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Original Research Article

The effect of body mass index on blood pressure in adults with hypertension

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ABSTRACT

Background: We investigated the association of body mass index (BMI) measurements in adult hypertensive patients with normal weight and overweight including obesity.

Methods: This was a randomized study performed in Udaipur, India, on 200 hypertensive patients aged (32-90) years. Patients were divided according to their body weight (normal weight vs overweight and obesity) into two groups. Weight, height and BMI were measured to estimate the various categories of bodyweight.

Results: We found significant relations between body weight and blood pressure. Patients with normal weight had a normal blood pressure. However, a significant increase in blood pressure was observed in patients with overweight and obesity.

Conclusions: BMI is related with weight status in hypertensive overweight / obese patients.

Keywords: Body mass index, Hypertension, Normal weight, Overweight, Obesity

INTRODUCTION

Hypertension is responsible for slightly less than 8 million deaths per year worldwide. It is the cause of nearly half of strokes and cardiovascular deaths.¹ Incidence and prevalence of hypertension is increasing day by day. According to the World Health Organization (WHO) hypertension is the most deadly cardiovascular risk factor.² It represents a major public health problem in almost all regions of the globe.³ In 2000, the estimated prevalence of hypertension was 26.4% (26.6% in men and 26.1% in women) and is expected to rise to 29.2% by 2025 (29% in men and 29.5% in women). Among the 972 million hypertensive adults, 333 million, or 34.3%, are from "developed" countries, and 639 million, or 65.7%, from "developing" countries.⁴ Hypertension is also the third leading cause of death in India, similar to the global situation where it is responsible for 30% of deaths. Six

million Indian suffer from this silent disease, to 26-35% of adult subjects.⁵ Lower blood pressure levels could theoretically be used to further reduce the risk of cardiovascular complications.⁶

Hypertension is recognized also as a complication of overweight/obesity, with several studies showing a strong link between body weight and blood pressure. Hypertension is a multifactorial disease resulting from the interaction of genetic and environmental factors including nutritional factors. Numerous epidemiological studies have reported the relationship between lifestyle, diet and blood pressure in different populations.⁷ Thus, changes in eating behaviors (reducing dietary intake of cholesterol, saturated fat and salt) can reduce blood pressure. These non-drug measures should be systematically integrated into the therapeutic approach as they act in a complementary manner.

The aim of our study was to analyze the relationship between body mass index (BMI) and hypertension.

METHODS

The study was carried out in the Department of General Medicine, Pacific Hospital, Udaipur, India. The permission of Institutional Ethical committee was taken in proper format according to guidelines. We conducted a cross-sectional survey by questionnaire to first identify the weight status of patients and subsequently to assess the association of blood pressure with body weight. The study included 200 patients (88 men and 112 women) aged 32-90 years of hypertension between November 2014 and July 2015, after taking well informed written consent. The participants were chosen randomly (patients that presented at the hospital for a consultation in a consecutive manner were selected). Each participant had to fill in a questionnaire about their weight.

Inclusion and exclusion criteria

We included hypertensive subjects who live in the city of Udaipur, aged over 30 years. We recruited only patients consulted in the hospital who accepted to participate in the study after receiving an explanation of its objectives. We excluded all hypertensive patients suffering from another disease or a complication of hypertension. We have included hypertensive subjects that were under treatment' but we excluded patients with resistant hypertension defined as blood pressure values which remained high despite the concomitant use of three antihypertensive drugs, according to the guidelines.^{8,9} None of the participants used any vitamins, mineral supplements or oral contraceptives. None of the females were pregnant or breastfeeding.

Body mass index measurements

Measurement of body weight (in kilograms) was performed using an electronic balance' and height (in meters) was measured using a body stadiometer. BMI (kg/m^2) was calculated by weight (in kilograms) divided by the square of height (in meters)' Adults were classified according to their BMI into two groups: normal weight (BMI: 18.5-24.9 kg/m^2) and overweight (BMI: 25.0-29.9 kg/m^2) including obese (BMI: >30 kg/m^2).

Blood pressure measurement

Blood pressure measurements were made in the presence of the attending physician. OMRON digital automatic blood pressure. We have performed three reading and considered the average of readings as the patient blood pressure. The measurements are expressed in millimeters of mercury (mm Hg). Normal blood pressure is defined as a systolic blood pressure between 120 and 139 mmHg and/or diastolic blood pressure 80 to 89 mmHg. Above these values, we could diagnose hypertension.

After blood pressure measurement, a questionnaire was distributed to patients in order to learn about their socio-economic status, physical activity, as well as their usual daily food intake. We used a 24 h reminder to estimate dietary intake of the subjects surveyed. After collecting the data from our study, we opted for the division of the population into two groups according to BMI: Group 1: normal weight; Group 2: overweight and obesity.

Statistical analyses

Data were expressed as mean \pm SD. We used Statistical package for social sciences (SPSS) 20.0 for Windows for statistical analyses. A $p < 0.05$ was considered statistically significant with a confidence interval of 90%. The student t-test was used to compare means of anthropometric measurement and blood parameters between groups and the Chi-square test was used for comparing percentage values.

RESULTS

The average age of the surveyed population was 56.90 ± 11.02 years with a minimum age of 32 years and a maximum age of 90 years. Males presented an average age of 57.26 ± 11.20 years and females 51.90 ± 10.82 years.

The average systolic blood pressure of the study population was 132.60 ± 15.40 mmHg, with a maximum value of 160 mm Hg and a minimum value of 110 mmHg. The average systolic blood pressure for men was 140.60 ± 14.90 mmHg with a maximum of 160 mmHg and a minimum of 110 mmHg. In women, the average systolic blood pressure was 132.70 ± 15.90 mmHg with a maximum of 160 mmHg and a minimum of 110 mmHg. The systolic blood pressure varied between 130mmHg in the age group 30-40 years and 160 mmHg in the age group (90-100) years. We give in Table 1 the mean values for weight, height and BMI according to sex.

Table 1: Mean values of weight, height and BMI of our study population.

BMI	Total			Men			Women			P value
	Mean \pm SD	Min	Max	Mean \pm SD	Min	Max	Mean \pm SD	Min	Max	
Weight (kg)	74.94 \pm 13.59	50	103	75.92 \pm 14.18	51	103	74.35 \pm 14.82	49	102	0.024
Height (cm)	167.08 \pm 6.09	154	178	173.60 \pm 3.15	167	178	164.78 \pm 4.37	154	174	0.054
BMI (kg/m^2)	25.96 \pm 5.11	17.5	36.5	24.46 \pm 4.65	17.5	35.1	28.20 \pm 4.62	18.5	36.9	0.058

Table 2: Blood pressure according to body weight.

BP	Total		Mean		Women		P value
	Systolic	Diastolic	Systolic	Diastolic	Systolic	Diastolic	
Underweight	122.00±05.00	72.00± 06.00	120.00±06.00	70.00±06.00	-	-	0.061
Normal	126.10±10.90	82.60±11.30	132.00±16.80	80.00±04.60	126.30±17.50	81.20±11.20	0.69
Overweight	142.60±18.10	88.50±09.50	152.00±07.80	78.00±08.00	138.70±17.60	88.70±11.40	0.032
Obesity	138.30±11.20	84.70±09.20	136.00±08.00	82.00±06.00	134.40±11.30	88.20±11.20	0.026

Overall, we recorded 129 subjects with normal weight status (66 women and 63 men), representing 64.66% of the total population. In total 71 subjects (38 men and 33 women), representing 35.33% of the population were overweight and obese. In men, the dominant class of BMI category was overweight with a percentage of 38.47% and 38.46% had normal weight. For women, the dominant class of BMI category was overweight with a percentage of 40.54%. We found that hypertensive patients who have a normal weight or were underweight have normal/low blood pressure. Blood pressure was significantly higher in patients who are overweight or obese, as shown in Table 2.

DISCUSSION

Hypertension is the cause of nearly half of strokes and cardiovascular deaths. The increasing prevalence of overweight and obesity is becoming a major public health crisis owing to its upsurge association with risk of major chronic diseases, such as hypertension.¹⁰ It is well established that factors like poor diet, sedentary lifestyle and smoking represent risk factors for hypertension.¹¹ The purpose of the present study was to investigate the relationship between weight status in hypertensive subjects, results are in consistency with data of many studies showing that males are taller and heavier as compared to females. However, females have higher BMI values.^{12,13}

Patients with hypertension tend to have a low socioeconomic status. For example, in our study 56.24 % had no occupation and 48% were illiterate and 67% a came from a large family. In addition, these patients live in precarious conditions and almost 65% live in communal houses. These conditions have a decisive influence on the diet of patients (poor nutrition). This is concordant with other published results showing that the prevalence of hypertension is inversely related to the level of education and the social environment: farmers, workers and the less educated are those who are diagnosed most often with hypertension.¹⁴ The frequency of poorly controlled blood pressure values was reported to be significantly greater in men.¹⁵

Women are more often aware of their hypertension diagnosis than men.¹⁶ This study showed that the rate of obese women is two times greater than that of men (23.62% versus 9.50%). Obese adults aged 25 to 45 are at risk of developing hypertension 5-6 times greater than the lean subjects. Obesity is considered one of the most important

cardiovascular risk factors that causes and maintains other risk factors such as hypertension.¹⁷ Body weight is not only regarded as a risk factor for hypertension, but also a parameter that controls the health status of hypertensive patients, the progression of the disease and the treatment of the disease.

Cross-sectional and prospective epidemiological studies have shown that blood pressure and, worse still, hypertension increase significantly with higher body BMI and waist circumference (WC).¹⁸ The rules for a healthy lifestyle and eating habits can sometimes be enough to normalize blood pressure and must always be available. These recommendations include: weight loss, aiming to maintain BMI below 23.5 kg/m², or at least to obtain a reduction of 10% of initial weight; decreased consumption of salt, if possible less than 6 gm/day, increased consumption of dietary fiber, especially with a diet rich in vegetables and fruits, and reduce that of fat, especially the saturated fats (thus, it was shown that a vegetarian diet reduces blood pressure by 5.2 mmHg in average); increasing potassium consumption; fight against well known hypertension risk factors (smoking, high cholesterol levels, diabetes, physical inactivity; use a low-dose estrogen pill).²⁰ The reduction in these risk factors is recommended to prevent and/or treat hypertension.²¹

It should be noted that cases with causes of secondary hypertension like diabetes mellitus, chronic renal failure, obesity, smoking, alcoholism and drugs were eliminated from the study, hence our results may vary slightly from other studies which have included all these factors. According to few studies, metabolic disturbances are common in hypertensives, so the blood test to measure the blood sugar levels and lipid profile of patients with hypertension is an essential part of their management.^{22,23} We must encourage a healthy change in lifestyle, diet and physical activity in hypertensive patients. However, it should be noted that this study has several limitations, including selection of patients from only one area of the country and that subjects were non-randomized from the general population. Replication of such studies in other regions and with a larger sample in order to cover the different departments of the country is required.

CONCLUSION

In 200 hypertensive patients we found that significant relations between body weight and blood pressure. The relationship between body weight and hypertension in our

study was not influenced by gender. This proves the importance of losing weight for hypertension subjects in order to improve the blood pressure control and reducing its complications. A modest weight loss, especially when maintained over time, significantly reduces the risk of complication associated with hypertension in overweight adults.

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