**ORIGINAL RESEARCH** 

# Exploring the differences in blood pressure and kidney function between overweight and obese hypertensive patients in Punjab

Mr. Sunpreet Singh<sup>1</sup>, Dr. Gesu Singla<sup>2</sup>, Dr. Sanjana Devi<sup>3</sup>, Dr. Varun Mohan Malhotra<sup>4</sup>

<sup>1</sup>MSc Medical Biochemistry Student, Adesh Institute of Medical Sciences and Research, Bathinda, India

<sup>2</sup>Professor & Head, Department of Biochemistry, Adesh Institute of Medical Sciences and Research, Bathinda, India

<sup>3</sup>Associate Professor, Department of Anatomy, Adesh Institute of Medical Sciences and Research, Bathinda,

India

<sup>4</sup>Professor, Department of Community Medicine, Adesh Institute of Medical Sciences and Research, Bathinda, India

**Corresponding Author** 

Dr. Gesu Singla

Professor & Head, Department of Biochemistry, Adesh Institute of Medical Sciences and Research, Bathinda, India

Email: gesu.singla88@gmail.com

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### ABSTRACT

Introduction: Obesity results in various metabolic abnormalities that have wide range of effects on diseases of the kidney. Obesity may cause kidney injury through direct mechanisms, through deranged synthesis of adipose tissue cytokines with nephrotoxic potential or indirectly by triggering hypertension and diabetes. Aim: Aim of the study was to compare the blood pressure and renal profile in overweight and obese hypertensive patients. Methods: 120 obese hypertensive patients having duration of hypertension>10 years were enrolled in the study.Body mass index (BMI) was measured in all the hypertensive patients. Based on the BMI, patients having BMI>25 kg/m<sup>2</sup> were chosen for the study. Further they were categorized into two groups: Group 1- Overweight hypertensive patients and Group 2- Obese hypertensive patients. Their Blood pressure and renal parameters in both the groups were analyzed and compared. Results: Out of 120 patients 88 patients were overweight and 32 patients were obese. The Mean ± SD of systolic blood pressure in overweight patients was 117.17±19.02 whereas in obese it was found to be 148.43±18.7mm of Hg. The Mean± SD of diastolic blood pressure for the overweight patients was 76.39±12.05 and for the obese patients was 81.37±10.53 mm of Hg. Mean± SD of blood urea for the overweight patients was 40.89 $\pm$ 20.61 and for the obese patients was 65.31 $\pm$ 37.85. Mean  $\pm$  SD of creatinine for overweight individuals was  $1.6\pm2.3$  and that of obese was  $3.6\pm1.5$ . Mean  $\pm$ SD of serum uric acid in the overweight patients was  $4.48\pm1.2$  and that of obese patients was 4.9±1.8. Mean± SD of eGFR was found to be 69.71±28.60 in overweight hypertensive patients whereas it was 38.93±18.48 in obese hypertensive patients. Conclusion: As seen in the above study, blood pressure and renal profile alterations in obese hypertensive patients are significantly higher than blood pressure and alterations of renal profile in overweight hypertensives, it is concluded that obesity along with uncontrolled hypertension or as independent factor plays a role in causing the renal changes in hypertensive patients.

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## **INTRODUCTION**

Obesity along with its associated cardiovascular, metabolic, and renal disorders have increasingly become a major threat to worldwide health. Obesity has nearly doubled globally since 1980 and current estimates indicate that more than 1.4 billion adults are overweight or obese.<sup>[1]</sup>Most of the consequences of being overweight or obese include higher prevalence of hypertension and a cascade of associated cardiac, renal and metabolic disorders. Some studies in diverse populations throughout the world have concluded that

the relationship between BMI and systolic and diastolic blood pressure (BP) is nearly linear. <sup>[2,3]</sup> Risk estimates from the Framingham Heart Study suggest that 78% of primary (essential) hypertension in men and 65% in women can be ascribed to excess weight gain.<sup>[4]</sup>Clinical studies indicate that maintenance of a BMI <25 kg/m2 is effective in primary prevention of hypertension and that weight loss reduces BP in most hypertensive subjects.<sup>[5,6]</sup> Increased renal sodium reabsorption plays a major role in initiating the rise in BP associated with excess weight gain and obese

subjects require higher than normal BP to maintain sodium balance, indicating impaired renal-pressure natriuresis.<sup>[7]</sup>

At least 3 major factors seem to impair renal-pressure natriuresis and increase BP during rapid, excessive weight gain: (1) physical compression of the kidneys because of increased visceral, retroperitoneal, and renal sinus fat; (2) renin-angiotensin-aldosterone system (RAAS) activation, including activation of mineralocorticoid receptors (MRs) independent of aldosterone; and (3) SNS activation, especially increased renal sympathetic nerve activity (RSNA). Also, CKD may, over a much longer time, amplify the BP effects of these mechanisms, making obesityassociated hypertension more difficult to control and less easily reversed by weight loss.Obesity results in complex metabolic abnormalities that have wide ranging effects on diseases of the kidney. Increased adipose tissue in obesity may lead to increased secretion of adiponectin, leptin and resistin which may result in development of inflammation, oxidative stress, abnormal lipid metabolism, and increased production of insulin and insulin resistance.<sup>[8]</sup>Obesity causes kidney injury through direct mechanisms through deranged synthesis of adipose tissue cytokines with nephrotoxic potential as well as indirectly by triggering diabetes and hypertension.<sup>[9]</sup>Although weight loss does not completely normalize blood pressure in all obese patients, this is perhaps not surprising since long-term obesity-induced hypertension may also cause pathological cardiovascular and renal changes that are not always reversible, such as glomerular injury and loss of functional nephrons. These changes can make the hypertension more severe and more difficult to control, even with weight loss and antihypertensive medications.<sup>[10]</sup>But clinical trials have also demonstrated the effectiveness of weight loss in primary prevention of hypertension.<sup>[11]</sup>

# MATERIAL AND METHODS

An observational comparative study was conducted in department of Biochemistry in collaboration with Medicine department in a tertiary care centre in Punjab.120 obese hypertensive patients having duration of hypertension>10 years were enrolled in the study. OPD and indoor patients were enrolled in the study. 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, patients having BMI>25 kg/m<sup>2</sup> were chosen for the study. Further they were categorized into two groups

Group 1- Overweight hypertensive patients

Group 2- Obese hypertensive patients

Out of 120 hypertensive patient,88 patients were overweight (BMI>25-29.9 kg/m<sup>2</sup>) whereas 32 patients were obese (BMI>30kg/m<sup>2</sup>)Their Blood pressure and renal parameters in both the groups were analyzed and compared.

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

**Body mass index (BMI)**-was calculated using Quetlet's index <sup>[12]</sup>

BMI=Weight(kg) / [Height (m<sup>2</sup>)]

Weight status	<b>Body Mass index</b>
Underweight	<18.5
Normal range	18.5-24.9
Overweight	25.0-29.9
Obese	≥30
Obese Class I	30.0-34.9
Obese Class II	35.0-39.9
Obese Class III	>40

 TABLE 1- WHO CLASSIFICATION OF BMI<sup>[13]</sup>

The following renal parameters were analyzed:**RENAL PARAMETERSMETHOD** 

Blood urea ClinReact<sup>TM</sup> Urea (GLDH) Method <sup>[14]</sup> Serum creatinine ClinReact<sup>TM</sup> creatinine (Alkaline Picrate) method <sup>[15]</sup>

Serum uric acid ClinReact<sup>TM</sup> uric acid (AOX) method [16]

eGFR MDRD equation [17]

All the results were expressed in mean standard deviation. The data analysis was done by using Microsoft excel. <0.05 was considered statistically significant. Comparison of blood pressure, blood urea, serum creatinine, serum uric acid and eGFR was seen between overweight and obese hypertensive patients.

### RESULTS

The study was conducted in overweight and obese hypertensive patients to compare the blood pressure and renal parameters(blood urea, serum creatinine, serum uric acid, eGFR) in the two groups. Out of 120 patients 88 patients were overweight and 32 patients were obese. The Mean  $\pm$  SD of systolic blood pressure in overweight patients was 117.17±19.02 whereas in obese it was found to be 148.43±18.7mm of Hg. The Mean± SD of diastolic blood pressure for the overweight patients was 76.39±12.05 and for the obese patients was 81.37±10.53 mm of Hg. Mean± SD of blood urea for the overweight patients was  $40.89\pm20.61$  and for the obese patients was  $65.31 \pm 37.85$ .Mean  $\pm$  SD of creatinine for overweight individuals was 1.6±2.3 and that of obese was

 $3.6\pm1.5$ . Mean  $\pm$ SD of serum uric acid in the overweight patients was  $4.48\pm1.2$  and that of obese patients was  $4.9\pm1.8$ . Mean $\pm$ SD of eGFR was found to be  $69.71\pm28.60$  in overweight hypertensive patients whereas it was  $38.93\pm18.48$  in obese hypertensive

patients. In addition to comparison of mean±SD of blood pressure and renal parameters in overweight and obese hypertensive patients, t value and p value was calculated and hence significance was established.

 TABLE 2-COMPARISON OF SYSTOLIC BLOOD PRESSURE IN OVERWEIGHT AND OBESE

 HYPERTENSIVE PATIENTS

SYSTOLIC BLOOD	OVERWEIGHT		OBESE		
PRESSURE (mm of Hg)	n=88 BMI (25-29.9)		n=32	BMI (≥30)	
Mean ±SD	11	7.17±19.02	148.43±18.7		
t value		7.98			
p value	0.001	**			

Table 2 shows comparison of systolic blood pressure in overweight patients who were having BMI between 25-29.9 kg/m<sup>2</sup> and obese patients with BMI ( $\geq$ 30 kg/m<sup>2</sup>). The difference of systolic blood pressure in the two groups was found to be significant with p value=0.001.

# TABLE 3- COMPARISON OF DIASTOLIC BLOOD PRESSURE IN OVERWEIGHT AND OBESEHYPERTENSIVE PATIENTS

OV	ERWEIGHT	OBESE		
n=88 BMI (25-29.9)		n=32	BMI (≥30)	
7	6.39±12.05	81.37±10.53		
2.065				
	0.04*			
	<b>OV</b> <b>n=88</b> 7	OVERWEIGHT           n=88         BMI (25-29.9)           76.39±12.05         2.06           0.04*         2.04	OVERWEIGHT         OC           n=88         BMI (25-29.9)         n=32           76.39±12.05         81.3           2.065         0.04*	

In the above table comparison of diastolic blood pressure in overweight and obese hypertensive patients is shown. As the p value=0.04 so the difference was found to be significant.

# TABLE4-COMPARISONOFBLOODUREABETWEENOVERWEIGHTANDOBESEHYPERTENSIVE PATIENTS

	OVE	RWEIGHT	(	OBESE
<b>BLOOD UREA</b>	n=88 BMI (25-29.9)		n=32	BMI (≥30)
Mean± SD	40	.89±20.61	65.	31±37.85
t value		3.46		
p value	0.000	1**		

Above table shows the comparison of blood urea between overweight and obese hypertensive patients. When compared the difference of blood urea between the two groups(overweight and obese) was found to be significant with p value =0.0001

 TABLE-5 COMPARISON OF SERUM CREATININE BETWEEN OVERWEIGHT AND OBESE

 HYPERTENSIVE PATIENTS

SERUM CREATININE	OVERWEIGHT		OBESE		
( <b>mg/dl</b> )	n=88 BMI (25-29.9)		n=32	BMI (≥30)	
Mean $\pm$ SD		1.6±2.3	3.6±1.5		
t value		4.6			
p value	0	.0001**			

Table 5 shows the comparison of serum creatinine levels between overweight and obese hypertensive patients. When compared between two groups the difference was found to be significant with p value=0.0001.

TABLE	6-	COMPARISON	OF	SERUM	URIC	ACID	BETWEEN	<b>OVERWEIGHT</b>	AND	OBESE
HYPER	ΓEN	<b>NSIVE PATIENT</b>	S							

SERUM URIC ACID	OVERWEIGHT		0	BESE
( <b>mg/dl</b> )	n=88	BMI (25-29.9)	n=32	BMI (≥30)
Mean $\pm$ SD		4.48±1.2		4.9±1.8
t value		1.73		
p value	0.086 .			

This table shows the comparison of serum uric acid between overweight and obese hypertensive patients. When compared the serum uric acid levels between two groups the difference was found to be non significant with p value 0.086.

 TABLE 7- COMPARISON OF eGFR BETWEEN OVERWEIGHT AND OBESE HYPERTENSIVE

 PATIENTS

eGFR	OVERWEIGHT           n=88         BMI (25-29.9)		OBESE		
$(ml/min/1.73m^2)$			n=32	BMI (≥30)	
Mean $\pm$ SD	69	9.71±28.60	38.9	93±18.48	
t value	5.66				
p value	0	0.001*			

Above table shows the comparison of eGFR between overweight and obese hypertensive patients. When compared the difference between the two groups was found to be significant with p value=0.001.

### DISCUSSION

Obesity increases blood pressure by increasing renal tubular reabsorption of sodium, via impairing pressure natriuresis and causing volume expansion via activation of the sympathetic nervous system and renin-angiotensin-aldosterone system and by physical compression of the kidneys, especially when there is increased visceral adiposity. Other factors such as inflammation, oxidative stressand lipotoxicity may also contribute to obesity-mediated hypertension and renal dysfunction. Initially, obesity causes renal vasodilation and glomerular hyperfiltration, which act 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 initiate a slowly developing vicious cycle that exacerbates hypertension and worsens renal injury. Body weight reduction, via caloric restriction and increased physical activity, is an important first step for management of obesity, hypertension, and chronic kidney disease.[18]

Our study concluded that obesity if present along with hypertension increases the chances of development of kidney disease which was truly supported by a study byHall ME et al<sup>[18]</sup>which concluded that obesity is an important risk factor for essential hypertension, diabetes, and other comorbid conditions that contribute to development of chronic kidney disease. A strong support was provided by a study by Prudhvi et al<sup>[19]</sup> which stated that obesity related metabolic abnormalities and impairment of renal functionmay progress asymptomatically before the development of clinical manifestations, so there is a need to have worldwide strategy to decrease the weight in hypertensive patients. Also Bramlage P et al <sup>[20]</sup>concluded that blood pressure levels were consistently higher in obese patients. The prevalence of hypertension in normal weight patients was 34.3%, which was much lesser in overweight participants which was 60.6%. In grade 1 obesity it was 72.9%, in grade 2 obesity it was 77.1%, and in grade 3 obesity it was 74.1%. Results of a study by Ribstein J et al<sup>[21]</sup> indicated that the overweight is associated with renal hyperperfusion and hyperfilteration irrespective of the presence of hypertension, and further that obesity can magnify the effect of hypertension on albuminuria, ultimately increasing the possibility of an increased susceptibility of obese hypertensive patients to the

development of renal damage.**Ozturk S et al** <sup>[22]</sup>also concluded that the severity of obesity was associated with the failure to achieve target blood pressure and metabolic syndrome. According to them, blood pressure and metabolic parameters in obese patients should be frequently monitored and treated with caution.

### CONCLUSION

The variations of renal profile in obese hypertensive patients are significantly higher than alterations of renal profile in overweight hypertensives concluding the fact that obesity alongwith uncontrolled hypertension or as independent factor plays a role in causing the renal changes in hypertensive patients.

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