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Effect of BMI on autonomic function tests amongst Hypertensives and non Hypertensives

Diksha Yadav[1], Shahin Dabhoivala[2], HN Parekh[3], Lajja Patel[4]*

ABSTRACT

Hypertension is the most common chronic condition dealt with by primary care physicians and other health practitioners. The autonomic nervous system plays a crucial role in blood pressure (BP) and heart rate (HR) control and may thus be an important pathophysiological factor in the development of hypertension. Detection of hypertension at an initial stage is crucial to prevent microangiopathic damage to the tissue. The present study was undertaken to determine the association between BMI and autonomic function test in hypertensive and non hypertensive. The BMI of subjects in both the groups was derived from their weight (kg) and height (cms). The BMI of hypertensive males and females was Mean SD of 25.84±4.38 and 27.77±4.73 respectively. While, in the normotensive males and females the BMI was Mean SD 22.9±4.0 and 21.94±4.30 respectively. The subjects in both the group underwent autonomic function tests, and the results were correlated with the BMI. Significant correlation ($p<0.05$) was found amongst the hypertensive groups with BMI >=25 and BMI <25 for valsalva ratio. Physical exercise has impact on BMI as well hypertension. BMI can emerge as an indicator for early detection of hypertension.

Keywords: BMI, Hypertension, Autonomic Function Test, Physical exercise.

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4. Corresponding Author: Lajja Patel, Department of Physiology, Baroda Medical College, Baroda, Gujarat, 390001, India, Mobile no. +919825755708, Email address- lajja.patel-physiology@msubaroda.ac.in. 1. Diksha Yadav, Department of Physiology, Dr. Kiran C Patel Medical College and Research institute, Bharuch, code: 392001, Gujarat, India, 2. Shahin Dabhoivala, Department of Physiology, Baroda Medical College, The Maharaja Sayajirao University Of Baroda, 390001, Vadodara, Gujarat, India 3. HN Parekh, Department of Physiology, Baroda Medical College, The Maharaja Sayajirao University Of Baroda, 390001, Vadodara, Gujarat, India

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INTRODUCTION

Obesity is one of the leading concerns of today's era due to its multiple implications on health. The co morbidities associated with obesity include coronary heart disease, hypertension and stroke, certain types of cancer, non-insulin-dependent diabetes mellitus, gallbladder disease, dyslipidaemia, osteoarthritis and gout, and pulmonary diseases, including sleep apnoea[1]. Obesity can be easily identified by variety of parameters like mass index (BMI), waist circumference, waist hip ratio and waist to stature ratio. Body mass index is the most widely used measure to diagnose obesity[2].

Increased blood pressure is associated with increased BMI because an increase in body weight and thus BMI related to an increase in body fluid volume, in peripheral resistance (e.g., hyperinsulinemia, cell membrane alteration, and hyperactivity of the rennin-angiotensin system lead to functional constriction and structural hypertrophy), and in cardiac output[3]. Hypertension being a silent killer is difficult to identify during asymptomatic stages. However, with the advent of autonomic function tests diagnosing it at a very early stage can be possible. Hyperkinetic hypertension is considered as the initial phase of sustained hypertension in young individuals of the future hypertensive population[4]. In large number of these individuals this is associated with increase in sympathetic activity and decrease in parasympathetic activity [5]. The principle objective of this study was to observe the effect of BMI on autonomic nervous system in hypertensive individuals and noting its impact on the severity of the disease.

METHODS

Approval from the IECHER, Medical College and S.S.G Hospital Baroda was obtained. Written and informed consent of the subjects was taken before beginning the study. The present study included a group of 63 Hypertensive subjects aged between 30 to 60 years from Medicine OPD, SSG hospital, Vadodara. Another group of 63 healthy normotensive age matched to the hypertensive subjects were included from staff of Medical College Vadodara, and SSG Hospital Vadodara as controls. Thorough history was taken in both the groups.

The inclusion criteria included:

- Hypertensive subjects aged between 30 to 60 years from Baroda city.
- Adults diagnosed as primary hypertensive for atleast 5 years and were on regular treatment.
- Adults between 30 to 60 years of age who are absolutely healthy and normotensive till date, in their entire life time, were considered as controls.

The exclusion criteria included:

Individuals with disease or illness other than Hypertension were not included in the study. For both the groups the exclusion criteria were similar.

After measuring the BMI autonomic function tests were performed in both the groups and there data was collected after institutional scientific review committee clearance and ethical approval by the ethical committee of the institute.

Anthropometric measurements

BMI was derived from standard anthropometric measurement such as weight and height. Weight in kilogram (Kg), and standing height was measured in centimetres (cm) without shoes. The measurements were taken on Detecto-scales inc. Brooklyn.N.Y. U.S.A Model No.239 Capacity 140.

BMI was obtained by following formula:

$$\frac{\text{Weight (kg)}}{\text{Height in m}^2}$$

Autonomous Function Test

The autonomic function tests were measured by using different instruments. We used Schiller's multipara monitor for measurement of Heart rate and ECG record in lead 2 for the measurement of R-R interval. Digital blood pressure monitor for measurement of blood pressure and hand grip dynamometer for sustained hand grip test. All the autonomic function tests were conducted as per protocol of autonomic function lab, All India Institute of Medical Science (AIIMS), New Delhi.

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For both the groups pulse rate, systolic and diastolic blood pressures at rest were measured before the tests were introduced. Than the following autonomic function tests were measured in them.

Expiration Inspiration Ratio

After instructing the subjects to carry out deep inspiration for 5 seconds followed by deep expiration for 5 seconds, highest heart rate during inspiration and lowest heart rate during expiration were measured. This was recorded for six respiratory cycles with the help of multipara monitor with pulse oximeter flap attachment. The Arithmetic average of highest heart rate during inspiration and lowest heart rate during expiration was calculated. Longest R-R interval during expiration was calculated by: 1500/ lowest average heart rate during expiration multiplied by 40 msec. Shortest R-R interval during inspiration was calculated by dividing 1500 with highest average heart rate during inspiration multiplied by 40 msec. And the expiration /inspiration ratio was measured by dividing the longest R-R interval during expiration in msec with the shortest R-R interval in inspiration msec.

Valsalva maneuver

The subjects were made to perform a valsalva maneuver. They were instructed to expire into the rubber tube attached to the mercury manometer and maintain the pressure at 40mmHg for 15 seconds, after taking deep inspiration. Heart rate and ECG (lead II) were recorded for 1 minute before the maneuver, 15 seconds during the maneuver and 45 seconds after the maneuver. The valsalva ration was then calculated as under:

valsalva ratio = Longest R-R interval after the maneuver/ Shortest R-R interval during the maneuver.

Sustained Handgrip Test

Subjects were made to hold the dynamometer with full grip in there dominant hand and compress it with maximum efforts. There diastolic pressure was measured in non dominant hand both pre and post test. The Maximum isometric tension (Tmax) was measured in kilogram (Kg). The procedure was repeated two times at an interval of one minute .The average of the three values was determined. 30% of maximum voluntary contraction (Tmax) was measured. The subjects were instructed to compress the dynamometer handle at 30 % value of Tmax for 5 minutes. Diastolic blood pressure was measured just before the release of hand grip.

Lying To Standing Test

The subjects were made to lie in supine position for 10 minutes with sphygmomanometer cuff attached to the arm. Pulse oxymeter flap was attached to the index finger for instantaneous measurement of heart rate. At the end of 10 minutes base line systolic blood pressure and heart rate were measured in supine position. The subjects were than instructed to attain upright posture without support and maintain the posture for 3 minutes. ECG was recorded for consecutive 30 ECG complexes during this time. Systolic blood pressure was recorded immediately, at the end of 1 minute and at the end of 3 minutes of unsupported standing. After the completion of the test the ratio of 30 ECG complexes to 15 ECG complexes was calculated as under 30:15 ratio = R-R interval of 30^{th} ECG complex / R-R interval of 15^{th} ECG complex.

RESULTS

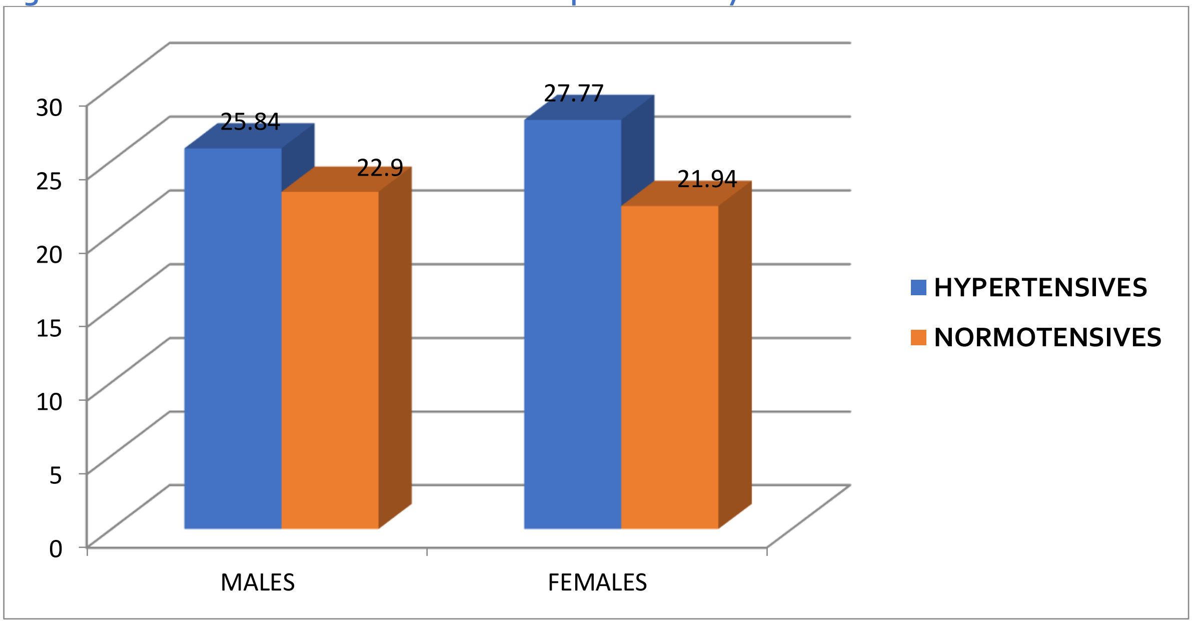
The mean age, height and weight of the 30 neurologically asymptomatic cases as well as equal numbers of controls was calculated. Out of the total 63 subjects in both the groups there were 27 males and 36 females in the hypertensive group and the normotensive group had 30 male and 33 females. The mean age, height and weight of the hypertensive group as well as the normotensive group was calculated as shown in Table no 1.

Table 1: Physical parameters of Hypertensive and normotensive individuals

	Hypertensives	Normotensives
	Mean±SD	Mean±SD
AGE(in years)	49±7.71	47±7.5
HEIGHT (in cms)	156.6±6.67	160.5±6.7
WEIGHT (IN KG)	65.8±10.42	57.58±9.75
BMI	26.94±4.65	22.4±4.17

Amongst the hypertensives, the males had a mean age of 48±7.5 years, with mean height of 160.51±6.7, and mean weight 66.37±10.39. The females in the hypertensive group had a mean age of 49±7.9 years. There mean height was 153.75±5.01, while mean was weight 65.52±10.58. The mean age in normotensive males was 47±7.5, while there mean was height 160.7±4.7 and mean weight was 59±9.6. The females in this group had a mean age of 46±7.5, whereas their mean height was 160.4±8.17, and mean weight 56.24±9.76. Out of the total hypertensive males 19 performed mild exercise daily while only 8 performed moderate exercise. 29 females of this group performed mild exercise whereas 7 performed moderate exercise. 18 males in normotensive group performed mild exercise and 12 performed moderate. Among the normotensive females 18 performed mild exercises while 15 performed moderate exercise shown in figure 1.

Figure 1: Ratio of moderate to mild exercises performed by females



Autonomic function test was compared between hypertensive individuals based on their BMI. The comparison was done after dividing the BMI in two groups i.e. <25 and >=25. P value < 0.05 was taken as significant.

Similarly after dividing the BMI in two groups of <25 and >=25, the autonomic function tests was compared between Hypertensive and normotensive individuals.

Table 2: Comparison of Autonomic Function tests between Hypertensive individuals according to their BMI

Autonomic function tests	BMI		
	< 25	>=25	
	Mean ± SD	Mean ±SD	P value
Valsalva ratio	1.22±0.16	1.11±0.14	0.0057
E : I ratio (HR variability)	1.19±0.27	1.14±0.22	0.425
30:15 ratio (HR response to standing)	1.05±0.8	1.04±0.08	0.938
Lying to standing test (SBP mmHg)	6.25±8.63	2.23±12.25	0.165
Sustained Handgrip test (DBP mmHg)	10.5±8.28	10.87±7.66	0.857

DISCUSSION

As seen in the present study, a study conducted by Feng et al.[6], showed that BMI was strongly associated with Hypertension. The increase in BMI was seen in both the sexes among the hypertensive group as compared to the normotensives. A cohort study by Sohn et al.[7] on 2127 participants show that objectively measured sedentary behavior is associated with higher SBP and with elevated BP, independent of age, MV physical activity, and other demographic and health factors. This was reflected in present study where the data showed that among the hypertensive males 70.3% did mild physical exercise whereas 29.63% performed moderate exercise. In hypertensive females 80.36% performed mild exercise while only 19.44% performed moderate. Similarly among the normotensive group 60% of males performed mild exercise and 40% performed moderate exercise. 54.55% females of normotensive group performed mild exercise and 45.45% performed moderate exercise. The results of a meta-analysis show that aerobic endurance training favorably affects BP, body weight, body fat, waist circumference, blood lipids, and insulin sensitivity, and support the general view that physical activity is important, not only for the prevention of cardiovascular disease but also in the management of hypertension[8].

Therefore exercise plays crucial role in reduction of BMI and thus controlling the blood pressure. There was no significant difference in the autonomic functions of hypertensive individuals with relation to BMI except for the Valsalva ratio. That means the results of Valsalva test may be affected with the increased BMI as evident in a study by Majeed et al[9]. This could possibly be due to the decreased parasympathetic response and increased sympathetic discharge[10]. The decreased parasympathetic response is associated with higher carbohydrate intake and lower fat and protein intakes in overweight subjects[11]. The present study examined the correlation of autonomic dysfunction and BMI (Body Mass Index) among the hypertensive and the normotensives. A significant autonomic dysfunction existed for almost all the tests between hypertensive and normotensive subjects with either BMI <25 or BMI >=25. Since the cut off value of BMI used in present study is 25 and not as per the new WHO criteria for Indian population, the results are parallel in both the groups.

CONCLUSION

Considerable increase in BMI was found in hypertensives as compared to the normotensives. The possible reason of which could be the magnitude of inactivity among the hypertensives irrespective of the gender. Cardiovascular autonomic function tests are reliable, noninvasive and simple tests to detect early involvement of autonomic nervous system. Valsalva ratio was significantly affected due to BMI as compared to other tests. However comparison of autonomic function tests among the hypertensives and normotensives based on BMI was highly significant. BMI can form an important marker to detect hypertension with the aid of autonomic function tests, before the onset of clinical symptoms.

Table 3 : Comparison of Autonomic Function tests between Hypertensive & Normotensive individuals according to their BMI

Autonomic function tests	BMI < 25			BMI >=25		
	HT(n=24)	N(n=47)		HT(n=39)	N(n=16)	
	Mean ± SD	Mean ±SD	P value	Mean ±SD	Mean ±SD	P value
Valsalva ratio	1.22±0.16	1.41±0.20	0.0001 (p<0.05)	1.11±0.14	1.46±0.21	0.0001 (p<0.05)
E : I ratio (HR variability)	1.19±0.27	1.35±0.16	0.002 (p<0.05)	1.14±0.22	1.32±0.14	0.003 (p<0.05)
30:15 ratio (HR response to standing)	1.05±0.8	1.14±0.9	0.680	1.04±0.08	1.09±0.04	0.02 (p<0.05)
Lying to standing test (SBP mmHg)	6.25±8.63	9.82±5.52	0.03 (p<0.05)	2.23±12.25	8.5±5.13	0.05
Sustained Handgrip test (DBP mmHg)	10.5±8.28	19.36±8.84	0.0001 (p<0.05)	10.87±7.66	16.37±2.33	0.007 (p<0.05)

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