Association of Body Mass Index with Blood Pressure in Middle Aged Males

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Abstracts: Background: Obesity is a condition in which excess body fat accumulates to such an extent that health may be adversely affected[1]. World Health Organization (WHO) has described rising rates of obesity in the developed world as an epidemic but even in a developing country like India incidence of obesity is rising[2].Obesity is a major risk factor for chronic diseases like hypertension, type 2 diabetes mellitus, ischemic heart diseases, colonic cancer, osteoarthritis and stroke. **Objectives:** The present study was planned to find association (if any) of obesity status with blood pressure in middle aged males. **Materials and Methods:** 125 middle aged male subjects were recruited for the study after applying exclusion criteria. According to their body mass index(BMI), they were divided in control, overweight & obese groups & their blood pressures were measured. Statistical analysis was done using t test & coefficient of correlation. **Results:** Higher values of systolic and diastolic blood pressure were found in overweight & obese group as compared to control group which were statistically significant. Statistically significant positive correlation between BMI and systolic as well as diastolic blood pressure was found. **Interpretation and Conclusions:** Higher values of systolic & diastolic blood pressures in both overweight & obese groups reiterates the role of higher BMI as a cardiovascular risk factor. It is necessary to impart health education to general public regarding health risks associated with higher BMI. [Phadke A NJIRM 2015; 6(1):40-44]

Key Words: Body Mass Index, Blood Pressure.

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Introduction: Obesity is a condition in which excess body fat accumulates to such an extent that health may be adversely affected[1]. World Health Organization (WHO) has described rising rates of obesity in the developed world as an epidemic but even in a developing country like India incidence of obesity is rising[2].The world health statistics 2012 report released by WHO mentions that in every region of the world, obesity has doubled between 1980 & 2008 & now 12% of world's population (half a billion people) is considered to be obese[3]. Over the last few decades in urban India, increased consumption of fats and calories in the diet, reduced levels of physical activity and increased sedentary life style has led the population towards obesity.

Obesity is a complex multifactorial disease that develops from the interaction between genotype and environment. Our understanding of how and why obesity occurs is incomplete; however, it involves the integration of social, behavioural, cultural, pathophysiological, metabolic and genetic factors[4].

Obesity is a major risk factor for chronic diseases like hypertension, type 2 diabetes mellitus, ischemic heart diseases, colonic cancer, osteoarthritis and stroke. These health consequences reduce the overall quality of life and also increase the risk of premature death. Taking note of this; present study was planned to find association (if any) of body mass index with blood pressure in middle aged males.

Material and Methods: Present study was a cross-sectional observational study. It was conducted in department of Physiology, of a local medical college, between January 2011 and January 2012. Institutional ethical committee approval was obtained for the study.

Selection of subjects: 125 healthy male staff members of medical college & hospital in the age group 36 to 60 years were recruited for the study. Following exclusion criteria were applied to the subjects:

- Subjects with history of diabetes mellitus.
- Subjects with history of hypertension.
- Subjects on any kind of medication such as steroids.
- Subjects with habit of smoking or alcohol.

- Subjects having chronic diseases like cardiovascular diseases, renal diseases, endocrinal disorders, neurological disorders or any psychiatric disorders.

Experimental Protocol: Written consent was taken from all the subjects after explaining nature of study to them. Detailed medical history was obtained and a thorough clinical examination was done to rule out presence of any major illness.

For the assessment of body mass index (BMI), weight, and height measurements were taken using standard protocols. Body weight was measured while the subject was minimally clothed and without shoes, standing motionless on a weighing scale and it was recorded to the nearest of 0.1 kg. Height was measured to the nearest of 0.1 cm while subject was standing in erect position with bare feet on flat floor with heels touching the wall and head straight against a vertical scale.
BMI was calculated by weight in kilograms divided by square of height in meters[5].

$$\text{BMI} = \frac{\text{Weight in (Kg)}}{\text{Height in meters}^2}$$

On the basis of BMI subjects were divided into three groups:

- Group I or control group: consisted of 39 subjects having BMI between 18.5 to 22.99 kg/m^2.
- Group II or overweight group: consisted of 53 subjects having BMI between 23 to 27.99 kg/m^2.
- Group III or obese group: consisted of 33 subjects having BMI ≥ 28kg/m^2.

After giving half an hour rest in all the groups, blood pressure was measured. For measurement of blood pressure standard mercury sphygmomanometer with appropriate cuff size was used. The subject was asked to sit comfortably in a chair with his arm supported and the pressure cuff was applied closely to the upper arm. Blood pressure was measured by palpatory method followed by auscultatory method. Blood pressure was measured 3 times with five-minutes interval. The average of second and third reading was taken into consideration for the record of systolic and diastolic blood pressure[6]. Statistical analysis was done using Student's t test and correlation coefficient.

Results:

Table 1: BMI Wise Distribution of Subjects in Each Group

Group	Range of BMI	Number of subjects
Control	18.99–23 kg/m^2	39
Overweight	23–27.99 kg/m^2	53
Obese	≥28 kg/m^2	33

Table 1 shows distribution of subjects according to their body mass index.

Table 2: Systolic & Diastolic BP in Control & Overweight Group

Parameter	Control group (n=39)	Overweight group (n=53)	p Value
Systolic BP (mm Hg) (Mean ± SD)	125.1±13.4	129.0±9.3	<0.01*
Diastolic BP (mm Hg) (Mean ± SD)	78.8±9.6	83.1±8.7	<0.01*

*Statistically significant

Table 2 shows comparison of blood pressure between control and overweight groups. Statistically significant higher values of systolic and diastolic blood pressure were recorded in overweight group as compared to control group.

Table 3: Systolic & Diastolic BP in Control & Obese Group

Parameter	Control group (n=39)	Obese group (n=33)	p Value
Systolic BP (mm Hg) (Mean ± SD)	125.1±13.4	133.38±7.71	<0.001*
Diastolic BP (mm Hg) (Mean ± SD)	78.8±9.6	85.18±8.64	<0.001*

*Statistically significant

Table 3 shows comparison of blood pressure between control and obese group. Higher values of

systolic and diastolic blood pressure were found in obese group as compared to control group which were statistically significant.

Table 4: Correlation Coefficient of BMI with Systolic Blood Pressure in All the Subjects (N = 125)

BMI (Kg/m^2)	Systolic BP (mmHg)	r value	p value
(Mean ± SD) 26.33± 7.01	98 ±10.91	0.24	<0.01

We have found a statistically significant positive correlation between BMI and systolic blood pressure in our subjects.

Figure 1: Scatter Diagram Showing Positive Correlation between BMI & Systolic Blood Pressure

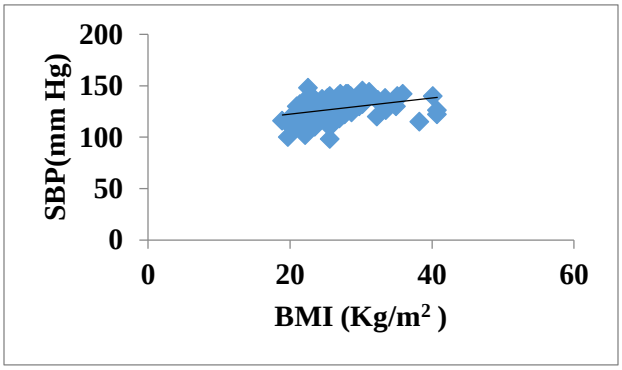
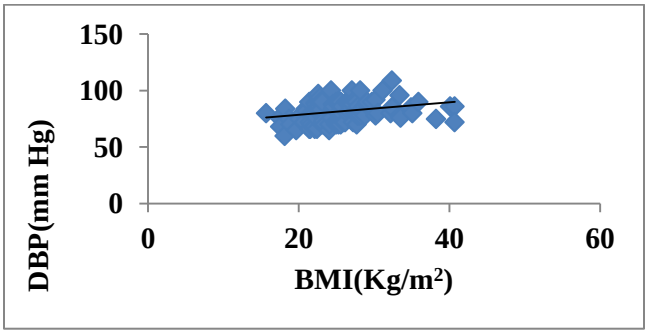


Table 5: Correlation Coefficient of BMI with Diastolic Blood Pressure in All The Subjects

BMI (Kg/m^2)	Diastolic BP (mmHg)	R value	P value
(Mean ± SD) 26.33 ± 7.01	60 ± 9.16	0.29	<0.001

Figure 2: Scatter Diagram Showing Positive Correlation between BMI & Diastolic Blood Pressure



We have found a statistically significant positive correlation between BMI and diastolic blood pressure in our subjects.

Discussion: The present study was aimed at exploring whether any association exists between BMI & blood pressure in healthy middle aged males. We have found higher values of systolic and diastolic blood pressure in both overweight & obese group as compared to control group and the difference was statistically significant. In subjects when taken together as a whole, Positive correlation was noted between BMI & systolic pressure as well as between BMI & diastolic pressure.

N.K. Mungreiphy, Satwanti Kapoor, and Rashmi Sinha[7] have also found increased levels of systolic and diastolic blood pressure in subjects having BMI more than normal in Tangkhul Naga tribal males of Northwest India[7]. Similar findings were obtained among Saudi citizens[8]. Sc Ho& co-workers from Hong Kong have reported that higher BMI was associated with higher values of blood pressure[9]. Data from National Health and Nutrition Examination Survey (NHANES) showed a remarkable linear relationship between rise in BMI and systolic, diastolic and pulse pressures in American population[10].

Now it is becoming clear that the adipose tissue is not merely an inert organ for storage of energy but it also secretes a host of factors which are responsible for rise in blood pressure. Adipose tissue in general and central adipose tissue in particular is recognized as a rich milieu and source of inflammatory cytokines, such as tumor necrosis factor- alpha (TNF-α), interleukin-6 (IL-6), C-reactive protein (CRP), and plasminogen activator inhibitor (PAI). As such, obesity has been suggested to be a low-grade inflammatory condition in the causation and progression of hypertension and atherosclerosis[11,12].

Increased renal sodium reabsorption, blood volume expansion, augmented sympathetic nervous system and higher intrarenal pressures associated with abdominal obesity are some of the mechanisms that are suggested to explain higher blood pressure levels associated with obesity[13].

For increased renal sodium reabsorption, the renin-angiotensin-aldosterone system has been causally implicated in obesity-associated hypertension. In obese subjects, increased circulating angiotensinogen, renin and angiotensin-converting enzyme activity have been reported[14]. The finding that angiotensinogen produced by adipose tissue may be released in the bloodstream suggests that high circulating angiotensinogen levels may be partially attributed to increased fat mass[15]. Angiotensin II exerts autocrine, paracrine and endocrine effects to stimulate sodium reabsorption [16]. A significant role of angiotensin II in stimulating renal sodium reabsorption and in contributing to obesity- hypertension is supported by the finding that treatment of obese dogs and obese hypertensive patients with an angiotensin-converting enzyme inhibitor increases sodium excretion as well as decreases blood pressure[17,18]. Increased sodium reabsorption leads to obligatory water reabsorption & consequently rise in blood volume.

Several observations suggest that overactivity of sympathetic nervous system is a major feature in causing obesity-hypertension in humans and animal models. Peripheral vasoconstriction and increased renal tubular sodium reabsorption are the consequences of long term sympathetic activation, which increases blood pressure[19]. Compared with lean individuals, obese and obese hypertensive patients had increased norepinephrine plasma levels and muscle sympathetic activity, measured directly with microneurographic methods[20]. The evaluation of regional sympathetic nervous activity in obese humans using norepinephrine spillover has also demonstrated that obesity is associated with increased sympathetic activity to the kidney, a central organ of cardiovascular homeostasis[21].

Conclusion: In the present study, we have found a positive correlation between BMI & systolic and diastolic blood pressures in middle aged males. This underlines the need to create awareness amongst general public about the risks associated with overweight & obesity.

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Conflict of interest: None

Funding: None

Cite this Article as: Phadke A, Obaidi R, Joshi A. Association of Body Mass Index with Blood Pressure in Middle Aged Males. Natl J Integr Res Med 2015; 6 (1): 40-44