

# Study on Essential Hypertension and Renal Impairment: A Descriptive Cross-Sectional Study

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## ABSTRACT

**Background and objectives:** Hypertension (HTN) is one of the commonest non-communicable diseases and it is the major public health problem in our country. The kidney is a main target of organ damage in uncontrolled chronic HTN. The aim of our study was to determine the correlation between the HTN, serum creatinine, MAU (Microalbuminuria) and eGFR (Estimated Glomerular Filtration Rate) and gender differences in renal function parameters.

**Methodology:** 112 essential hypertensive subjects between the age group of 30-60 years were included in the present study. Physical measurements, Blood pressure and biochemical investigations were done in the study subjects who were consented to be part of the present study.

**Results:** Out of 112 hypertensive subjects 70 (62.5%) had MAU, 1 (0.9%) had increased serum creatinine and 57 (50.89%) had lower eGFR. The mean values of MAU, serum creatinine were lower among female hypertensives as compared to male hypertensives. However mean value of eGFR was higher among male hypertensives as compared to female hypertensives. From the Receiver Operative Characteristic (ROC) curve it was found that, area under the curve (AUC) for MAU -0.796, eGFR - 0.617 and serum creatinine - 0.456 with stages of HTN.

**Conclusion:** In our study, males had higher percentage of MAU and decreased eGFR was common among female hypertensives. AUC for MAU was more as compared to other two parameters and hence in our study MAU is a better parameter to assess the renal impairment with stages of HTN. Therefore early screening of hypertensive patients for MAU might reduce the risk of chronic kidney diseases.

**Key words:** Hypertension; Serum creatinine; Microalbuminuria; eGFR and renal impairment.

## INTRODUCTION

Hypertension (HTN) is growing globally and causing about 9.4 million deaths every year and it is the leading cause of premature death. Though the condition is most common, easily detectable and treatable, it often leads to dangerous complications if not treated, due to its asymptomatic nature. [1]

HTN is classified as essential (primary) HTN and secondary HTN. The essential HTN accounts for about 90-95% of cases with no underlying medical cause.

The remaining 5-10% of cases is secondary HTN that are caused by other conditions that affect the kidneys, arteries, heart and endocrine system. [2]

Essential HTN produces clinical proteinuria and results in significant reduction in renal function by about 5-15%. Chronic uncontrolled HTN leads to renal disease and it is symptomless at its early stage and hence laboratory diagnosis is essential. In case of chronic kidney failure, patients will develop few signs or symptoms and hence many patients don't realize that

they have a problem until their kidney function has decreased to less than 25% of its normal. [3,4]

In hypertensive patients, routine measurement of Microalbuminuria (MAU) is recommended by Joint National Committee - VII (JNC) guidelines as part of the diagnostic work-up and it is included in the optional tests of prescribed laboratory investigations. [5,6]

Recent data from Framingham heart study suggests that individuals who are normotensive at the age of 55 years will have a 90% lifetime risk for developing HTN. As the age advances the prevalence of HTN increases and more than half of the individuals will have HTN by the age of 60-69years. [7,8]

WHO has reported that HTN is more prevalent in low and lower middle income countries than high and middle income countries. In the year 2000, there were about 118 million persons who had HTN and this is expected to be 214 million by 2025, with nearly equal numbers of men and women. There is no difference in the overall prevalence of HTN among men and women but in all over the world, consistently the prevalence of HTN increasing with age. [9,10]

Only few studies have demonstrated the gender differences between essential HTN and renal impairment. Hence the present study was undertaken to determine the correlation between the HTN, serum creatinine, MAU and eGFR (Estimated Glomerular Filtration Rate) and gender differences in renal function parameters.

**MATERIALS AND METHODS**

The cross-sectional study was conducted for a period of one year. Patients in the age group of 30 to 60 years, with

Essential hypertension, visiting General Medicine Out Patient Department (OPD) of Mandya Institute of Medical Sciences (MIMS), Mandya were included in this study. Study was initiated after obtaining approval from the Institutional Scientific Committee and the Institutional Ethics Committee of MIMS, Mandya, vide letter no. MIMS/ IEC /01-05 /2012-13. Cases: Subjects in the age group of 30-60 years, who have been diagnosed with essential HTN according to JNC VII and consented to be part of the study. [11]

Informed written consent was obtained by explaining to the subjects the need, method of study and outcome. An assurance to the subjects about confidentiality of the subject's data was ensured.

A questionnaire (including sociodemographic details) was used for the study with the assurance to the participant that they were free to disagree to answer a question or to walk out of the study. Physical measurements like Height, Weight, Waist circumference, Hip circumference and Blood pressure (BP) were taken. Biochemical Investigations - Random Blood Sugar (RBS), Serum creatinine, Urine Creatinine and urine microalbumin were done. Calculated Parameters: Body Mass Index (BMI), Waist Hip ratio and eGFR.

In view of both patient and doctor, the random spot urine collection is the easiest and most convenient way. The American Diabetic Association (ADA) guidelines of 2004 recommend to follow more commonly used methods like measuring urinary albumin concentration or ACR on random samples. [12,13]

**Therefore in our study we have used ACR in spot urine sample to measure microalbumin.**

**Table 1: Diagnostic criteria for Microalbumin excretion [12,13]**

Category	Spot collection ACR (mg/gm creatinine)	24-h collection (mg/24h)	Timed collection (µg/min)
Normal	< 30	< 30	< 20
MAU	30-299	30-299	20-199
Macroalbuminuria	≥ 300	≥ 300	≥200

eGFR was calculated using serum creatinine by Modification of Diet in Renal Disease (MDRD) formula.

The MDRD equation was re-expressed in the year 2006: [14]

The re-expressed MDRD equation (ml/min per 1.73 m<sup>2</sup>) is as follows:

$$eGFR_{MDRD} = 175 \times (SCr)^{-1.154} \times (Age)^{-0.203} \times 0.742 \text{ (if patient is female)} \times 1.212 \text{ (if patient is black)}$$

In our study, eGFR >90ml/min/1.73m<sup>2</sup> was considered as normal renal function and eGFR <90ml/min/1.73m<sup>2</sup> was considered as decreased renal function.

Data was entered into Microsoft Excel sheet and analyzed using SPSS v25 software. Descriptive statistics like frequency, percentages, measures of central tendency and measures of dispersion was calculated. Means of various groups was compared using t test. Inferential statistical test like chi-square test was used to analyse categorical data. The statistical significance was evaluated at 95% confidence level and p value less than 0.05 was considered as statistically significant.

## RESULTS

A total of 112 patients with essential hypertension were included in the study.

Table 2: Distribution of study subjects by their age group

Age group in years	Male n(%)	Female n(%)
30 – 40	8 (44.44)	10 (55.55)
41 – 50	15 (48.38)	16 (51.61)
51 – 60	31 (49.20)	32 (50.79)
Total	54 (48.21)	58 (51.78)

Table 1 shows the distribution of study subjects by their age group and gender. Out of 112 hypertensives, 54 subjects were males and 58 were females. Majority (63) were in the age group of 51 to 60 years.

Table7: Distribution of subjects by their duration of Hypertension

Characteristics			Duration of Hypertension		Total
			< 5 years	≥ 5 years	
Gender	Male	Count	37	17	54
		% within Gender	68.5%	31.5%	100.0%
	Female	Count	33	25	58
		% within Gender	56.9%	43.1%	100.0%
Total		Count	70	42	112
		% within Gender	62.5%	37.5%	100.0%
p value		0.204			

Table 3: Distribution of subjects by their Body Mass Index (BMI) in Kg/m<sup>2</sup>

BMI	Essential hypertensives	
	Number	Percentage
Under weight	10	8.9
Normal	45	40.2
Overweight & obese	57	50.9
Total	112	100

Among hypertensives more than half of the subjects (50.9%) were overweight and obese.

Table 4 – Serum creatinine value among Hypertensive patients

Serum creatinine (mg/dl)	Hypertensives	
	Number	%
Normal	111	99.1
Abnormal	01	0.9
Total	112	100

Majority (99.1%) of the individuals had normal serum creatinine in hypertensives

Table 5- MAU among male and female hypertensives

MAU (mg/gm)	Hypertensives		
	Male	Female	Total n (%)
Absent	17	25	42 (37.5)
Present	37	33	70 (62.5)
Total	54	58	112 (100)
p value	0.204		

MAU was present in 62.5% of the subjects included. Among that two third (37) males and 33 females had MAU but the difference was not significant statistically.

Table 6–Estimated Glomerular Filtration Rate (eGFR) among male and female hypertensives

eGFR <sub>MDRD</sub> (ml/min/1.73m <sup>2</sup> )	Hypertensives		
	Male	Female	Total
≥90	36	19	55
<90	18	39	57
Total	54	58	112
p value	<0.001		

Fifty five subjects (36 males and 19 females) had eGFR≥90 ml/min, rest of the subject's < 90 ml/min. The difference was found to be statistically significant with p value less than 0.001

Out of the 112 study subjects, 70 (62.5%) of them were having hypertension for less than 5 years duration and the rest 42(37.5%) of them had for the past 5 years or more. The difference among males and females was not significant statistically.

**Table 8: Distribution of subjects by their anthropometric measurements and Blood pressure**

Gender		Height	Weight	BMI	Systolic BP	Diastolic BP
Male	Mean	157.37	61.96	25.02	149.89	95.67
	N	54	54	54	54	54
	Std. Deviation	8.354	13.531	5.12	17.873	11.853
Female	Mean	149.43	58.88	26.30	142.93	87.66
	N	58	58	58	58	58
	Std. Deviation	6.105	12.492	5.08	16.493	11.444
Total	Mean	153.26	60.37	25.68	146.29	91.52
	N	112	112	112	112	112
	Std. Deviation	8.267	13.036	5.12	17.448	12.268
p value		<0.001	0.212	0.188	0.034	<0.001

The table shows the mean differences of Height, Weight, BMI & BP among the subjects with different gender. The mean weight of the male subjects was higher compared to females and the mean BMI of females was higher than males. But, none of them was statistically significant. The mean value of systolic BP and Diastolic BP were higher among male subjects as compared to female hypertensives and found to be statistically significant.

**Table9: Renal function parameters among the study participants**

Gender	Serum Creatinine (mg/dl)	MAU (µg/min)	eGFR <sub>MDRD</sub> (ml/min/1.73m <sup>2</sup> )
Male Mean ± SD	0.85 ± 0.17	98.20 ± 81.17	99.83 ± 20.87
Female Mean ± SD	0.73 ± 0.10	73.71 ± 74.60	86.58 ± 13.29
Total Mean ± SD	0.79 ± 0.14	85.51 ± 78.45	92.97 ± 18.51
p value	<0.001	0.099	<0.001

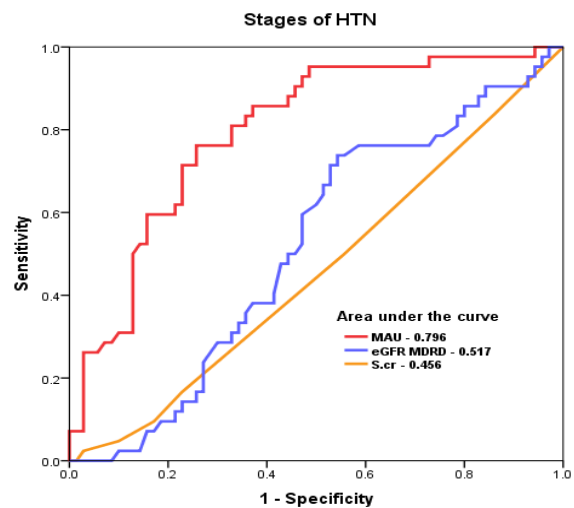
The table shows the mean difference of Serum creatinine, Microalbuminuria, eGFR among male and female subjects in the study.

**Table 10: Correlation with duration of hypertension**

Correlation	Serum Creatinine	Microalbuminuria	eGFR <sub>MDRD</sub>
Pearson correlation	-.096	.577	-.073
P value	.313	.000	.442

Microalbuminuria values was positively correlated with statistical significance (p value <0.05) with duration of hypertension. Serum creatinine and eGFR<sub>MDRD</sub> were

negatively correlated but not significant statistically.



**Graph 1 - ROC curve to compare serum creatinine, MAU# & eGFR<sub>MDRD</sub> with stages of HTN**

From the above ROC curve it was found that, area under the curve for MAU was 0.796, eGFR - 0.617 and for serum creatinine - 0.456 with stages of HTN. Area under the curve for MAU was more as compared to other two parameters and hence in our study population MAU is a better parameter to assess the renal impairment with stages of HTN.

## DISCUSSION

HTN is an important public health problem worldwide. It has been identified as one of the leading risk factor for morbidity and mortality and it is the third cause of disability-adjusted life years. It exhibits

iceberg phenomenon where unknown morbidity exceeds the known morbidity. [15]

Hypertension is a complex multifactorial disorder. High BP is an important independent predictor of the development and progression of chronic renal disease. MAU and vascular disease are known to occur early in the course of essential HTN and MAU is a reversible urine component expressed as the cellular and molecular status of the renal function. [18, 16]

The prevalence of chronic renal disease is severely underestimated when it is defined on the basis of serum creatinine level instead of GFR. Sabharwal RK et al, in their study showed that out of 174 cases of essential HTN, 58 (33.3%) had MAU and prevalence was 34% in males and 30.7% in females. No correlation was found between BMI and albumin excretion and also with duration of HTN. [17, 18]

Out of 112 hypertensives, 54 subjects were males and 58 were females. Majority (63) were in the age group of 51 to 60 years. Among hypertensives more than half of the subjects (50.9%) were overweight. Majority (99.1%) of the individuals had normal serum creatinine in hypertensives. Microalbuminuria (MAU) was present in 62.5% of the subjects included. Out of the 112 study subjects, 70 (62.5%) of them were having hypertension for less than 5 years duration and the rest 42(37.5%) of them had for the past 5 years or more.

In our study, the mean weight of the male subjects was higher compared to females and the mean BMI of females was higher than males. But, none of them was statistically significant. Similar observation was made by Third National Health and Nutrition Examination Survey (NHANES III) that an increasing rate of hypertension with increasing BMI class. [19]

The mean waist circumference of male was  $89.65 \pm 11.605$  cm and female ( $88.48 \pm 11.517$  cm) subjects was similar. There was a statistically significant (p value – 0.026) difference in mean Hip

circumference among males (99.26 cm) and females (103.62 cm). The difference in mean Waist Hip ratio among males (0.90) and females (0.85) was also found to be statistically significant with p value of  $<0.001$

The difference in systolic blood pressure (p value 0.034) and diastolic blood pressure (p value  $<0.001$ ) among males and females was found to be statistically significant. There was a statistically significant difference of eGFR among male and female subjects.

The prevalence of hypertension is high in India and hypertensive nephropathy is a common cause of chronic kidney disease and hence the present study was undertaken to evaluate the association of serum creatinine, MAU (estimated using ACR) and eGFR among hypertensive patients. As the age of the participants increased, the systolic, diastolic BP, Serum creatinine and microalbuminuria increased but not significant statistically. BMI and Waist circumference was inversely correlated with age.

Microalbuminuria values were positively correlated with statistical significance (p value  $<0.05$ ) with duration of hypertension. Previous study done by Pontremoli et al showed that prevalence of MAU correlates with the BP and MAU patients are characterized by high BP levels. Serum creatinine and EGFR were negatively correlated but not significant statistically. [20]

In our study, the area under the curve for MAU was more as compared to other two parameters and hence in our study population MAU is a better parameter to assess the renal impairment with stages of HTN.

Untreated HTN is commonly associated with MAU or macroalbuminuria, the prevalence of which increases with age, with duration and severity of HTN and is higher in males as compared to females [21]

### Limitations of the study:

A 24 hour urine sample is the gold standard to measure MAU but it could not be collected in the present study. Small sample size is another limitation; our study results would have been more conclusive if the sample size was larger.

### CONCLUSION

Kidney is considered as prime target of hypertensive damage. The present study was a prospective study conducted at MIMS, Mandya over a period of one year. One hundred twelve hypertensive subjects were included in the study. Early identification of patients at risk is essential to diagnose the renal disease and prevent its progression of renal disease. Serum creatinine alone can be difficult to interpret as a measure of renal function. In clinical practice, the results of the serum creatinine test can be used to estimate GFR as it is cost effective and MAU estimation can be done routinely among essential hypertensive patients to assess the renal function.

In our study, males had higher percentage of MAU and decreased eGFR was common among female hypertensives and hence further study with large population is needed.

**Conflict of Interest: None**

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