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Original Research Article

A Hospital Based Observational Assessment of the Association between BMI, Blood Pressure and Age of Male Patients

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Abstract

Aim: The aim of the present study was to assess the association between BMI, blood pressure and age.

Methods: A cross-sectional study was carried out in department of physiology, Government medical college, Bettiah, Bihar, India for one year age ranging from 20 to 70 years among 200 male patients. The subjects were divided into five different age groups with ten years interval each to study the age trend of height, weight, BMI, and BP.

Results: The differences in mean BMI was statistically significant between all the age groups except for 40–49 yr and 50–59 yr age groups. The differences in mean height were statistically significant only between 50– 59 yr and 60–70 yr age groups, whereas among the rest of the groups, the differences were statistically non-significant. The differences in mean systolic BP between different age groups were statistically nonsignificant. The mean values of both the systolic and diastolic BP increased from underweight to normal and then to overweight and obese category. It showed that mean systolic and diastolic BP increased with increasing BMI level. There was also significant ($P < 0.05$) positive correlation between age and BMI, but the magnitude of correlation of age with systolic and diastolic BP ($P < 0.01$) was more than that of age with BMI.

Conclusion: BMI was found to be associated with age independently. Although the magnitude of correlation differed, there was significant positive correlation among BMI, age, systolic and diastolic BP. Odd ratios showed overweight/obese subjects to be more likely to have hypertension than those with normal BMI.

Keywords: Body Mass Index, Blood Pressure, Hypertension.

Introduction

High body mass index (BMI) is an important modifiable determinant of high blood pressure, as evidenced by meta-analyses of observational studies and weight-loss interventions. [1,2] While providing precise estimates of association between BMI and blood pressure, such studies have not elucidated whether this association has changed across time. Evidence from British birth cohorts born in 1946 and 1958 suggested an approximate doubling of the positive correlation

between BMI and blood pressure in midlife from 1989 to 2003. [3] Other studies have reported increasing strength of association, yet used hypertension as the sole outcome [4,5] (defined as elevated blood pressure or use of antihypertensive medication) and thus may be simply reflecting increases in treatment use. [6] In contrast, other studies have reported weakening of the association [7,8] or reported no clear systematic change. [6]

Understanding whether the associations between BMI and blood pressure have changed across time is important to inform future public health responses to obesity, the prevalence of which has increased markedly since the 1980s [9-11] and may continue to increase. [12] In developing countries, high blood pressure is one of the risk factors for cardiovascular diseases, and the estimated 7.1 million deaths especially among middle, and old-age adults is due to high BP. [13] Developing countries are increasingly faced with the double burden of hypertension and other cardiovascular diseases, along with infection and malnutrition. [14] The relationship between BMI and BP has long been the subject of epidemiological research. Positive association BMI and BP have also been reported among Asian populations. [15,16]

The burden of cardiovascular disease is high in South Asian countries, in their process of economic development. [17] Several studies indicate that high BP is associated with age and is also because of the process of modernization. [18,19] India in a process of rapid economic development and modernization with changing lifestyle factors has an increasing trend of hypertension, especially among the urban population. [20] Hypertension was found to be more prevalent among men than women in a study conducted among senior citizens of Delhi, India. [21] In Ethiopia and Vietnam, also hypertension was significantly more prevalent among men than women. Urban residence is the common factor in the abovementioned studies. A higher urban prevalence of hypertension was also reported in a multicentre study among elderly people in Bangladesh and India. [22]

The aim of the present study was to assess the association between BMI, blood pressure and age of male patients.

Materials and Methods

A cross-sectional study was carried out in department of physiology Government medical college, Bettiah, Bihar, India for one year age ranging from 20 to 70 years among 200 male patients. The subjects were divided into five different age groups with ten years interval each to study the age trend of height, weight, BMI, and BP. The attendant of patients coming on OPD was included in the study.

Only those who volunteered and gave written consent were studied. All experiments were performed in accordance with relevant guidelines and regulations. The research described was compliant with basic ethical standards.

Assessment and Classifications of BMI and BP

For the assessment of BMI, height, and weight measurements were taken using standard protocols given by Weiner and Lourie.[23] Stature was measured by anthropometer to nearest 0.1 cm and weight was measured using portable spring weighing machine with least count of 0.5 kg, in light clothing and without shoes. Standard mercury sphygmomanometer with appropriate cuff size was used to measure blood pressure. The subject was asked to sit relaxed in a chair with her/his arm supported comfortably and the pressure cuff was applied closely to the upper arm. The cuff was rapidly inflated to pressure above the level at which the radial pulse could no longer be felt. The stethoscope was placed lightly over the brachial artery and the mercury column was immediately allowed to fall at the rate of 2 mmHg per second. The first perception of the sound

was taken as the systolic pressure and then the mercury was allowed to fall further till the sound ceased to be tapping in quality, became fully muffled, and finally disappeared. The level where it disappeared was taken as the diastolic pressure. The cuff was then deflated to zero pressure. The measurement was repeated twice with five-minute interval and the average taken for accuracy.

Statistical analyses of the data collected were carried out using SPSS 10.0. Beside descriptive statistics, to test the differences between the age groups, t-test was done. Correlation analyses were done to determine the association between BMI, age, systolic, and diastolic BP. Multinomial logistic regression was performed to explain the impact of predictor variables in terms of odds ratios. The value of BMI was calculated and summarized age group wise, and in order to assess BMI-based nutritional status, recommended cutoff points for Asians were used. Blood pressure was classified based on JNC 7.[23,24]

Results

Table 1: Basic data and BMI of males in different age groups

Age group (years)	Stature (cm)	Body weight (kg)	Body mass index (kg/m2)
	Mean±SD	Mean±SD	Mean±SD
20–29	165±6.10	60±5.50	20.5±1.80
30–39	164.6±4.50	58.4±2.14	21.4±1.90
40–49	162.5±5.40	58.6±8.00	22.8±2.50
50–59	161.8±5.50	57.2±10.50	21.6±3.40
60–70	159.40±5.40	54.46±7.20	20.5±2.25

Maximum value for mean BMI was 22.8 kg/m2, found among 40– 49 yr age group. BMI was found to be lowest among 20–29 yr age group and declined thereafter. The differences in mean BMI was statistically significant between all the age groups except for 40–49 yr and 50–59 yr age groups. The mean value for height was found to be highest in the youngest (20–29 years) age group. Mean height decreased in each decade in the successive age groups and lowest mean height was found among the oldest (60–70 years) age group. The differences in mean height were statistically significant only between 50– 59 yr and 60–70 yr age groups, whereas among the rest of the groups, the differences were statistically non-significant. Body weight increased with age till the age of 49 and decreased thereafter but the differences were statistically significant only between 20–29 yr and 30–39 yr age groups and between 50–59 yr and 60–70 yr age groups. Weight was found to be highest among 40–49 yr age group and lowest among 60–70 yr age group.

Table 2: Blood pressure among males in different age groups

Age group (years)	N	Systolic	Diastolic
20–29	70	123.5±13.30	78.3±10.45
30–39	50	124.8±13.50	76.4±10.60
40–49	25	125.5±14.30	81.5±10.34
50–59	30	126.4±22	83.7±14.26
60–70	25	132.5±24.26	80±15.45

Both the mean systolic and diastolic BP were found to be lowest among the youngest age groups. Systolic BP increased steadily with age and the highest was found among the oldest age group. The differences in mean systolic BP between different age groups were statistically nonsignificant. Diastolic BP increased with age till 40–49 yr and declined thereafter but the differences in mean BP between age groups were statistically nonsignificant with the exception of 20–29 yr and 30–39 yr age groups.

Table 3: Distribution of subjects in different categories of BMI and BP

Distribution of subjects	N	%
BMI		
Underweight	28	15
Normal	140	70
Overweight/obese	32	16
Systolic BP		
Normal	60	30
Prehypertension	96	48
Hypertension stage I	32	16
Hypertension stage II	12	6
Diastolic BP		
Normal	86	43
Prehypertension	48	24
Hypertension stage I	56	28
Hypertension stage II	10	5

Maximum numbers of subjects were in normal BMI category (70%) followed by those in overweight/obese category (16%). Lowest numbers of subjects were found in underweight (14%) category. As assessed from systolic blood pressure, maximum numbers of subjects were in prehypertension (48%) stage followed by those with normal (30%) systolic BP. Diastolic BP showed maximum subjects to have normal (43%) BP followed by those in prehypertension (23.3%). There were sizeable numbers of stage I hypertensive subjects as assessed from both systolic (16%) and diastolic (28%) blood pressure among males. There were also 6% and 5% stage II hypertensive subjects as assessed from systolic and diastolic blood pressure respectively.

Table 4: Systolic and diastolic blood pressure of males in different BMI categories

BMI classifications	N	Systolic	Diastolic
Underweight	28	116.4±13.06	73.7±10.66
Normal	140	125.5±15.25	78.2±12.58
Overweight/obese	32	130.4±5.75	88.2±11.89

Minimum mean systolic and diastolic BP was found in underweight category and the maximum systolic and diastolic BP were found among obese category. The mean values of both the systolic and diastolic BP increased from underweight to normal and then to overweight and obese category. It showed that mean systolic and diastolic BP increased with increasing BMI level.

Table 5: Correlation matrix between BMI, blood pressure, and age

Variables	Correlation between BMI and BP			
	BMI	**Systolic BP**	**Diastolic BP**	**Age**
BMI	1.000	0.270	0.350	0.120
Systolic BP	0.260	1.000	0.565	0.160
Diastolic BP	0.365	0.540	1.000	0.155
Age	0.105	0.176	0.156	1.000

There were significant ($P < 0.01$) positive correlations of BMI with both systolic and diastolic BP. It showed that BP increased with increase in BMI. Correlation coefficient showed that relationship of BMI with diastolic BP (0.350) was stronger than systolic BP (0.270). There was also significant ($P < 0.05$) positive correlation between age and BMI, but the magnitude of correlation of age with systolic and diastolic BP ($P < 0.01$) was more than that of age with BMI.

Discussion

Obesity is a major cause of hypertension (HTN), diabetes mellitus (DM), and dyslipidemia, which are risk factors for cardiovascular diseases. [25] The body mass index (BMI) is one of the indicators that can be used to easily assess the degree of obesity and is positively correlated with blood pressure (BP). [26] High BMI values in adolescence are associated with coronary heart disease, stroke, and mortality in adulthood. [27] Globally, high blood pressure is estimated to cause 7.1 million deaths, about 13% of the total. About 62% of cerebrovascular disease and 49% of ischaemic heart disease are attributable to suboptimal BP (systolic > 115mmHg). Overweight and obesity increase the risks of high BP, coronary heart disease, ischaemic stroke, type II diabetes mellitus, and certain cancers. Worldwide, about 58% of diabetes mellitus and 21% of ischaemic heart disease are attributable to BMI above 21 kg/m2. [13]

The increase in body weight and BMI with age and decline in advanced age has also been reported by Kapoor and Tyagi [28] and Tandon. [29] Increase in body weight till middle age may be due to the accumulation of fat with age as the younger subjects have larger appetite leading to increased energy intake, fat rich diet, and relatively less energy expenditure due to lesser involvement in physical activities. The decline in body weight in more advanced age may be attributed to the decrease in muscle mass in response to reduced amount of protein intake as well as decline in number and size of muscle fibers due to degenerative diseases associated with the advancing age. It may partly be due to bones becoming lighter because of gradual mineral mass loss. [30] Age was positively correlated with BMI and both systolic and diastolic BP. Systolic and diastolic blood pressures increased with age steadily from the youngest to the oldest age group showing the dependence of BP on age. Earlier studies also indicated that high BP is associated with age. [31,32] In the present study, association of age with systolic and diastolic blood pressures was stronger than that of age with BMI. Thus, the association of systolic and diastolic BP with age was more significant than that of BMI with age. Blood pressure was higher in the elderly strata of the sample with or without a corresponding elevation in BMI suggesting the involvement of some other contributory factors also for hypertension besides fats accumulation alone. A significant correlation between BP and age was also reported in a study from North India. [33]

The present study showed BMI as strong predictor of blood pressure. Kumanyika et al. [34] have shown body mass index to be even more strongly related than race to blood pressure and that its effect is similar

across surveys in the United State and within sex and racial groups. A number of investigators have concluded that among many relevant factors, body mass index is one of the most important predictors of blood pressure. Although ethnicity and genetics have long been known to influence the distribution of blood pressure levels within a population, these factors seem to have less bearing on the difference in blood pressure levels between populations [35]. Underweight subjects were less likely to have high blood pressure than those who were in normal BMI category. Overweight or obese subjects were more likely to have significantly higher blood pressure than those with normal BMI in all the three stages of prehypertension, stage I hypertension, and stage II hypertension.

Conclusion

The study demonstrated that body mass index is closely associated with both systolic and diastolic blood pressure among males. BP is also associated with rising age independently. Though the magnitude of correlation differed, there was positive and significant correlation among BMI, age, systolic and diastolic blood pressures. Mean systolic and diastolic BP levels were higher among subjects with elevated BMI. The risk of hypertension was higher among population groups who were overweight or obese. There were sizable numbers of hypertensive subjects, especially in stage I.

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