for male and >30% for female. BF% was calculated from following formula (11):

BF%= (BMI x 1.20) + (Age x 0.23) – (Sex x 10.8)-5.4

(BMI in kg/m2; Age n Years; Sex is 1 for male and 0 for female)

Fat mass (FM) were calculated from following formula;

Weight X Body Fat %

Fat free mass (FFM) were calculated from following formula;

Weight - FM

Resting Heart Rate (RHR) was recorded in early morning using the ECG after fixing the standard bipolar limb leads. ECG was recorded in lead 2, which runs for one full minute for each test. The R-R peaks indicated the heart rate and calculation is done noting the speed of the of the ECG paper in unit time. Since 25 mm/sec is the speed normally used, the RHR is counted with the calculation as:-

1500/Distance between two consecutive R-R waves in mm

Computer software of Microsoft Excel 2007 on window 7 platform was used. The significance of differences within groups and across the groups was evaluated by student T-test. The correlation between various Anthropometric Indices and RHR was done using Pearson's correlation coefficient. The correlation coefficient values 'r' was compared with the table of coefficient correlation in Biostatistics.

Results: Table-1

Distribution of subjects in to normal & obese groups based on the cut-off points used in this study

Obesity Indices	Cut-off	Normal		Obese	
		No. of cases	Percentage	No. of cases	Percentage
Body Mass Index	25kg/m2	104	52%	96	48%
WC	85 cm	115	57.5%	85	42.5%
WHR	0.85	116	58%	84	42%
WSR	0.50	110	55%	90	45%

Table-2

Effect of obesity on RHR in standing and supine position and difference in HR n=200

Obesity indices	RHR st (bpm)		RHR sup (bpm)		Δ HR(bpm)	
	NW	OB	NW	OB	NW	OB
BMI	72.05±2.42	82.26±6.15**	65.05±2.05	73.17±5.36**	7.01±1.15	9.10±1.89**
WC	72.79±2.39	84.29±5.35**	65.72±2.02	74.85±4.87**	7.07±1.13	9.45±1.81**
WHR	72.72±2.22	84.52±5.09**	65.65±1.86	75.06±4.68**	7.07±1.12	9.48±1.80**
WSR	72.68±2.23	83.79±5.68**	65.61±1.88	74.48±5.03**	7.07±1.13	9.31±1.86**
BF %	74.28±4.21	86±4.90**	66.92±3.53	76.16±4.70**	7.36±1.29	9.84±1.91**

**P<0.001 HS

Data is expressed as Mean ± SD; NW: Normal weight (below cut off point), OB: obese (above cut off point for the respective index of obesity). BMI: body mass index, WC: waist circumference, WHR: waist to hip ratio, WSR: waist to stature ratio, RHRst: resting heart rate in standing position, RHRsup: resting heart rate in supine position, ΔHR: change in heart rate due to change in posture from lying down to Standing position.

Table-3

Correlation of BMI, WC, WSR, WHR & BF% with Resting Heart Rate

Name of parameters	BMI	WC	WSR	WHR	BF
RHR (Supine)	0.75	0.81	0.81	0.72	0.80
RHR (Standing)	0.77	0.86	0.85	0.77	0.84

RHR in supine condition is showing stronger correlation with WC and WSR although RHR (Supine) was also significant associated with other obesity parameters. RHR (Standing) is also strongly correlated with WC and WSR.

Table-4

Showing multiple regression analysis

Results of Multiple regression analysis (Normal Weight Group)						
	BMI	WC	WHR	WSR	FFM	Comment
RHR(Supine)	0.0022*	0.0590	0.1185	0.0336	0.0234	P value for BMI is <0.01
RHR(Standing)	0.0029*	0.4561	0.0899	0.2480	0.2697	
*P<0.01 Multiple regression method was applied to find the effect of BMI, WC, WHR, WSR and FFM on RHR. Result shows that only BMI is significant contributor for RHR in supine and standing condition						
Results of Multiple regression analysis (Obese Group)						
	BMI	WC	WHR	WSR	FFM	Comment
RHR(Supine)	0.0288	0.0012**	0.0678	0.0199	0.0088**	P value for WC is <0.01
RHR(Standing)	0.0572	0.0071**	0.1092	0.0766	0.0562	
** P<0.01 Multiple regression method was applied to find the effect of BMI, WC, WHR, WSR and FFM on RHR. Result shows that only WC is significant contributor for RHR (supine and standing) while FFM also significantly contribute for RHR (supine).						

Discussion:

To our knowledge, there are very less studies investigating the relationship between indices of general and central obesity and RHR in young adult male subjects of western Rajasthan (a desert state of India).To best of our knowledge this study might be the first to assess relationship of resting heart rate with body composition and obesity among young adults male subjects of western Rajasthan in India.

Present study was done with the aim to determine correlation of Resting Heart Rate with obesity indices in Young Male subjects of Western Rajasthan. The prevalence of obesity is now reaching epidemic proportions in India and is of great concern because it increases risk of Coronary Heart disease, Stroke, Diabetes and mortality (12) as per WHO report.

WC, WHR & WSR are good indicator of abdominal obesity. Increased WC represents increased abdominal fat or visceral fat. WHR takes into account the distribution of body fat in the abdominal region but it may remain the same even when these is a change in body size because WC & HC can increase or decrease proportionality. WSR takes into consideration both the height & WC and the WSR will change only when these is change in WC in grown up adult's (13) BMI on other hand does not take into account the proportion of weight related to increased muscle mass or the distribution of excess fat within the body, both of which affect health risks associated with obesity. Individuals with a similar BMI can vary considerably in their abdominal fat mass.

Resting heart rate (RHR) is a marker of sympathetic tone, and independently associated with cardiovascular events and death in various populations. Abdominal obesity is characterized by sympathetic nerve activation (SNA), probably mediated by elevated insulin and leptin levels. Visceral adipose Tissue (VAT) is the predominant adipose tissue compartment producing various proinflammatory cytokines and adipokines. The results of our study also show a significant positive correlation between RHR sup and BMI, WC, WHR, WSR & BF%. The correlation of RHR standing with indices of obesity is much stronger than RHR Supine.

This study is first only that investigated the relationship between indices of general & central obesity and RHR in both standing & supine position in young adult males of Western Rajasthan (Desert State of India) and showing evidence that both general & abdominal obesity are positively and significantly correlated with RHR in this young male population. The study has shown that both RHR standing & RHR supine are significantly greater in persons having general obesity or central obesity as compared to non-obese individuals. Multiple regression method was applied to find the effect of BMI, WC, WHR, WSR and FFM on RHR supine and RHR standing. Result shows that in normal weight group only BMI is significant contributor for RHR supine and RHR standing and in obese group only WC was the significant contributor ($p<0.05$) for

RHR standing while WC and FFM were the significant contributors (P<0.05) for RHR supine for the population of Western Rajasthan adult males.

An elevated heart rate is a warning about an increased risk of cardiovascular dysfunction (14) It has been shown that on increase in heart rate by 10 beats per minutes was associated with an increase in the risk of cardiac death by at least 20% and this increase in the risk was similar to the one observed with an increase in systolic blood pressure by 10 mm Hg (15) The literature indicates that a heart rate of more than 80bpm significantly increases the risk of cardiovascular complications, morbidity, & mortality (16) Obesity and the cardiac autonomic nervous system are intrinsically related. A 10% rise in body weight is associated with a decline in parasympathetic tone, accompanied by a rise in mean heart rate, & conversely heart rate declines during weight-reduction. Reduction in vagal activity with increment in weight may be one mechanism m for the arrhythmias and other cardiac abnormalities that accompany obesity. Visceral adipose tissue secretes a variety of bioactive substances, termed adipocytokines, such as leptin, tumour necrosis factor-α (TNF- α), interleukin-6 (IL-6) angiotensinogon and non-esterified fatty acids (NEFA), which play a role in development of hypertension and metabolic syndrome.

RHR changes are known to occur when one moves from a recumbent to an upright position or vice versa. Multiple regression shows that WC, BMI and FFM were the significant contributor (p<0.05) for change in RHR for the population of Western Rajasthan adult males. It could be explained on the basis of a higher sympathetic tone in the obese group than NW group, or the Para sympathetic tone was comparatively more in NW. The effects of autonomic dysfunction would be reduced in supine position especially if they are related to the sympathetic activation (17) this is probably why the difference in RHR supine between Normal and Obese group is less significant as compared to RHR standing and the correlation of RHR sup with adiposity is weaker than that of RHR standing. The changes in the B.P & HR that occur in humans on standing up or lying down are done for the most part to baroreceptor reflex (18)

One major benefit of this study could be that young adults of Western Rajasthan may be advised to change their eating habit & lifestyle by demonstrating them an immediate observable effect of obesity on RHR & B.P. A recent study by Gupta R. & Mishra A. et al (2009). Showed a low prevalence of multiple cardio-vascular risk factors (including dyslipidemias, diabetes & obesity) in adolescent but a rapid escalation of these risk factors by age of 30-39 years (19)

The heart rate is an integrated index of autonomic cardiovascular function and elevated heart rate values indicate adrenergic overdrive, leading to / or worsening ischemia with risk of acute coronary syndromes (ACS), fatal or non-fatal arrhythmias or heart failure. Secondly, the elevated heart rate exerts mechanical effects on the cardiac vasculature leading to increased shear stress, impaired arterial compliance and favours the development of atherosclerotic vascular lesions.[20,21]

Conclusion:

It is worthwhile to mention that the stronger correlation of WC, compared to that with BMI has led to the suggestion that WC should be used as an index of abdominal obesity and may be more sensitive in the assessment of disease risk than BMI alone in the population of Western Rajasthan adult males.

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Disclosure: No conflicts of interest, financial, or otherwise are declared by authors