WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Obesity: Effect on Parasympathetic Nervous System

Gursimran Jeet Singh[1], Dr Manila Jain[2*], Dr Harmeet Singh[3]

[1]PhD Scholar, Department of Physiology, Index Medical College, Hospital and Research Centre, Malwanchal University, Indore (M.P)
[2]Professor & Head, Department of Physiology, Index Medical College, Hospital & Research Centre, Malwanchal University, Indore (M.P)
[3]Assistant Professor, Department of Physiology, Govt Medical college Sri Ganganagar, Rajasthan

ABSTRACT

Background: Obesity is defined as abnormal or excessive fat accumulation in the body that may impair the health of an individual. It is considered as a major health issue worldwide. **Methods and Materials:** The present study was conducted in the Department of Physiology, Index Medical College, and Indore. 60 obese (30 male and 30 female) and 60 non-obese (30 male and 30 female) subjects were examined in the study. Heart rate response to deep breathing' test was performed on all subjects to assess the activity of parasympathetic nervous system. **Result:** All data is expressed as mean ±standard deviation. Comparison between all 4 groups (obese male, non-obese male, obese female, and non-obese female) was performed using the student's t-test (t-test for two independent samples). Differences were considered significant at $p<0.05$. It was observed that parasympathetic activity was blunted in obese subjects. This alteration in the balance of autonomic nervous system increases the chances of cardiovascular disorders. **Conclusion:** Obesity has been associated with major adverse effects on health. With the increasing obesity worldwide chronic non-communicable diseases are becoming an epidemic.

Keywords: Parasympathetic Nervous System and Obesity, Cardiovascular Disorders and Obesity.

Introduction

According to the World Health Organization (WHO), health is a "state of complete physical, mental and social wellbeing and not just the absence of disease or infirmity" [1]. Due to the prevailing condition of overweight and obesity, the state of well-being as recommended by WHO may not be triumphed by many individuals giving rise to severe health issues. Thus, overweight and obesity may serve as parameters that may not allow an individual to attain this definition of health as per WHO [2].

Prevalence rates of obesity are booming rapidly in industrialized countries as well as developing countries according to epidemiological data [3]. Approximately 60% of people with obesity have metabolic syndrome along with three or more of the following factors: elevated abdominal circumference, blood pressure, blood triglycerides, fasting blood sugar, and low high-density lipoprotein [HDL] cholesterol. Certain cancers (colon, ovary, and breast), thromboembolic disorders, digestive tract diseases (gallbladder disease, gastroesophageal reflux disease), and skin disorders are also more prevalent in the obese. Surgical and obstetric risks are greater with obesity. Obese patients also have a greater risk of pulmonary functional impairment including sleep apnea, endocrine abnormalities, proteinuria, and increased haemoglobin concentration [4].

Autonomic imbalance associated with increased sympathetic activity and reduced vagal tone has been strongly implicated in the pathophysiology of arrhythmogenesis and sudden cardiac death [5]. Hyperactivity of the vagus nerve often exerts a beneficial effect in obesity [6]. It has also been shown in Western studies on obese adults that weight loss reverses back to parasympathetic control of cardiac functions [7]. The present study is undertaken to evaluate the parasympathetic autonomic functions in young obese adults. An early establishment of this correlation will help in preventing future cardiac autonomic disturbances like hypertension, congestive heart failure, coronary artery disease etc.

Material and Methodology

The present study was conducted among the students of Index Medical College, Indore. It is a comparative type of study in which 120 subjects were assessed. All 120 adults were between age group 18-30 and were divided into 4 groups based on obesity and gender.

1. Group 'A' – 30 Obese Males
2. Group 'B' – 30 Non-obese Males
3. Group 'C' – 30 Obese Females
4. Group 'D' – 30 Non-obese Females

Inclusion criteria

Willing consent participants; students within the age group 18 – 30 years and both genders were included.

Exclusion criteria

Non-consenting subjects, any subject below 18 years or above 30 years of age, chronic smokers and chronic alcoholics, subjects on any drug that alters autonomic functions of their body and known cases of diabetes mellitus, hypertension, congestive heart disease or endocrine disorder subjects were excluded from study.

Test for Parasympathetic Function Slow Deep Breathing Test

Deep autonomic breathing at a ratio of six cycles per minute is probably the most common and reliable test to assess respiratory sinus arrhythmia, with the acceleration of heart rate during inspiration and deceleration during expiration under optimized conditions [8].

Subject in supine posture was instructed to inspire with the examiner's index finger going up and expire when the finger goes down to regulate his/her respiratory rate at 6 cycles per minute

[9].

The E:I ratio (Expiratory: Inspiratory Ratio) is the ratio of averaged maximum and minimum R-R intervals during expiration and inspiration respectively during the maneuver. The E:I ratio above 1.20 will be considered normal [9].

Statistical Analysis

For each variable group mean and standard deviation of the mean, was calculated. Mean differences were tested for significance by students unpaired 't' test. The statistical significance was assigned at $p<0.05$.

Observations and Results

Table 1: Comparison of slow deep breathing test in Obese (Group A) and non-obese Males (Group B) using student t-test

	GROUP A (OBESE MALES)	**GROUP B (NON-OBESE MALES)**	**p VALUE**
	Mean ±SD	Mean ±SD	
E: I RATIO	1.21 ± 0.04	1.33 ± 0.07	< 0.0001

Table 2: Comparison of slow deep breathing test in Obese (Group C) and non-obese Females (Group D) using student t-test

	GROUP C (OBESE FEMALES)	**GROUP D (NON- OBESE FEMALES)**	**p VALUE**
	Mean ±SD	Mean ±SD	
E: I RATIO	1.23 ± 0.11	1.34 ± 0.08	< 0.0001

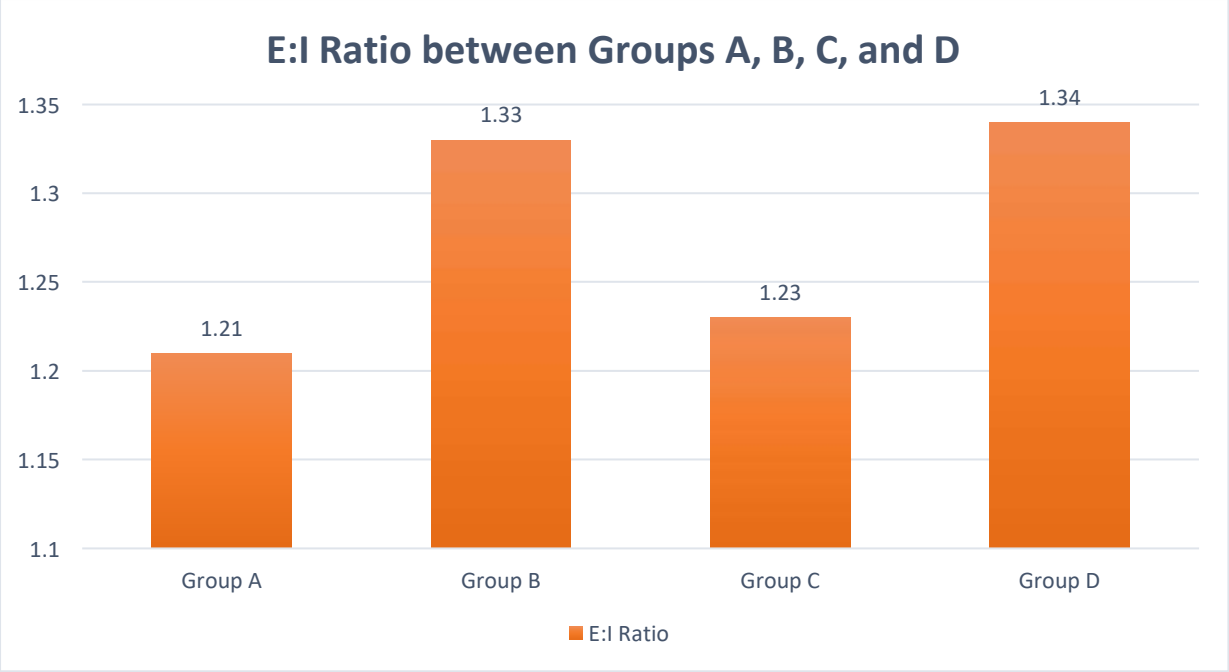

Fig 1: Comparison of slow deep breathing test in using student t-test Group A (Obese boys), Group B (non-obese boys). Group C (obese girls), Group D (non-obese girls).

Discussion

The present study was conducted to find the effect of obesity on parasympathetic functions in young adults between ages 18 – 30 years among 120 subjects. All the subjects were divided into 4 groups (Obese Males, Non-Obese Males, Obese Females, and Non-obese Females) based on their gender and obesity. Body Mass Index (BMI) was measured of all subjects to categorize between obese and non-obese groups.

The results of the present study depicted a decline in the E: I ratio in Obese subjects compared to non-obese subjects. This indicates the blunted activity of the parasympathetic nervous system in obese individuals.

E: I ratio was negatively associated with obesity that's the E: I ratio was decreased in obese [10], as compared to controls which is similar to our study. The effect of obesity on cardiac autonomic activity and found the presence of E: I decrement along with the elevated level of sympathetic [11] activity in the obese group, which is contradictory to our studies.

Another study that depicted a decline in parasympathetic activity and baroreflex activity in obese subjects [12], also supports the outcomes of the present study. Baroreceptor resetting may occur in obese individuals due to atherosclerosis that hardens the carotid sinus walls, which leads to decreased compliance [13]. Emdin M et al, 2001 also stated in their study that there is a decrease in sympathetic and parasympathetic activity in obese people as compared to normal subjects which also supports the results of our study [13].

People with metabolic syndrome (central obesity, insulin resistance, and dyslipidemia) are known to be at higher risk for cardiovascular diseases (CVD). A 10% increase in body weight above an individuals' usual weight is accompanied with a decrease in parasympathetic activity. The effect of increased weight is one mechanism for cardiac alterations such as arrythmias that accompany obesity [14].

Conclusion

Obesity has been associated with major adverse effects on health. With the increasing obesity worldwide chronic non-communicable diseases are becoming an epidemic. Decreased E: I ratio among the obese individuals as compared to their counterparts indicates towards a blunted parasympathetic activity and also decreased baroreflex sensitivity in obese subjects.

References

1. Garrow JS, Webster J. Quetelet's index (W/H2) as a measure of fatness. International Journal of Obesity 1985; 9(2):147-53
2. Mukhra R, Kaur T, Krishan K, Kanchan T. Overweight and Obesity: A major concern for health in India. Clin Ter. 2018 Sep-Oct;169(5):e199-e201. doi: 10.7417/CT.2018.2078. PMID: 30393804.

3. World Health Organization. Obesity: preventing and managing the global epidemic. Report of a WHO consultation presented at: the World Health Organization; Geneva, Switzerland, Publication WHO/NUT/NCD/98.1, 1997 June.
4. Samuel K, Lora E B, George A B, Steven B, David B A, Xavier P S, Yuling H, Robert H E: Clinical implications of obesity with specific focus on cardiovascular disease: A statement for professionals from the American Heart Association council on Nutrition, Physical activity and Metabolism. Circulation. 2004; 110: 2952-2967.
5. Zipes D P, Wellens H J J: Sudden Cardiac Death. Circulation. 1998; 98: 2334-51.
6. Vanoli E, Schwartz PJ. Sympathetic- Parasympathetic interaction and sudden death. Basic Res Cardiol. 1990;85(1):305-21.
7. Akehi Y, Yoshimatsu H, Kurokawa M, Sakata T, Eto H, Ito S, Ono J: VLCD-induced weight loss improves heart rate variability in moderately obese Japanese. Exp Biol Med (Maywood). 2001 May;226(5): 440-5.
8. Gholamrezaei, A., Van Diest, I., Aziz, Q., Vlaeyen, J. W. S., & Van Oudenhove, L. (2021). Psychophysiological responses to various slow, deep breathing techniques. Psychophysiology, 58(2), Article e13712. https://doi.org/10.1111/psyp.13712
9. Jha RK, Acharya A, Nepal O. Autonomic Influence on Heart Rate for Deep Breathing and Valsalva Maneuver in Healthy Subjects. JNMA J Nepal Med Assoc. 2018 Mar- Apr;56(211):670-673. PMID: 30381762; PMCID: PMC8997273.
10. Baum P et al, 2013. Dysfunction of autonomic nervous system in childhood obesity: a cross-sectional study. PloS One. 2013; 8(1):e54546
11. Chetan et al, 2012 Chethan HA, Niranjan Murthy, Basavaraju K. Comparative study of heart rate variability in normal and obese young adult males. Int J Biol Med Res. 2012; 3(2): 1621-23
12. Mudasir Ahmed Wani, Dr Vinita Ailani, Dr Shikha Saxena obesity: effect on parasympathetic nervous system volume-9 | Issue-9 | September - 2019 | PRINT ISSN No. 2249 - 555X | DOI: 10.36106/ijar
13. Emdin M et al, 2001 Emdin M, Gastaldelli A, Muscelli E, Macerata A, Natali A, Camastra S, Ferrannini E: Hyperinsulinemia and autonomic nervous system dysfunction in obesity: Effect of weight loss. Circulation. 2001; 103: 513-19.
14. Kimura T, Matsumoto T, Akiyoshi M, Owa Y, Miyasaka N, Aso T, et al. Body fat and blood lipids in postmenopausal women are related to resting autonomic nervous system activity. Eur J Appl Physiol. 2006;97:542–7