*Section A-Research paper*

# IS THERE ANY CORRELATION OF BODY MASS INDEX WITH BLOOD PRESSURE AND RENAL PARAMETERS IN OVERWEIGHT/OBESE HYPERTENSIVE PATIENTS? - A STUDY IN MALWA REGION OF PUNJAB

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## ABSTRACT

**BACKGROUND:** Hypertension is known to be one of the important risk factors for human morbidity and mortality. Chronic hypertension can lead to stroke, coronary artery disease, heart failure and chronic kidney disease. Obesity is a very important risk factor for diabetes, essential hypertension, and other comorbid conditions that contribute to development of chronic kidney disease.

**METHODS**: Hypertensive patients were taken, their BMI was calculated and those were having BMI≥25(overweight) or having BMI≥30(obese), such 120 patients were enrolled in the study. In those 120 patients, renal profile was assessed including blood urea, serum creatinine, serum uric acid and eGFR. Further correlation of BMI was calculated with blood pressure and renal parameters.

**RESULTS:** The Mean ± SD of BMI was 28.22±2.31. The Mean ± SD for systolic blood pressure was 125.84±23.62 mm of Hg and that of diastolic blood pressure was 77.85±11.99 mm of Hg. The Mean± SD of blood urea was 48.5±29.51. Mean ± SD of serum creatinine was 1.82±1.44. Mean± SD of serum uric acid was 4.6±1.43 whereas that of eGFR was 62.22±29.52.BMI and systolic blood pressure were significantly correlated (0.00) and the correlation of BMI with blood urea, serum creatinine and eGFR was found to be significant with p values 0.000,0.000 and 0.000 respectively.

**CONCLUSION:** The study concluded that obesity along with hypertension is a major risk factor in development of renal insufficiency and in addition presence of obesity alone can also act as risk factor for renal alterations in hypertensive patients having controlled blood pressure.

## INTRODUCTION

Hypertension is known to be one of the important risk factors for human morbidity and mortality. Hypertension has been ranked on the top as a cause of disability adjusted life years on a worldwide basis.[1] Around 7.5 million deaths or 12.8% of the total annual deaths worldwide occur due to hypertension.[2] It is predicted that it will increase to 1.56 billion adults in 2025.[3] Myocardial infarction, congestive heart failure, stroke and end-stage renal disease also have hypertension as one of the underlying major risk factor.

Hypertension is a disease in which the blood pressure in the arteries is persistently elevated.[4] High blood pressure, in general, does not cause symptoms. Chronic hypertension can however lead to stroke, coronary artery disease, heart failure, chronic kidney disease, atrial fibrillation, peripheral arterial disease, and vision loss.[4]

Hypertension is categorized as primary hypertension (also known as essential hypertension) or secondary hypertension.[5] 90–95% of the cases are of primary hypertension which is defined as high blood pressure due to lifestyle and genetic factors.[5][4] Excessive intake of salt, excess body weight, smoking, and alcohol use are some of the lifestyle factors that increase the risk.[1][5] The rest 5–10% of cases are categorized as secondary hypertension

which is defined as high blood pressure due to an identifiable cause, such as narrowing of the kidney arteries, chronic kidney disease, the use of birth control pills, or an endocrine disorder.[5] Some inherited abnormalities in patients can make them prone to the development of hypertension and also a complex series of cardiovascular disease risk factors. They may include elevated lipids, arterial stiffening, insulin resistance, increased left ventricular hypertrophy (LVH), renal function abnormalities and neuroendocrine changes. Raised blood pressure has been known to be a cause for renal dysfunction in hypertensive patients. The renin-angiotensin system (RAS) and Sympathetic nervous system (SNS) are believed to play a very crucial role in the pathogenesis of hypertension. It is difficult to control the hypertension because of its related complex pathogenesis and a variety of related cardiovascular diseases. Feedback mechanisms, both positive and negative, and multiple signalling pathways contribute to the disease process of hypertensive disease and further it is confounded by the interrelationship of hypertension with some associated diseases such as diabetes and renal dysfunction.[7]

If there occurs a decreased renal blood flow, juxtaglomerular (JG) cells of the kidneys convert the prorenin(precursor) into renin and secrete it directly into the blood. Plasma renin then causes the conversion of angiotensinogen (released by the liver) to angiotensin I. [8] Angiotensin I is then converted to angiotensin II by the angiotensin-converting enzyme (ACE) which is found on the surface of vascular endothelial cells of lungs predominantly. [9] Also constriction of blood vessels (and further increased blood pressure) is induced by Angiotensin II as it is a potent vasoconstrictive peptide.[5] Also the secretion of the hormone aldosterone from the adrenal cortex is stimulated by Angiotensin II. [10] Aldosterone will further causes the renal tubules to increase the reabsorption of sodium which in turn causes the reabsorption of water into the blood, and at the same time it causes the excretion of potassium to maintain electrolyte balance.[11] This further leads to increase in the volume of extracellular fluid in the body, which also increases blood pressure.[12] Obesity is a very important risk factor for diabetes, essential hypertension, and some other comorbid conditions that contribute to development of chronic kidney disease. Increase in blood pressure by obesity is via impairing pressure natriuresis, causing volume expansion via activation of the sympathetic nervous system and renin–angiotensin–aldosterone system, increase in renal tubular sodium reabsorption and also by physical compression of the kidneys in obese persons. Some other factors such as oxidative stress, inflammation and accumulation of lipid intermediates in non-adipose tissue (lipotoxicity) may also contribute to obesity-mediated hypertension and renal dysfunction. At first, obesity causes renal vasodilation and glomerular hyperfiltration, which further acts as compensatory mechanisms to maintain sodium balance despite increased tubular reabsorption. However, these compensations, along with increased arterial pressure and metabolic abnormalities, may ultimately lead to glomerular injury and start a slowly developing vicious cycle that aggravates hypertension and worsens renal injury.[13] At an individual level, a combination of excessive food intake and a lack of physical activity might explain most of the cases of obesity.[14]Some of the cases are primarily due to genetics, medical reasons, or psychiatric illness.[15] In contrast, increasing rates of obesity at a societal level are felt to be due to an easily accessible and palatable diet,[16] and automated manufacturing.[17,18]

So the present study was done to study the effect of obesity on hypertension and its subsequent effect on renal profile including blood urea, serum creatinine, serum uric acid and eGFR.

## MATERIALS AND METHODS

An observational study was conducted in department of Biochemistry in a tertiary care centre in Malwa region of Punjab.120 obese hypertensive patients having duration of hypertension>10 years were enrolled in the study. The patients were taken from Medicine OPD and ward. The patient enrolment and sample collection was started after approval from Institutional Research Committee and Ethical Committee.

Body mass index (BMI) was measured in all the hypertensive patients. Based on the BMI, overweight (BMI≥25 kg/$m^2$) and obese hypertensives (BMI≥30kg/$m^2$) were chosen for the study and further their renal profiles were tested.

**Body mass index-**was calculated using Quetlet's index [19]

$$BMI=Weight(kg) / [Height (m^2)]$$

**Blood pressure** was measured in all the patients using sphygmomanometer.

Further 4ml of blood was collected from the antecubital vein using all aseptic precautions in a plain vacutainer for estimation of renal parameters. All serum samples were analysed using fully automated analyser BIOSYSTEMS. All the analytical reagents were standardized before instrument was calibrated.

The following renal parameters were analysed in overweight/obese hypertensive patients:

| RENAL PARAMETERS | METHOD |
|---|---|
| Blood urea | ClinReact™ Urea (GLDH) Method [20] |
| Serum creatinine | ClinReact™ creatinine (Alkaline Picrate) method [21] |
| Serum uric acid | ClinReact™ uric acid (AOX) method [22] |
| eGFR | MDRD equation [23] |

## STATISTICAL ANALYSIS

All the results were expressed in mean standard deviation. The data analysis was done by using Microsoft excel. <0.05 was considered statistically significant. Correlation of BMI with blood pressure, blood urea, serum creatinine, serum uric acid and eGFR was seen and graphs were plotted.

## RESULTS

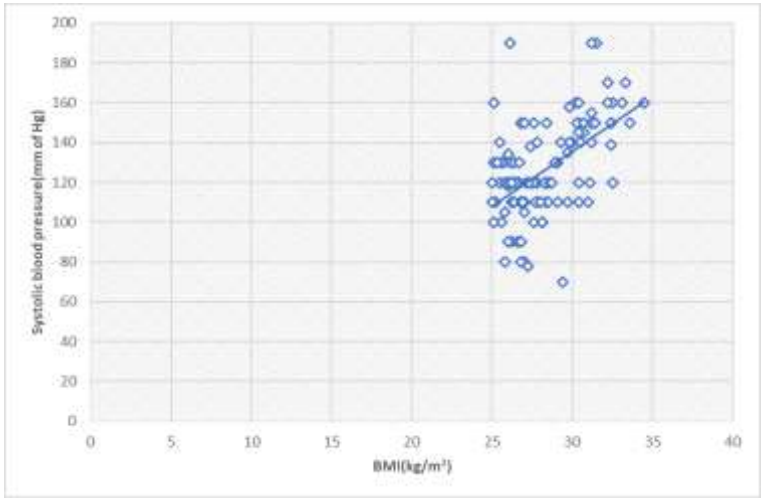
This present study was done to analyse the renal profile in overweight/obese hypertensive patients in Malwa region of Punjab. 120 obese hypertensive patients were enrolled in the study. Maximum patients, that is, 80% were in the age group between 51-60 years. There were 75 males (62.5%) and 45 females (37.5%) among total of 120 obese hypertensive patients. The range of duration of illness in the study was 10.5-18 years and mean ±SD was 12.4±1.55 years. The systolic blood pressure range was between 70-190 mm of Hg and the Mean ± SD was 125.84±23.62 mm of Hg. The overall range of DBP was between 50-100 mm of Hg and Mean ±SD was 77.85±11.99 mm of Hg. The range of height among obese hypertensives was 145-183 cm. The Mean ± SD was 166.04±10.53. The range of weight was 55-102 kg and mean± SD was 78.02 ±11.50. The overall range of BMI in the patients was between 25-34.50 and the Mean ± SD was 28.22±2.31. The range of blood urea was from 15-175 mg/dl. The Mean± SD was 48.5±29.51. The range of serum creatinine in obese hypertensive patients was from 0.1-8.9 mg% and mean ± SD was 1.82±1.44. The range of the uric acid in patients was between 1.6-10 mg/dl whereas Mean± SD among 120 patients was 4.6±1.43. The eGFR ranged from 6-159ml/min/1.73 $m^2$. The Mean ± SD for all the 120 patients was 62.22±29.52. The correlation of BMI was calculated with blood pressure (systolic blood pressure and diastolic blood pressure) as well as renal parameters (blood urea, serum creatinine, serum uric acid and eGFR) was seen. The following are the tables showing the correlation:

**Table-1 TABLE SHOWING CORRELATION OF BODY MASS INDEX (BMI) AND BLOOD PRESSURE IN OVERWEIGHT/ OBESE**

| Correlation | r (Pearson's correlation) | p value | Significance |
|---|---|---|---|
| BMI and systolic Blood pressure | 0.540 | 0.00 | S |
| BMI and diastolic blood pressure | 0.140 | 0.125 | NS |

**HYPERTENSIVE PATIENTS**

BMI and systolic blood pressure are significantly correlated (0.00) whereas correlation of BMI with diastolic blood pressure was found to be nonsignificant (p value=0.125). It is shown in figure 1 and figure 2.



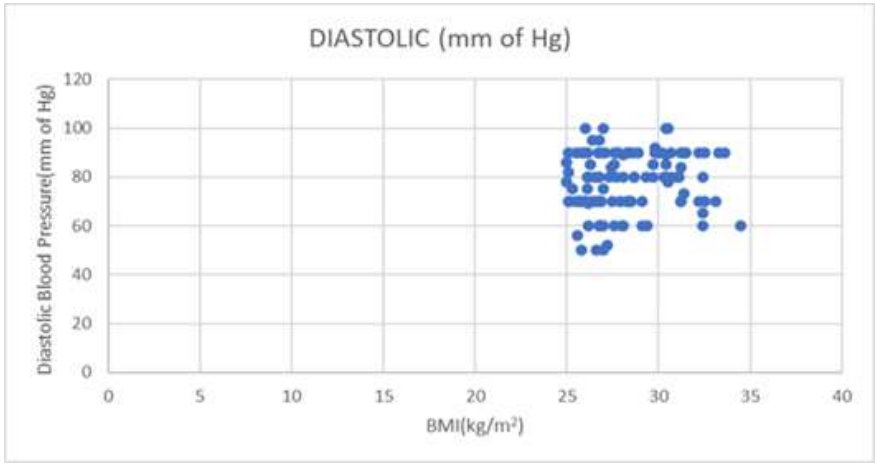




**Figure 1-Correlation of BMI with systolic blood pressure** **Figure 2-Correlation of BMI with diastolic blood pressure**

| Correlation | r (Pearson's correlation) | p value | Significance |
|---|---|---|---|
| BMI and Blood urea | 0.385 | 0 .000 | S |
| BMI and Serum creatinine | 0 .653 | 0 .000 | S |

| | | | |
|---|---|---|---|
| BMI and Serum uric acid | 0.168 | 0 .067 | NS |
| BMI and eGFR | 0.417 | 0 .000 | S |

**Table 2-TABLE SHOWING CORREALTION OF BODY MASS INDEX (BMI) WITH RENAL PARAMETERS IN OVERWEIGHT/OBESE HYPERTENSIVE PATIENTS**

The correlation of BMI with serum uric acid was found to be nonsignificant with p value 0.067 whereas correlation of BMI with blood urea, serum creatinine and eGFR was found to be significant with p values 0.000,0.000 and 0.000 respectively. The following are the figures showing the correlation of BMI with blood urea, serum creatinine, serum uric acid and eGFR:

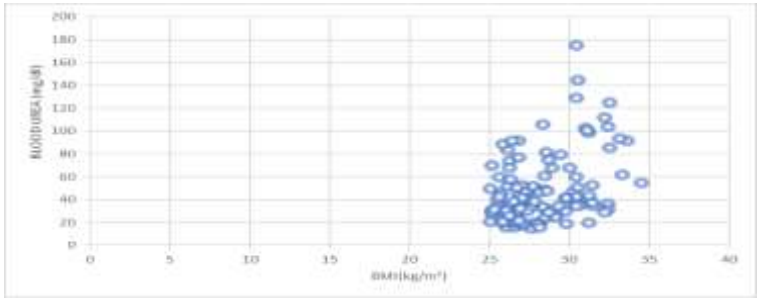


Figure-3 showing correlation of BMI with blood urea

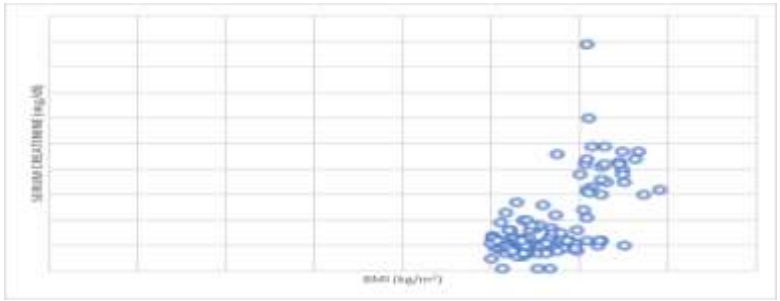


Figure-4 showing correlation of BMI with serum creatinine

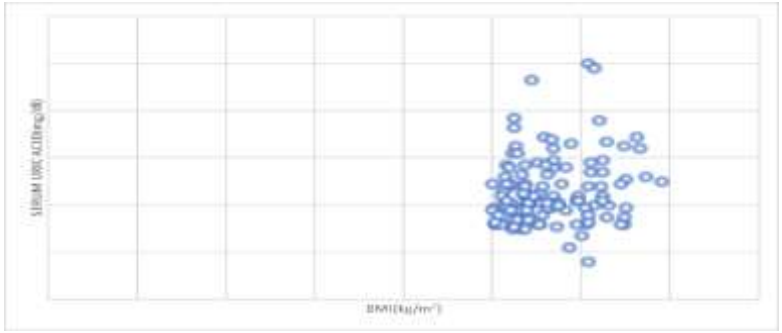


Figure-5 showing correlation of BMI with serum uric acid

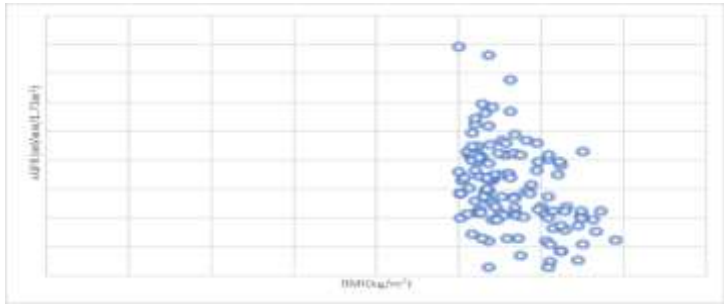


Figure-6 showing correlation of BMI with eGFR

## DISCUSSION

Hypertension is a very prevalent and important disease with major global public health challenges. It is more in developing countries and in coming future almost 3/4th of people with hypertension will be there in developing countries. [24] Globally it is a major cause of chronic kidney disease.[25] It is also the most prevalent cause of end stage renal disease. [26,27] The functional impairment of kidney is highly variable in those who are developing CKD and this is totally attributed to individual variability of risk. So the need is to predict those who may develop CKD and it has further led to the search for risk factors which are linked with hypertension and they significantly cause impact on renal function and finally leading to ESRD. [28] The study was planned to assess the alterations in renal parameters in obese hypertensive patients having duration of hypertension more than 10 years.

In the present study the corelation of systolic blood pressure came out to be positively correlated with BMI whereas correlation of BMI with diastolic blood pressure was found to be nonsignificant, likewise a study by **Sagaro GG et al**[29] also concluded that mean blood pressure levels increase parallel to the rise of BMI so stress should be given on a weight management for the control of high blood pressure Also another study by **Hall ME et al** [30]shown that blood pressure is closely correlated with anthropometric indices of obesity, such as BMI ,waist circumference, or waist-to-hip ratio.

In addition to that the correlation of BMI was seen with renal parameters like blood urea, serum creatinine, serum uric acid and eGFR in obese hypertensive patients. It was seen that the correlation of BMI with blood urea, serum creatinine and eGFR was found to be significant whereas the correlation of BMI with serum uric acid was found to be nonsignificant. The reason for the above findings could be that obesity causes increase in blood pressure via impairing pressure natriuresis, causing volume expansion via activation of renin–angiotensin–aldosterone system, increase in renal tubular

sodium reabsorption and also by physical compression of the kidneys in obese persons and further this high blood pressure can increase the thickness of the glomerular basement membrane reduce the glomerular filtration rate. Also high blood pressure can constrict and narrow the blood vessels, which further damages the kidneys. Another finding in the present study related to BMI was that some of the patients who were having only higher BMI but controlled blood pressure were also having alterations of renal parameters indicating that obesity alone can act as risk factor for altering the renal profile. Very few studies have studied the correlation of BMI with renal parameters in obese hypertensive patients but a study by **Mohammedi K et al**[31] concluded that the higher BMI is an independent predictor of major renal events in patients with type 2 diabetes and they suggested to encourage weight loss to improve nephroprotection in these patients. Another study by **Krzysztof N** [32] concluded that there is growing evidence that obesity and associated metabolic abnormalities may induce and accelerate renal complications in essential hypertension.

**Conclusion**: Obesity along with hypertension or alone increases the risk of kidney disease many a times. There is a greater need for prevention of overweight and obesity for preventing its effect on kidney.

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