Original Research Article

A cross-sectional study on newly detected hypertensive individuals and its correlation to BMI

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Abstract

Background: With obesity turning into a global epidemic, the incidence of hypertension is also increasing and this is the morbidity due to its long term effect on the heart and kidneys. Identification of the disease at the earliest stage possible is crucial in preventing the irreversible pathologies occurring as a direct consequence of hypertension. Since the early disease course of hypertension is predominantly silent in most individuals, early diagnosis is largely rewarding to the patient as well as the physician.

Aim of the study: To study the correlation between BMI and the incidence of hypertension in individuals with normal BMI and raised BMI.

Material and methods: This was an observational study conducted among 1980 adults attending Non-Communicable disease OPD at Government Royapettah Hospital over a period of 12 months. BMI was calculated for all individuals and blood pressure was measured by standard technique. All the individuals were categorized according to JNC 8 and WHO criteria for BMI. The mean BP in each of the BMI categories was calculated and compared with each other. Similarly, the mean BMI was calculated for individuals falling in each of the BP categories and the incidence of hypertension was compared.

Results: Among 1980 individuals studied, 1200 were diagnosed with hypertension. The mean BP of individuals with Normal BMI was found to be 127/88 mm Hg, whereas for those with overweight BMI was found to be 142/93 mm Hg. The BMI and BP correlation was found to be strongest with the Overweight individuals, where the mean BMI was 27.1 kg/m^2.

Conclusion: The association between BMI and BP is positive across tens of thousands of individuals in population subgroups, and, if causal, given its magnitude, would have significant implications for public health.

Key words

Hypertension, Coronary artery disease, Obesity, Dyslipidemia.

Introduction

Due to industrialization and urbanization, the standard of living continues to rise particularly in developing countries. This has led to weight gain and obesity, which are posing a threat to the health of citizens [1]. Obesity is perhaps the most prevalent form in developing countries, both among adults and children. Studies have demonstrated that obesity is related to elevated systolic blood pressure (SBP) and diastolic blood pressure (DBP) elevation, dyslipidemia, diabetes, etc. Obesity, its attendant health consequences, and consequent health burden are expected to reach epidemic proportions in developing countries like India [2]. An increase in the dimension of this problem has been reported in the high socioeconomic group in India. A study in Delhi revealed even higher prevalence (32-50%) of overweight (body mass index (BMI) >25) among adults belonging to high income group as compared with 16.2-20% in those belonging to middle-income groups. BMI, calculated as weight in kg/height in meters squared, is most widely used to estimate the prevalence of obesity or underweight within a population [3]. The relationship between BMI and blood pressure has long been the subject of epidemiological research. A positive association of BMI and blood pressure has also been reported among Asian populations [4]. India in a process of rapid economic development and modernization with changing lifestyle factors has an increasing trend of hypertension, especially among urban population [5]. It is important from a public health perspective to have data on the characteristics and health of a population and of different subgroups in the population because of the racial/ethnic disparities in terms of long-term health consequences. It is necessary to identify individuals and populations at risk. The present study was therefore undertaken to examine the prevalence of overweight and obesity among adults on the basis of BMI and to analyze the relationship between and blood pressure [6].

Materials and methods

An observational study was conducted among patients attending Non-Communicable Diseases screening OPD at Government Royapettah Hospital during a period of 12 months from January 2018 to December 2018. In this study, 1980 patients aged above 30 years were included. The parameters measured were height, weight using an analog weighing scale. Body Mass Index was calculated using Pondrel Index Weight (kilograms)/ Height (meter) BMI was classified according to World Health Organization criteria. To measure blood pressure, patient was advised to empty their bladder and to be seated for five minutes with back supported and legs resting on the ground. Arm used for measurement was made to rest on a table at heart level. Using an automated electronic device, with a correct size arm cuff, two readings were made two minutes apart and the average was considered. Blood pressure was measured and classified according to JNC 8 guidelines. All the individuals screened were divided into hypertensive and non-hypertensive group. In each group the individuals were allocated into each of the BMI classes. The mean systolic and diastolic BP was calculated for each of the BMI class and compared for both the groups.

Statistical analysis

All statistical analyses were conducted using R, version 3.3 (The R Foundation for Statistical Computing). The proportion of individuals with stage 1 hypertension (SBP ≥140 mm Hg or DBP ≥90 mm Hg) and stage 2 hypertension (SBP

≥160 mm Hg or DBP ≥100 mm Hg), as classified by JNC 7 (the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure) [14], were reported. The association between BMI and BP was analyzed for subgroups of greater than 5000 patients, defined by sex, age, household income, occupation, race/ethnicity, marital status, "Hukou" status (urban vs rural vs unified residence status), province, educational level, currently smoking, history of stroke, and antihypertensive treatment status. The smoothed conditional mean of BMI given BP for these subgroups was fit with an unadjusted generative additive model to visually explore the linearity of the association between BMI and BP.

Results

Among 1980 individuals studied, 1200 individuals were diagnosed with hypertension. The mean systolic and diastolic BP was observed to be in a progressive raising trend in proportion to the rise in BMI. The mean BP in individuals with normal BMI was found to be 127/88mm Hg. The mean systolic BP was found to be highest in Obesity class III and diastolic BP was highest in Obesity class II (**Table – 1**).

Table – 1: BMI comparison.

BMI	**Mean BP hypertensive**		**Mean BP non-hypertensive**	
	Systolic	**Diastolic**	**Systolic**	**Diastolic**
Underweight	121	84	107	76
Normal	127	88	112	78
Overweight	142	93	118	75
Obesity class I	144	94	123	77
Obesity class II	148	106	126	82
Obesity class III	148	102	129	80

Table – 2: Mean BP in each category of BP.

BP category	**BMI**						
	Under weight	**Normal**	**Over weight**	**Obese class 1**	**Obese class 2**	**Obese class 3**	**Total**
Normal	90	322	153	101	99	15	780
Pre-hypertension	43	134	172	81	75	19	524
Stage I HTN	37	143	142	90	62	12	486
Stage II HTN	17	48	69	32	21	3	190
	187	647	536	304	257	49	1980

The individuals studied were also grouped as per JNC 8 classification and the number of individuals falling into each category of BMI was recorded. The distribution of the population studied was maximum in normal BMI category followed by overweight category. It was found that the majority of people with prehypertension fell into the category of Overweight. The individuals in Stage I hypertension had almost equal numbers falling in normal BMI and Overweight. The individuals with normal BP category had a mean BMI of 24.3 kg/m^2, whereas the mean BMI for prehypertension individuals was calculated to be 27.1 kg/m^2 (**Table – 2**).

Discussion

Hypertension is defined as either Systolic BP ≥140 mm Hg or Diastolic BP ≥90 mm Hg. Of the various environmental and genetic factors

contributing to hypertension, Obesity and weight gain are considered to be a strong and independent risk factor for the development of hypertension [7]. JNC 8 has classified elevated blood pressure in adults into prehypertension, Stage I and Stage II hypertension. Obesity has been acknowledged as a global epidemic by the World Health Organization. The present obesity epidemic is mainly due to lifestyle modification in recent times [8]. Obesity is predisposed by genetic factors and influenced by inappropriate food intake in proportion to energy expenditure. The ob gene on chromosome 7 is found to be expressed exclusively adipose tissue and encodes a 16 kDa protein called leptin [9]. Leptin acts as a feedback mechanism between adipose tissue and brain, controlling fat stores by regulating hunger and satiety [10]. In addition, a number of substances released centrally and peripherally control hunger and satiety [11]. Centrally, arcuate nucleus and lateral hypothalamic area play a key role in appetite [12]. The central appetite-suppressing (anorexigenic or leptin-melanocortin) pathway expresses α MSH from POMC to act on melanocortin-4 receptors [13]. These pathways interact with each other to influence the autonomic nervous system and ingestive behavior. The peripheral appetite-suppressing signals include leptin and insulin, while Ghrelin acts as a peripheral appetite-stimulating signal. The circulating concentration of ghrelin is inversely related to BMI while the concentration of leptin and insulin is directly related to BMI. The peripheral hormones implicated in control of satiety are cholecystokinin (CCK), bombesin, glucagon-like peptide (GLP 1) and somatostatin from small intestine as well as glucagon and insulin from pancreas [14]. Another system involved in central and peripheral regulation of food intake is the endocannabinoid system. The endocannabinoids produced form the hypothalamus is inversely proportional to the amount of leptin in blood [15]. The neurotransmitters which act as appetite inhibitors are dopamine, serotonin, γ-aminobutyric acid and the appetite stimulators are opioids. All these central and peripheral mechanisms lead to obesity. Obesity is related to pathogenesis of hypertension by increasing the activation of sympathetic nervous system, adipose RAS synthesis, nephron number/body size mismatch and renal parenchymal compression causing hyperfiltration and glomerulopathy and finally leading to the development of hypertension [16].

Conclusion

BMI is positively correlated with the incidence of hypertension in adults. Overweight is strongly associated with the development of systolic and diastolic hypertension. In this study, the mean BMI of newly detected hypertensives is found to be 27.1 kg/m^2. Hence, screening for hypertension should begin at high normal BMI range itself in adults to identify hypertension earlier.

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