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Original Research

Study Of Parasympathetic Autonomic Activity In Indian Obese Inviduals

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ABSTRACT
Background:-Obesity is a nutritional health problem, which is a potential risk factor for cardiovascular morbidity and mortality and it is gradually rising and affecting a major section of adult population**.** Altered parasympathetic activity may be considered as a risk factor for obesity and vice versa. **Material and method:-** The present study is an attempt to pinpoint the defect (if any) in the activity of parasympathetic limb of the autonomic nervous system (ANS) in obesity. Total 80 subjects belonging to the age group of 18-60 years were recruited for the study. The participants were divided into two groups as non obese and obese based body mass index (BMI). The functioning of parasympathetic autonomic nervous system was evaluated by 4 non invasive cardiovascular reflex tests- Resting heart rate,30:15 ratio, expiration/inspiration ratio (E/I ratio) and valsalva maneuver **Results:-**In the present study, the resting heart rate (beats/minute) was insignificantly ($p>0.05$) higher in obese subjects and lower values of Expiration/inspiration ratio ,30:15 Ratio and Valsalva Ratio were found in obese subjects when compared to normal weight subjects indicating reduced vagal or parasympathetic activity. Statistically result of Expiration/inspiration ratio and 30:15 Ratio showed significant results (p-value<0.05) and on the other side result of valsalva maneuver showed statistically insignificant result(p-value>0.05).**Conclusion:-**So from our study it may concluded that there is need of early interventional programs (weight reduction, life style changes and physical exercise) to prevent obesity related cardiovascular sequel in future.

Key Words: Obesity, parasympathetic activity, autonomic nervous system (ANS), body mass index (BMI),resting heart rate,30:15 ratio, E:I ratio and valsalva maneuver.

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INTRODUCTION

The prevalence of overweight and obese individuals is increasing at an alarming rate throughout the world, in both developed and developing countries. In 2005, it was estimated that 937 million people throughout the world were overweight, and 396 million people were obese. In 2030, the respective number of overweight and obese adults was projected to be 1,35 billion and 573 million individuals.[1] Obesity is a serious, chronic disease that can have a negative effect on many systems in your body. People who are overweight or obese have a much greater risk of developing serious conditions. Obesity in India has reached epidemic proportions in the 21st century, with morbid obesity affecting 5% of the century 's population. Obesity is chronic imbalance between energy intake and energy expenditure. The energy balance is to a reasonable extent affected by the status of autonomic nervous system (ANS) activity in the individual.[2] The autonomic nervous system (ANS) dysfunction has a two-way relationship with obesity. Indeed, alterations of the ANS might be involved in the pathogenesis of obesity, acting on different pathways. On the other hand, the excess weight induces ANS dysfunction, which may be involved in the haemodynamic and metabolic alterations that increase the cardiovascular risk of obese individuals, i.e., hypertension, insulin resistance and dyslipidemia. It has been suggested that the Autonomic Nervous System(ANS) acts as central in the co-ordination of this system. A 10% increase in body weight is associated with a decline in parasympathetic tone, accompanied by a rise in mean heart rate, and conversely, heart rate declines during weight reduction.[3] The hypothesis of this study was that the cardiovascular autonomic function is affected by obesity and becomes an additional cardiovascular risk in this population.[4,5] Thus, the present study was conducted

in obese subjects to look at their status of the ANS compared with normal subjects.

MATERIAL AND METHODS

This study was conducted in Department of Physiology, Dr. S.N.Medical College , Jodhpur,Rajasthan with 80 healthy subjects of the age group 18-60 years after obtaining their informed consent for the study. The study was undertaken after the ethical clearance was obtained by the institutional ethical committee. Each subject was given verbal instructions and demonstration before being tested and further instructions were provided at the time of the test. Tests for autonomic function were performed 2-3 hours after a light breakfast.

Inclusion criteria

Totally, 80 healthy volunteer subjects (not having any major illness or chronic addiction) of Western Rajasthan were selected for the study. Based on the BMI they were divided into two groups, Study Group, composed of 40 obese individuals, and Control Group, composed of 40 non obese individuals, matched for age and height.

Obesity

Overweight and obesity are defined as abnormal or excessive fat accumulation that presents a risk to health.[6]

Weight in kilograms and height in centimeters were measured and recorded for all the subjects to calculate the body mass index (BMI) by **Quetelet's index** as follows:

$$\textbf{BMI=Weight(kg)/(Height(m))}^2$$

A person with a BMI of 30 or more is generally considered obese. A person with a BMI equal to or more than 25 is considered overweight.[7] In our study both overweight and obese subjects to be clubbed together in Study group and identical number of age and sex matched non-obese subjects served as controls.

Exclusion criteria

Subjects suffering from any major illness like diabetes mellitus, cardiac failure, cardiac arrhythmias and chronic obstructive lung disease or with any chronic addiction were excluded from the study. Data comprising the clinical history, including name, age, sex, occupation were obtained from all the subjects and recorded. Special importance was paid in the clinical history to any symptoms suggestive of autonomic neuropathy.

Tests of predominantly parasympathetic function:-

1. Resting Heart Rate

2. Heart Rate variation during deep breathing (Expiration/Inspiration ratio):

While recording ECG, the subject was asked to inhale deeply for 5 seconds followed by exhalation for 5 seconds at a rate of 6 breaths per minute. The ratio between longest R-R interval during expiration and shortest R-R interval during inspiration (E/I ratio) in each respiratory cycle is calculated for evaluation. A value of 1.20 or higher was taken as normal.[8,9]

3. Heart-rate response to standing (30:15 ratio)

The subject was instructed to lie down comfortably and ECG was recorded to calculate the heart rate. Then the subject was instructed to stand up within 3-4 seconds and remained motionless thereafter. The 30:15 is the ratio of the longest R-R interval at beat 30 during the inspiration/expiration cycle and the shortest R-R interval at beat 15 after standing. It examines the integrity of the efferent parasympathetic branch. The 30:15 ratio of ≥1.04 is taken as normal and value of <1.04 is considered abnormal.[9]

4. Heart-rate response to Valsalva maneuver (VM ratio)

The subject was asked to blow out or to expire forcefully through a mouthpiece attached to the sphygmomanometer to maintain the pressure at about 40mm Hg for 15 seconds. The ECG is recorded simultaneously during this maneuver and 15 seconds afterwards to see the RR interval changes. The valsalva ratio = Longest R-R interval after maneuver (after the strain)/ Shortest R-R interval during maneuver (during the strain). The normal valsalva ratio is >1.21 and in autonomic dysfunction this ratio is <1.21.[9]

Stastical Analysis

Various autonomic parameters obtained from study group and controls were compared by Student 't' test (two tailed dependent). P values of < 0.05 were accepted as significant difference between the compared values.

RESULTS

Table 1: Anthropometric variables.

PARAMETER	NON OBESE SUBJECTS		OBESE SUBJECTS		P VALUE
	MEAN	S.D.	MEAN	S.D.	
AGE	37.6	11.5	40.0	10.4	0.2947 (NS)
WEIGHT	60.26	6.56	81.22	10.48	<0.0001 (HS)
HEIGHT	1.67	5.63	1.69	6.4	0.03(S)
BMI	21.54	1.99	28.01	2.02	<0.0001 (HS)

Nonobese subjects having BMI between18.50 to 24.90 kg/m2, Obese subjects having BMI >25 kg/m2

NS= not significant(p value >0.05), S=Significant(p value <0.05), HS= significant at <0.001 level.

All data are expressed as Mean and Standard deviation(S.D.).

Table 2: Parasympathetic function test in Non obese and obese subjects.

PARAMETER	NON OBESE SUBJECTS		OBESE SUBJECTS		P VALUE
	MEAN	S.D.	MEAN	S.D.	
RHR	73.45	8.41	78	8.92	0.73 (NS)
E:I RATIO	1.42	0.46	1.28	0.23	0.0033 (S)
30:15 RATIO	1.19	0.35	1.09	0.21	0.0019 (S)
VAL. MA.	2.22	1.5	2.1	1.14	0.09 (NS)

NS= not significant(p value >0.05), S=Significant(p value <0.05),All data are expressed as Mean and Standard deviation(S.D.)

DISCUSSION

The present study was carried out in 80 healthy subjects in the age range of 21-60 years, to assess the influence of obesity on parasympathetic function. The subjects were distributed into two groups-obese and non obese group. The significant findings are being enumerated briefly. In the present research, it was found that the mean body mass index of obese subjects was 28.02 ± 2.02 kg/m2 and that of non-obese subjects was 21.54 ± 1.99 kg/m2. The BMI difference between obese and non-obese subjects was statistically highly significant ($p<0.0001$). In the present study, resting heart rate (beats/minute) was insignificantly ($p>0.05$) higher in obese subjects 78±8.92 than 73.45±8.41 in non obese subjects. Expiration/inspiration ratio showed statistically significant ($p<0.005$) decrease in obese subjects 1.28±0.23 as compared to non-obese subjects 1.42±0.46. Similar results have been reported by other researchers.[10-12] Our study showed that 30:15 ratio was lower in obese 1.09±0.21 than non-obese subjects1.19±0.35,which is statistically significant ($p>0.05$).In another studies, Rossi M et al,[13] Akhter S et al[14] and Garg R et al[15] also found that 30:15 ratio was significantly lower in obese subjects as compared to non-obese subjects. Our study shows that valsalva maneuver was insignificantly ($p>0.05$) lower in obese subjects 2.1±1.14 than 2.22±1.5 in non obese subjects.Our finding matches with findings of Grewal S et al[16] and Thorat K et al (2011).[12], Shetty et al.[17] and Yakinci et al.[18] Reason behind decline in parasympathetic activity has not yet been clearly established. Some researchers suggested that gradual development of insulin resistance in target tissues with the beginning of excess weight gain in obesity is responsible for subsequent development of hyperinsulinaemia.[19] This hyperinsulinaemia has got a role in low cardiac vagal activity in obese person.[20] High insulin level or insulin resistance may cause damage to autonomic nerves at any level of their reflex arc, insulin resistance may cause a deterioration of microcirculation in many tissues including nerves which may lead to neural ischemia and thereby damage of cardiac parasympathetic nerve terminals occur at the level of cardiac muscle orvascular wall.[21] The results of study by Garg R et al,[15]shows decrease in parasympathetic nerve function and baroreflex sensitivity in obese subjects. Baroreceptors resetting may occur in obese individuals due to atherosclerosis that hardens the carotid sinus walls. This decreases compliance.In another study it has been seen that Cardiac parasympathetic dysfunction present in obese subjects could be associated with higher carbohydrate intake and lower fat and protein intake which results in parasympathetic abnormality.[20] It is also demonstrated that parasympathetic activity increased with weight loss in obese.[22]
Our results are not in agreement with study done by DasDev et al,[23] Çolak et al ,[24] Bedi et al [2]and Pal et al[25] reported normal activity of parasympathetic system and hypoactivity of sympathetic nervous system in obese participants.

CONCLUSION

So from our study it may concluded that obesity is associated with parasympathetic nervous system dysfunction which may result in higher risk for development of cardiovascular disorders. So, if this dysfunction is diagnosed early by doing various autonomic function tests, it will be of great help in identification of those which are prone to weight gain and at risk of various cardiovascular complications.

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