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Research Article

**CORRELATION BETWEEN BODY MASS INDEX (BMI) AND  
BLOOD PRESSURE**<sup>1</sup>Dr. Faizan Majeed, <sup>2</sup>Dr Sumaira Jabeen, <sup>3</sup>Dr. Muhammad Aamir<sup>1</sup>Gujranwala Medical College<sup>2</sup>Islamic International Medical College Rawalpindi<sup>3</sup>DHQ Hospital Rajanpur**Abstract:**

**Background:** Obesity and hypertension are long thought to be related. Correlation between Body Mass Index (BMI) and Hypertension has been consistently observed, but remain poorly understood. It is inferred that BMI is strong indicator of obesity and increased BMI is a prognostic factor for hypertension. One unresolved question is whether there is a correlation present between them or not.

**Objective:** To study correlation between BMI and Hypertension.

**Research Methods:** This hospital based descriptive and cross-sectional study was conducted in medical OPD of District Headquarter Hospital, Gujranwala from 1st June to 30th June, 2014. A total number of 50 patients between ages of 25 to 55 were investigated through preformed structured questionnaire.

**Results:** Among 50 investigated patients, 27 (54%) were found to have hypertension and among these 21(77.77%) were overweight and 6 (22.22%) had normal BMI.

**Conclusion:** Patients with increased BMI or overweight had significantly more frequent hypertension.

**Keywords:** Obesity, Hypertension, Body Mass Index, BMI, Correlation

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## INTRODUCTION:

The correlation of both hypertension and BMI, as important public health challenges, is increasing worldwide. The correlation between body mass index and blood pressure has been established more than 70 years ago. 01 The definition of hypertension has evolved over time. Normal BP is defined as less than 120/80 mmHg, pre hypertension as 120–139/80–89 mmHg, stage I hypertension as 140–159/90–99 mmHg, and stage II hypertension as equal to and above 160/100 mmHg [01].

Hypertension (HTN) is usually found incidentally by healthcare professionals measuring blood pressure during a routine checkup [2]. Although no specific medical cause can be determined in essential hypertension, it often has several contributing factors which include obesity, salt sensitivity, renin homeostasis, insulin resistance, genetics and age. 02 Hypertension is also known as a Silent killer because in many cases there are no symptoms until serious complications develop.

BMI means body mass index and is used to calculate a healthy weight range from underweight to overweight people. 03 The healthy range for BMI is considered to be between 19.5 and 25.0 [3]. The deposition of fat could be generalized or may occur preferentially in different adipose tissue compartments [4]. Centrally located body fat is a more important determinant of blood pressure elevation than is peripheral body fat [5]. Obesity is graded according to BMI as: Healthy weight between 18.5-24.9, Overweight between 25-29.9, Obesity-I between 30-34.9, Obesity-II between 35-39.9, Obesity-III 40 or more[6]. Increased BMI is associated with many health complications e.g.: Type-2 Diabetes, CHD, hypertension, stroke, arthritis and gall bladder diseases [7].

Though body fat is thought to be a major casual factor of increased pressure, the true correlation between high blood pressure and body mass index remains obscure [8]. The correlation between BMI and hypertension is of particular interest as excess cardiovascular mortality among lean hypertensive subjects has also been reported in some longitudinal studies [9,10]. Other studies that have examined the relationship between body weight and cardiovascular mortality also reported a curvilinear relationship with increased risk of mortality among the very lean and very overweight [11,12]. Measurement of blood pressure in the obese requires use of a larger cuff size to avoid artifactual increases. Obesity-induced hypertension is associated with increased peripheral resistance and cardiac output, increased sympathetic

nervous system tone, increased salt sensitivity, and insulin-mediated salt retention; it is often responsive to modest weight loss[13]. Weight control throughout life is key to prevention of high blood pressure during middle age[ 14].

Literature suggests that diastolic blood pressure intervention alone may avert one million deaths per year throughout in Asia. Increased blood pressure is a very important public health issue with prevalence of 15% in different parts of world. 15 Pakistan health demographic survey 2006-07 shows that excessive body weight is important cause of hypertension and achieving a desirable bodyweight is one of the non-pharmacological therapies, which helps controlling hypertension[15].

Hypertension being a major health issue, we intended to find the correlation between BMI and hypertension in the patients of DHQ, Gujranwala attending medical OPD, where a large number of patients are hypertensive having different nutritional status and BMI. In this way we were able to know one of the modifiable factors of hypertension.

## LITERATURE REVIEW

There are a number of studies that suggest there is a strong relationship between blood pressure and body mass. We studied several articles which previously reported the relationship between blood pressure and body mass index.

INTERSALT was a large scale study from men and women from 52 centers and 32 different countries. This study focused on urinary electrolytes and blood pressure but it also provided an opportunity to examine the relation of body weight and blood pressure [16, 17]. A linear regression of systolic blood pressure, diastolic blood pressure, and BMI were conducted for men and women separately. The relation of BMI and blood pressure was found to be positive and significant for men and women. The prevalence of hypertension was higher in those individuals who were overweight [17].

A study published in American Journal of Epidemiology explored the relationship between blood pressure and weight in urban adolescents. 18 Black and White youth with high body weight had higher blood pressure compared to normal weight youth[18].

Humayun, Shah AS, Sultan R studied the relation of hypertension with body mass index and age in male and female population of Peshawar, Pakistan [19].

This study was conducted at KMC, Peshawar during 2008-2009. A total of 1006 adult male and female volunteers were the subject of research and were categorized in terms of their ages. BMI was determined from weight and height. The results show a consistence relation between BMI and hypertension within age groups in both male and females. The results showed a higher trend of hypertension with increasing BMI. It was noted that with a shift from normal BMI the incidence of hypertension was very high [19].

An article was published in The Aric Study Obesity Research, 2000 by title of "Associations of fat distribution and obesity with hypertension in the bi-ethnic population" which examined the association of high blood pressure and fat distribution using the Atherosclerosis Risk in Communities (ARIC) Study [20]. This study included 15,063 African American and White participants in Mississippi, Minnesota, Maryland, and North Carolina. Participants were between the ages of 45-64. The indices which they studied included BMI, waist-to-hip ratio (WHR), and waist/height ratio. African American women were heavier and had larger waist circumferences and waist/height ratios than White women. African American men were similar in weight and had lower WHRs, waist circumferences, and waist/height ratios than white men. 20 The prevalence of hypertension was disproportionately higher in African Americans than Whites. Logistic regression models were used to derive pseudo R-square values for each anthropometric variable (BMI, WHR, waist circumference, waist/height ratio) regressed on hypertension. The r-square values were higher for White women than African American women. R-square values were similar for both African American men and White men. Overall, the models that included BMI and WHR had slightly greater explanatory power on hypertension than models that only included BMI [20].

In the study from Great Britain [21] researchers tracked more than 3,000 men and women born in

1946. Each was regularly contacted since birth, and various tests, including blood pressure and body mass index (BMI, a measure of body fat through weight for height) were done at ages 36, 43, and 53. The researchers looked to see if birth weight, long suspected of influencing blood pressure later in life, had an effect on increasing blood pressure during a person's lifetime. 21 They found that high BMI throughout life had "a strong effect" on high blood pressure between ages 36 to 53, reports researcher Rebecca Hardy, PhD, an epidemiologist with the Royal Free and University College Medical School in London. Weight Control Is Key [21].

## **MATERIALS AND METHODS**

### **❖ Study Design:**

Study design was Descriptive and Cross Sectional.

### **❖ Study Area:**

Research took place at medical OPD of District Headquarter Hospital, Gujranwala.

### **❖ Duration of Study:**

Duration of study was 1 Month.

### **❖ Study Subject:**

Our study subjects were patients of ages 25 to 55 years attending medical OPD of District Headquarter Hospital, Gujranwala.

### **❖ Sample Size:**

The Sample size was calculated by using EPI-Info computer software. The sample size was 50 patients.

### **❖ Data Collection:**

Data was collected through simple preformed structured Questionnaires..

### **❖ Data Analysis:**

Data was entered into SPSS software and Chi Square Test was used on qualitative outcome. A p-value of 0.05 or less was taken as significant. Frequency charts were formed.

### **❖ Sampling Technique:**

Non probability convenience sampling technique was used.

**RESULTS****Table No. 1:****Age of patient**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 25-35 years	25	50.0	50.0	50.0
36-45 years	12	24.0	24.0	74.0
45-55 years	13	26.0	26.0	100.0
Total	50	100.0	100.0	

Among 50 investigated patients, 25 (50%) were of ages between 25-35 years. 12 (24%) were between ages 36-45 years and 13 (26%) were of ages between 45-55 years.

**Table No. 2:****Sex of patient**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Male	24	48.0	48.0	48.0
Female	26	52.0	52.0	100.0
Total	50	100.0	100.0	

Of the patients under study, 24 (48%) were females and 26 (52%) were males.

**Table No. 3:****Occupation of the patient**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid farmers/laborers	9	18.0	18.0	18.0
employees	18	36.0	36.0	54.0
businessman	1	2.0	2.0	56.0
unemployed	22	44.0	44.0	100.0
Total	50	100.0	100.0	

We divided our patients into four (4) categories based on their occupation. It was found that most of them were either unemployed / housewives i.e. 22 (44%) or doing some job i.e. 18 (36%). 9 (18%) patients were farmers / laborers and 1 (2%) was businessman.

**Table No. 4:****Weight of patient**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid less than 50 Kg	2	4.0	4.0	4.0
Between 50-70 Kg	24	48.0	48.0	52.0
greater than 70 Kg	24	48.0	48.0	100.0
Total	50	100.0	100.0	

Patients' weights were measured in OPD and it was found that 24 (48%) patients weighed greater than 70 Kg and 24 (48%) patients had weight between 50 to 70 Kg. While only 2 (4%) patients weighed less than 50 Kg.

**Table No. 5:**  
**Height of patient**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than 5 feet	2	4.0	4.0	4.0
	5 feet to 5 feet 6 inches	26	52.0	52.0	56.0
	5 feet 7 inches to 6 feet	22	44.0	44.0	100.0
	Total	50	100.0	100.0	

While measuring height 26 (52%) patients measured between 5 feet to 5 feet 6 inches. 22 (44%) were tall enough to be between 5 feet 7 inches to 6 feet. Only 2 (4%) were of height less than 5 feet.

**Table No. 6:**

**Body Mass Index of Patient**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	underweight	2	4.0	4.0	4.0
	normal	20	40.0	40.0	44.0
	overweight	28	56.0	56.0	100.0
	Total	50	100.0	100.0	

BMI was calculated by using standard formula and it was found that among 50 patients 28 (56%) were overweight. 20 (40%) had BMI within normal range and 2 (4%) were regarded as underweight.

**Table No. 7:**

**Blood pressure**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	120/80 mmHg	23	46.0	46.0	46.0
	121-139 / 80-89 mmHg	15	30.0	30.0	76.0
	140-159 / 90-99 mmHg	12	24.0	24.0	100.0
	Total	50	100.0	100.0	

Blood pressure was measured and 23 (46%) patients had normal BP. Meanwhile 15 (30%) patients had pre hypertension and 12 (24%) had full blown Stage-I Hypertension.

**Table No. 8:**

**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.242a	4	.016
Likelihood Ratio	13.462	4	.009
N of Valid Cases	50		

a. 4 cells (44.4%) have expected count less than 5. The minimum expected count is .48.

Chi Square test was performed on BMI and BP variables with  $df = 4$ . The outcome value was 0.016 which was less than 0.05 and found to be significant.

## DISCUSSION

In our study, among total of 50 patients 28 (56%) were overweight and 21 (42%) had hypertension whereas 22 (44%) were normal and only 6 (12%) of these were hypertensive showing increasing frequency of hypertension with increased with BMI in both genders. These results are similar to results obtained in large study by Frederique Thomas et al, who also reported similar results that when patients with BMI overweight were compared to those with BMI normal, overweight had more chances of hypertension [22].

In our research, a total of 27 (54%) patients were hypertensive. Out of these, 21 were obese (77.77%) while 06 were non-obese patients (22.22%), with significant statistical differences ( $p=0.016$ ). These findings correlate well with INTERSALT 23 study where the relationship between BMI and blood pressure was studied in over 10,000 men and women between the ages of 20 and 59 years, sampled from 52 centers around the world. BMI was significantly associated with systolic and diastolic blood pressure, independent of age, alcohol intake, smoking habit, and sodium and potassium excretion, and obesity was noted to be a single best predictor of hypertension incidence [23].

Our study shows that 21(42%) were overweight among 27 (54%) hypertensive patients, which is in accordance to a study published in American Journal of Epidemiology which explored the relationship between blood pressure and weight in urban adolescents. 24 Black and White youth with high body weight had higher blood pressure compared to normal weight youth [24]. We also investigated urban population and not rural so our trend is found to be same as this study.

In our study only 6 (12%) normal weight patients had hypertension while 21 (42%) overweight patients had hypertension. We investigated patients of ages between 25 to 55 years and concluded that people falling in this age group have more risk of hypertension if they are overweight. Similar to the study done in Great Britain where researcher Rebecca Hardy reports that high BMI throughout life had "a strong effect" on high blood pressure between ages 36 to 53. So, in this age group this trend is found to be similar.

However, a Population-Based Observational Study, conducted by Anthony Jerant, MD, Peter Franks, MD in 2000–2006 [25] shows results in contrary to our study. It says that if not adjusted for diabetes or

hypertension, only severe obesity was associated with mortality (adjusted hazard ratio, 1.26; 95% confidence interval, 1.00–1.59). After adjusting for diabetes and hypertension, severe obesity was no longer associated with mortality. There was a significant interaction between diabetes (but not hypertension) and BMI. Obesity-associated mortality risk was lower than estimated in studies employing older BMI data [26]. The difference in result may be due to that in our study Diabetes or other co morbidities weren't brought into account.

A research published in International Journal of Medicine and Medical Sciences [27]. was conducted in Nigeria to study the effects of obesity on hypertension. The results were totally opposing our study may be due to ethnic background or because we did not look for persistent hypertension. Their study showed that, Obesity doesn't necessarily associate with persistent, poor control of HTN in Nigeria. Some obese individuals never had corresponding elevated (systolic and diastolic) blood pressure when compared with some normal BMI subjects who have high blood pressure [27].

## CONCLUSION

It was concluded that, BMI is directly correlated to hypertension, as hypertension was significantly more common in obese patients.

- With increasing weight (BMI) risk of having hypertension increases.
- People with BMI in overweight range have more prevalence of hypertension than those having normal weight.
- Significant weight loss helps to reduce blood pressure and decreases risk of having complications of increased Blood pressure and obesity.

## RECOMMENDATIONS

- As overweight people had more hypertension so reduction in weight will help in controlling hypertension.
- Proper awareness among public for correlation between BMI and Blood Pressure should be there.
- Patients with high Blood Pressure should not ignore their weight and BMI and regularly measure them and try to keep it in healthy normal range.
- Consultants should prescribe weight loss in obese patients rather than just advice.

**LIMITATIONS**

- Duration of study was short and only of 1 month.
- Sample size chosen was only 50 patients.
- Patients of only one hospital and locality were investigated.

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