A Study Of Prevalence Of Chronic Kidney Disease In Patients With Metabolic Syndrome In Urban Population Attending A Tertiary Care Center In India: A Hospital-Based Prospective Cross-Sectional Observational Study

***Yasmee Khan[1], Arati Lalchandani[2], AC Gupta[2]**
[1]Department of General Medicine, LN Medical College, Bhopal, MP, India.
[2]Department of General Medicine, GSVM, Kanpur, UP, India.

***Correspondence:** dryasmeekhan@gmail.com

Received: Sep 11, 2022; Revised: Oct 17, 2022; Accepted: Oct 18, 2022; Published: Oct 27, 2022

CITATION: Khan Y, Khan MM, Lalchandani A, Gupta AC. A Study Of Prevalence Of Chronic Kidney Disease In Patients With Metabolic Syndrome In Urban Population Attending A Tertiary Care Center In India: A Hospital Based Prospective Cross-Sectional Observational Study. *Recent Adv. Biol. Med*. 2022; 8(4): 9800027. DOI: 10.18639/RABM.2022.9800027

ABSTRACT
The study aims to determine the prevalence of Chronic Kidney Disease (CKD) and its risk factors in patients with Metabolic Syndrome in a tertiary care center in India. It was a hospital-based prospective observational study where NCEP ATP III CRITERIA was used to diagnose patients with Metabolic Syndrome, and CKD was defined according to KDIGO Guidelines. Out of 172 patients with Metabolic Syndrome, CKD was seen in 52 patients, of which 29 were males and 23 were females, so the prevalence of CKD in Metabolic Syndrome patients was about 30.23%. (52/172) P Value = 0.0000204. In our study, the prevalence of hyperglycemia in CKD patients with Metabolic Syndrome was 24.41% (42/172) P Value = .0011. The prevalence of obesity was 19.18% (33/172) P Value = .00844. The prevalence of hypertension was 28.48% (49/172) P Value = 2.72. The prevalence of hypertriglyceridemia was 26.12% (45\172) P Value = 0.000002086. The prevalence of hyperglycemia, obesity, and hypertriglyceridemia was significantly high in males. The prevalence of CKD in Metabolic Syndrome is 30.23% which is quite high, and since the prevalence of CKD is rising in India, we need more studies to look into this aspect of Metabolic Syndrome.

KEYWORDS: Metabolic Syndrome, Diabetes, Hypertension, Chronic Kidney Disease, Obesity, Hypertriglyceridemia, Hyperglycemia.

1. INTRODUCTION

Metabolic Syndrome is a concept that is a combination of risk factors for cardiovascular disease. The concept is as old as proposed by Vague *et al.* in 1947 that body fat topography was a better correlate of the complications of obesity [1]. In 1985 Modan *et al.* proposed that hyperinsulinemia could be a common factor in the pathophysiology of hypertension, diabetes, and obesity [2]. Metabolic Syndrome is associated with increased cardiovascular mortality by 12% [3]. The association between CKD and Metabolic Syndrome is gaining interest in certain populations [4,5]. CKD and Metabolic Syndrome have a very complex relationship, as each component of Metabolic Syndrome is a risk factor for the development of CKD [6]. Even increased CV mortality is seen in CKD with a rise in serum creatinine Values [7]. All over the world, different health organizations such as the World Health Organization (WHO) [8], the European Group for the study of Insulin Resistance (EGIR) [9], National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) [10], American Association of Clinical Endocrinologists (AACE) [11], International Hyperglycemia Federation (IDF) [12], use different criteria for Metabolic Syndrome, they are same on some parameters. However, they differ from each other on some criteria. In this study, we have used NCEP ATP III criteria which are more clinician-friendly [13].

2. METHOD(S)

It was a hospital-based prospective cross-sectional observational study conducted at a tertiary health center in India. Data of all patients admitted to the medical department with DM, HTN, and Dyslipidemia and fulfilling NCEP ATP III criteria for Metabolic Syndrome was recorded and analyzed.

Exclusion criteria were age <14 years and pregnant females. Patients were diagnosed with Metabolic Syndrome according to NCEP ATP III criteria. According to the NCEP ATP III criteria, the diagnosis of Metabolic Syndrome was made when three or more of the following were present:

1. Waist circumference >102 cm in males and >88 cm in female
2. Fasting blood glucose >110 mg/dl
3. Systolic blood pressure >130 mmHg or diastolic blood pressure >85 mmHg

4. Fasting triglyceride (TG) >150 mg/dl
5. High-density lipoprotein cholesterol (HDL-C) <40 mg/dl in men and <50 mg/dl in women.

Serum creatinine was measured using an enzymatic auto analyzer, and GFR was calculated using the CKD- EPI equation. Urine ACR was estimated with a urine analyzer. CKD was defined according to KDIGO Guidelines. The data were summarized as frequencies and percentages.

3. RESULTS

Out of the total study participants of 420 cases, 172 cases were identified to be having Metabolic Syndrome. Out of 172 patients with Metabolic Syndrome, CKD was seen in 52 patients, of which 29 were males, and 23 were females.

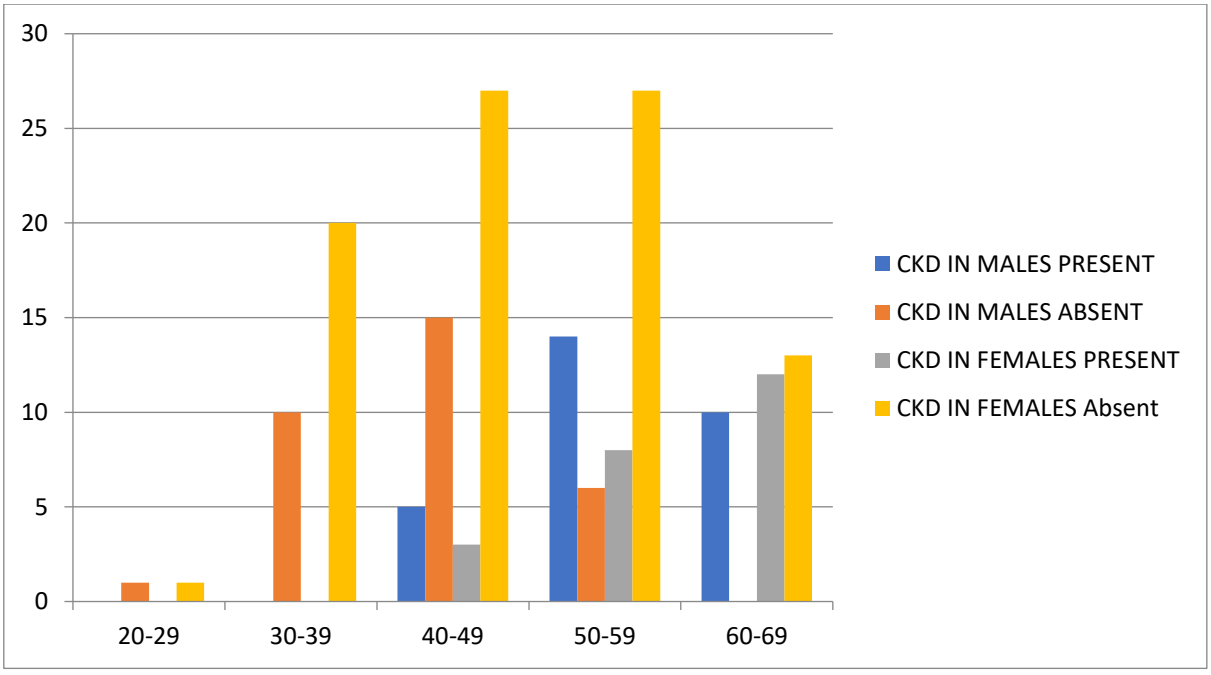
PREVALENCE OF CKD IN METABOLIC SYNDROME IN MALES AND FEMALES:

Table 1

AGE	20-29	30-39	40-49	50-59	60-69	TOTAL
CKD IN MALES PRESENT	0	0	5	14	10	29
CKD IN MALES ABSENT	1	10	15	6	0	32
CKD IN FEMALES PRESENT	0	0	3	8	12	23
CKD IN FEMALES ABSENT	1	20	27	27	13	88

X2 = 49.05
P Value = 0.0000204
Prevalence of CKD = 30.23%

Figure 1



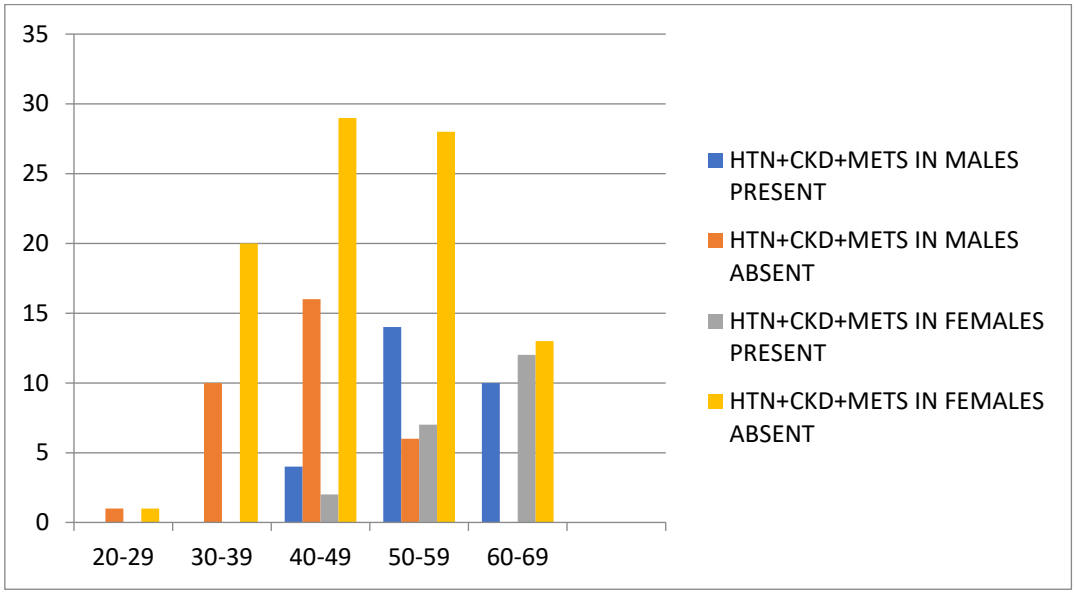
PREVALENCE OF HTN IN CKD PATIENTS:

Table 2

AGE	20-29	30-39	40-49	50-59	60-69	TOTAL
HTN+CKD+METABOLIC SYNDROME IN MALES PRESENT	0	0	4	14	10	28
HTN+CKD+METABOLIC SYNDROME IN MALES ABSENT	1	10	16	6	0	33
HTN+CKD+METABOLIC SYNDROME IN FEMALES PRESENT	0	0	2	7	12	21
HTN+CKD+METABOLIC SYNDROME IN FEMALES ABSENT	1	20	29	28	13	90

X2 = 54.0084
P Value = 2.72

Figure 2



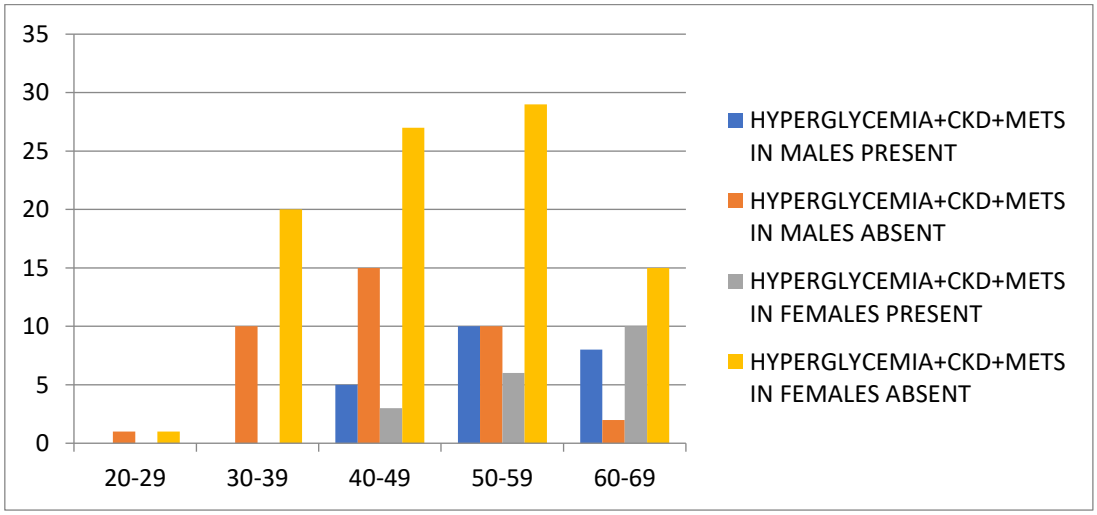
PREVALENCE OF HYPERGLYCEMIA IN CKD PATIENTS:

Table 3

AGE	20-29	30-39	40-49	50-59	60-69	TOTAL
HYPERGLYCEMIA+CKD+METABOLIC SYNDROME IN MALES PRESENT	0	0	5	10	8	23
HYPERGLYCEMIA+CKD+METABOLIC SYNDROME IN MALES ABSENT	1	10	15	10	2	38
HYPERGLYCEMIA+CKD+METABOLIC SYNDROME IN FEMALES PRESENT	0	0	3	6	10	19
HYPERGLYCEMIA+CKD+METABOLIC SYNDROME IN FEMALES ABSENT	1	20	27	29	15	92

X2 = 32.62
P Value = .0001101

Figure 3



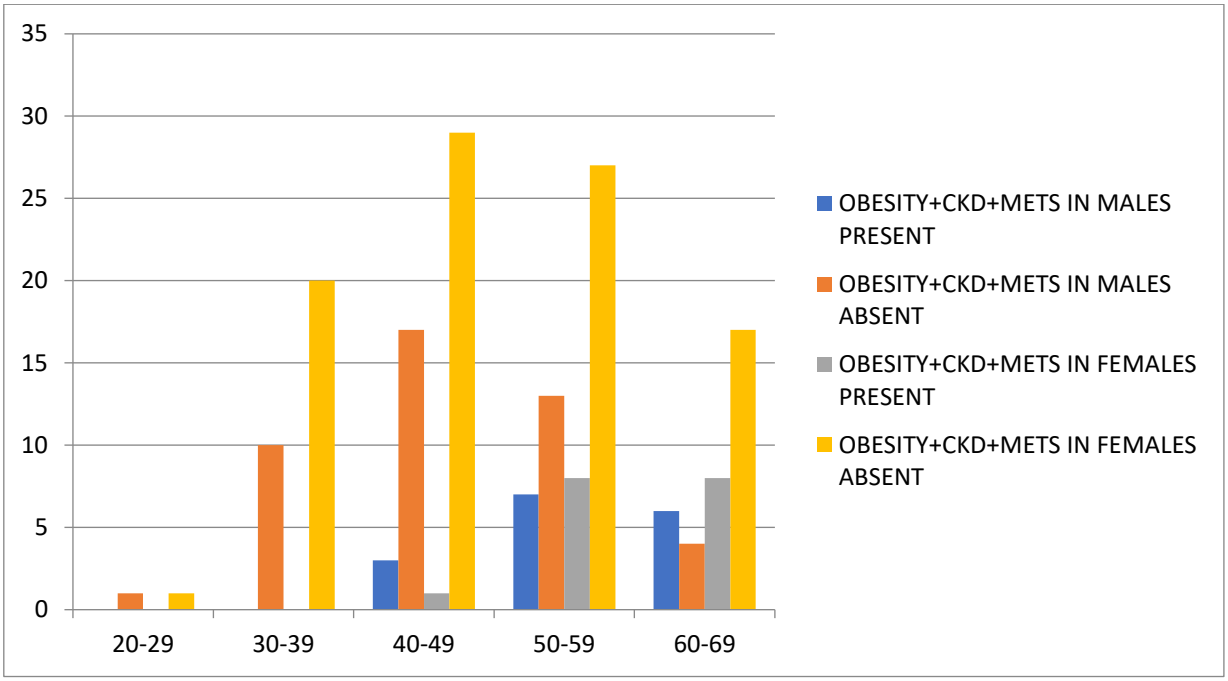
PREVALENCE OF OBESITY IN CKD PATIENTS:

Table 4

AGE	20-29	30-39	40-49	50-59	60-69	TOTAL
OBESITY+CKD+METABOLIC SYNDROME IN MALES PRESENT	0	0	3	7	6	16
OBESITY+CKD+METABOLIC SYNDROME IN MALES ABSENT	1	10	17	13	4	45
OBESITY+CKD+METABOLIC SYNDROME IN FEMALES PRESENT	0	0	1	8	8	17
OBESITY+CKD+METABOLIC SYNDROME IN FEMALES ABSENT	1	20	29	27	17	94

X2 = 26.73
P Value = .00844

Figure 4



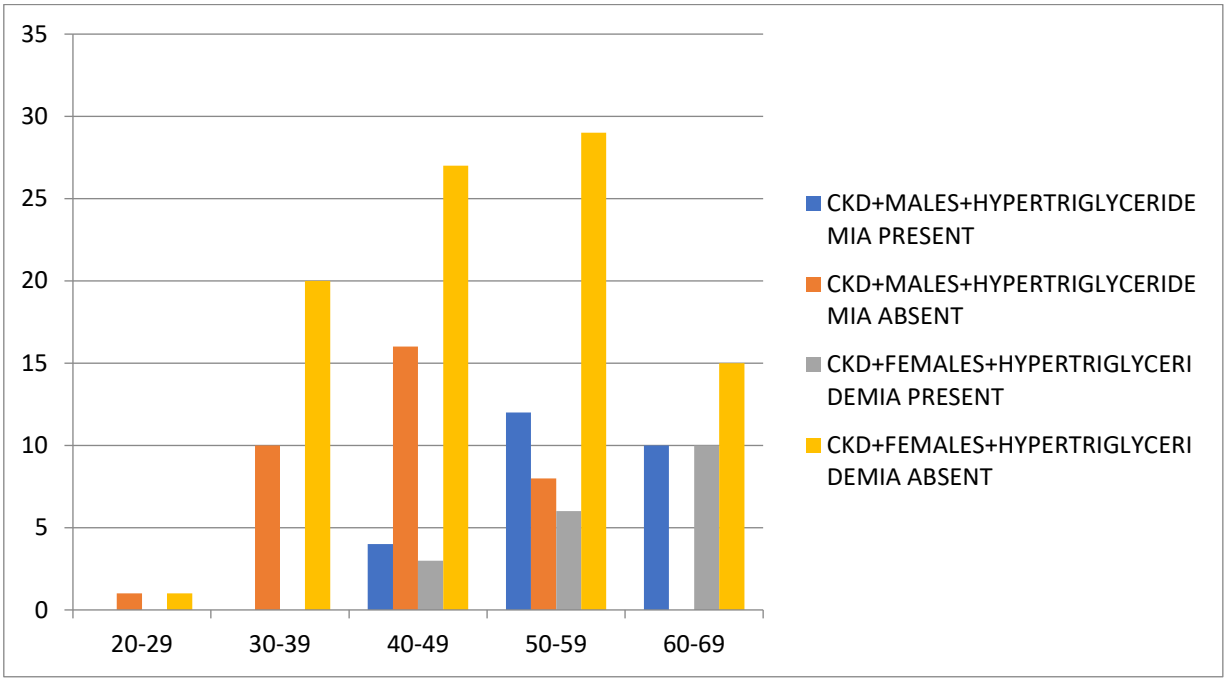
PREVALENCE OF HYPERTRIGLYCERIDEMIA IN CKD PATIENTS:

Table 5

AGE	20-29	30-39	40-49	50-59	60-69	TOTAL
CKD+MALES+HYPERTRIGLYCERIDEMIA PRESENT	0	0	4	12	10	26
CKD+MALES+HYPERTRIGLYCERIDEMIA ABSENT	1	10	16	8	0	35
CKD+FEMALES+HYPERTRIGLYCERIDEMIA PRESENT	0	0	3	6	10	19
CKD+FEMALES+HYPERTRIGLYCERIDEMIA ABSENT	1	20	27	29	15	92

X2 = 43.202
P Value = 0.000002086

Figure 5



The prevalence of CKD in Metabolic Syndrome patients was about 30.23%. (52/172) P Value = 0.0000204. among these, 29 were males, and 23 were females, so the prevalence in males was 47.5% (29/61), and in females, it was 20.72% (23/111) (Table 1, Figure 1).

Hypertension was seen in 49 patients, so the prevalence of hypertension was 28.48% (49/172) P Value = 2.72. Out of these, 28 were males, and 21 were females, so the prevalence of hypertension in CKD patients was 45.90% (28/61), and in females, it was 18.91% (21/111) (Table 2, Figure 2).

Hyperglycemia was seen in 42, so the prevalence of hyperglycemia in CKD patients with Metabolic Syndrome was 24.41% (42/172) P Value = .0011. Out of these, males were 23 and females were 19, so the prevalence of hyperglycemia in CKD patients with Metabolic Syndrome in males was 37.7% (23/61) and in females, it was 17.11% (19/111) (Table 3, Figure 3).

Obesity was seen in 33 patients, so the prevalence of obesity was 19.18% (33/172) P Value = .00844. Of these, 16 were males, and 17 were females, so the prevalence of obesity in CKD females was 17. The prevalence of obesity in CKD patients with Metabolic Syndrome in males was 26.22% (16\61), and in females, it was 15.31% (17\111) (Table 4, Figure 4).

Hypertriglyceridemia was seen in 45 patients, so prevalence was 26.12% (45\172) P Value = 0.000002086. Of these, 26 were males, and 19 were females, so the prevalence in males was 42.62% (26\61), and in females was 17.11% (19\111) (Table 5, Figure 5).

4. DISCUSSION

Metabolic Syndrome has been seen to be a risk factor for CVD, but its role in the development of CKD still needs to be defined. There have been many associating factors between Metabolic Syndrome and CKD, and these are GFR (eGFR) < 60 mL/min per 1.73 m^2, microalbuminuria or proteinuria, tubular atrophy, interstitial fibrosis, arterial sclerosis, increased intrarenal resistive indices [6]. A meta-analysis of eleven studies of 30146 subjects reported that Metabolic Syndrome was associated with the development of an estimated GFR (eGFR) < 60 mL/min per 1.73 m^2, (Stage Ⅲ CKD) with an odds ratio (OR) of 1.55 (95% CI: 1.34-1.80) [14].

Metabolic Syndrome, when associated with CKD, has a higher risk of a high burden of coronary plaques and, when associated with Myocardial Infarction, presents higher overall mortality [15,16]. Chen *et al.* reported that the prevalence of Metabolic Syndrome is about 24.7% of adults in the USA and had a positive correlation between components of Metabolic Syndrome and albuminuria and eGFR, 60 mL/min/1.73 m^2 [17]. Palaniappan *et al.* showed that people with Metabolic Syndrome are at increased risk for microalbuminuria [18].

In our study, we tried to study the prevalence of CKD in Metabolic Syndrome patients and the prevalence of risk factors of Metabolic Syndrome in these CKD patients. In our study, we found that the prevalence of CKD in the Indian population was 30.23%, which was highly significant and very high compared to other studies in different parts of the world.

Tanaka *et al.* reported a prevalence of 13.7% in a Chinese study [19]. Ninomiya *et al.* reported a prevalence of 10.6% in the Japanese population [20]. The prevalence of CKD in Metabolic Syndrome is quite low in the African population [21]. There are no studies available on the Indian population. In our study, the prevalence in males was higher (47.5%) than in females (20.72%). Among the risk factors prevalence of hyperglycemia in CKD patients with Metabolic Syndrome was 24.41%. Of these, males had a prevalence of 37.7%, and in females, it was 17.11%, as hyperinsulinemia is an important risk factor for CKD [22]. The prevalence of obesity was 19.18%; out of these, it was 26.22% in males and 18.91% in females. In 2014 a Korean study reported that increased waist circumference had a 69.1% chance of developing CKD [23]. Renal hyperfiltration and hyper perfusion as focal glomerulosclerosis and other histological changes have been observed in the kidneys of obese patients [24].

In a cross-sectional survey conducted in 2018 in China, Xie *et al*. reported that the prevalence of CKD was 22% in people with hypertension. The components of Metabolic Syndrome, such as elevated TG and elevated FBS strongly and significantly associated with CKD [25]. Xiao *et al.,* in a cross-sectional study conducted in a southern province in China, reported the prevalence of CKD as 20.7%. He also reported that Metabolic Syndrome and its components were significant risk factors for CKD [26]. Aljabri *et al.,* in a retrospective cross-sectional study, reported that the prevalence of CKD was 28.3% in patients with Metabolic Syndrome. It was 50.6% in males and 34.1% in females. CKD was seen more in older age patients. In the patients with CKD, there was a significantly higher prevalence of type 2 diabetes (T2DM), hypertension, and raised serum triglyceride than in the patients without CKD [27].

In our study, we found out that the prevalence of hypertension was 24.28%, an insignificant P Value of 2.42, while in other studies, hypertension was a significant risk factor. The prevalence of hypertriglyceridemia was 26.12%, while it was 34.64% in the Korean study by Kang *et al*.

The limitations of the study are hospital-based and observational study. We adopted NCEP III criteria to diagnose Metabolic Syndrome without its modification to Indian subjects. The strength of the present study was the adequate sample size and representative sampling technique.

5. CONCLUSION

The prevalence of Metabolic Syndrome was more than 40%, and the prevalence of CKD in Metabolic Syndrome was 30.23% but was significantly higher in males as compared to females. The prevalence of obesity, hyperglycemia, and hypertriglyceridemia was significantly higher in CKD patients. There are few studies regarding the prevalence of CKD in Metabolic Syndrome in the Indian population. Since India has the world's largest diabetes population and the prevalence of CKD is also increasing in India, this study tries to explore this important association. However, more studies are required in this field.

AUTHOR CONTRIBUTIONS

All authors contributed equally to this work.

CONFLICT OF INTEREST

None.

REFERENCES

1. Vague J. Sexual Differentiation, a Factor Affecting the Forms of Obesity. La Presse Médicale, 1947;30:339-340.
2. Modan M, Halkin H, Almog S, Lusky A, Eshkol A, Shefi M, *et al*. Hyperinsulinemia. A link between hypertension obesity and glucose intolerance. J Clin Invest. 1985;75(3):809-17. doi: 10.1172/JCI111776.
3. Alberti KG, Zimmet P, Shaw J. IDF Epidemiology Task Force Consensus Group. The metabolic syndrome – A new worldwide definition. Lancet 2005;366:1059-62.
4. Lucove J, Vupputuri S, Heiss G, North K, Russell M. Metabolic syndrome and the development of CKD in American Indians: the Strong Heart Study. Am J Kidney Dis. 2008;51:21–28.
5. Kitiyakara C, Yamwong S, Cheepudomwit S, Domrongkitchaiporn S, Unkurapinun N, Pakpeankitvatana V, *et al*. The metabolic syndrome and chronic kidney disease in a Southeast Asian cohort. Kidney Int. 2007;71:693–700.
6. Prasad GVR. Metabolic syndrome and chronic kidney disease: Current status and future directions. World J Nephrol. 2014;3(4):210-219.
7. Mann JF. Cardiovascular risk in patients with mild renal insufficiency: implications for the use of ACE inhibitors. Presse Med. 2005;34:1303–1308.
8. Alberti KG, Zimmet PZ. Definition, diagnosis and classification of diabetes mellitus and its complications. Part 1: Diagnosis and classification of diabetes mellitus: a provisional report of a WHO consultation. Diabetes Med. 1998;15:539-53.
9. Balkau B, Charles MA. Comment on the provisional report from the WHO consultation. European group for the study of insulin resistance (EGIR). Diabetes Med. 1999;16:442-3.
10. Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults. Executive Summary of the Third Report of the National Cholesterol Education Program (NCEP) expert panel on detection, evaluation, and treatment of high blood cholesterol in adults (Adult treatment panel III). JAMA 2001;285:2486-97.
11. Einhorn D, Reaven GM, Cobin RH, Ford E, Ganda OP, Handelsman Y, *et al*. American College of Endocrinology position statement on the insulin resistance syndrome. Endocr Pract. 2003;9:237-52.

12. Lam DW, LeRoith D. Metabolic syndrome. In: De Groot LJ, Chrousos G, Dungan K, Feingold KR, Grossman A, Hershman JM, *et al.*, editors. Endotext. South Dartmouth (MA): MDText.com, Inc.; 2000. Available from: http://www.ncbi.nlm.nih.gov/books/NBK278936/
13. Ritchie SA, Connell JM. The link between abdominal obesity, metabolic syndrome and cardiovascular disease. Nutr Metab Cardiovasc Dis. 2007;17:319-26.
14. Thomas G, Sehgal AR, Kashyap SR, Srinivas TR, Kirwan JP, Navaneethan SD. Metabolic syndrome and kidney disease: a systematic review and meta-analysis. Clin J Am Soc Nephrol. 2011;6:2364-2373. DOI: 10.2215/CJN.02180311
15. Kunimura A, Amano T, Uetani T, Harada K, Yoshida T, Suzuki A, *et al*. Prognostic impact of concurrence of metabolic syndrome and chronic kidney disease in patients undergoing coronary intervention: Involvement of coronary plaque composition. J Cardiol. 2013;61:189-195. DOI: 10.1016/j.jjcc.2012.10.003
16. Kim CS, Choi JS, Bae EH, Ma SK, Ahn YK, Jeong MH, *et al*. Association of metabolic syndrome and renal insufficiency with clinical outcome in acute myocardial infarction. Metabolism 2013;62:669-676 DOI: 10.1016/j.metabol.2012.11.002
17. Chen J, Muntner P, Hamm LL, Jones DW, Batuman V, *et al*. The metabolic syndrome and chronic kidney disease in US adults. Ann Intern Med. 2004;140:167–174.
18. Palaniappan L, Carnethon M, Fortmann SP. Association between microalbuminuria and the metabolic syndrome: NHANES III. Am J Hypertens. 2003;16:952–958.
19. Tanaka H, Shiohira Y, Uezu Y, Higa A, Iseki K. Metabolic syndrome and chronic kidney disease in Okinawa, Japan. Kidney Int. 2006;69:369–374.
20. Ninomiya T, Kiyohara Y, Kubo M, Yonemoto K, Tanizaki Y, Doi Y, *et al.* Metabolic syndrome and CKD in a general Japanese population: the Hisayama Study. Am J Kidney Dis 2006;48(3):383-91.
21. Emem-Chioma PC, Siminialayi IM, Wokoma FS. Prevalence of Chronic Kidney Disease in Adults with Metabolic Syndrome. Saudi J Kidney Dis Transpl. 2011;22(5):949-954.
22. Kubo M, Kiyohara Y, Kato I, Iwamoto H, Nakayama K, Hirakata H, *et al*. Effect of hyperinsulinemia on renal function in a general Japanese population: the Hisayama study. Kidney Int. 1999;55(6):2450–2456. doi: 10.1046/j.1523-1755.1999.00458.x
23. Kang YU, Kim HY, Choi JS, Kim CS, Bae EH, Ma SK, *et al*. Metabolic syndrome and chronic kidney disease in an adult Korean population: results from the Korean National Health Screening. PLoS One. 2014;9(5):e93795. doi: 10.1371/journal.pone.0093795
24. Tomaszewski M, Charchar FJ, Maric C, McClure J, Crawford L, *et al.* Glomerular hyperfiltration: a new marker of metabolic risk. Kidney Int. 2007;71:816– 821.
25. Xie K, Bao L, Jiang X, Ye Z, Bing J, Dong Y, *et al*. The association of metabolic syndrome components and chronic kidney disease in patients with hypertension. Lipids Health Dis. 2019;18(1):229. Doi: 10.1186/s12944-019-1121-5.
26. Xiao H, Shao X, Gao P, Zou H, Zhang X. Metabolic Syndrome Components and Chronic Kidney Disease in a Community Population Aged 40 Years and Older in Southern China: A Cross-Sectional Study. Diabetes Metab Syndr Obes. 2022;15:839-848. doi: 10.2147/DMSO.S353305.
27. Aljabri KSJ, Bokhari SA, Alshareef MA, Khan PM, Abuelsaoud HM, Jalal MM, *et al*. Prevalence of Chronic Kidney disease in Patients with Metabolic Syndrome in Saudi Population. Clin Res Diabetes Endocrinol 2018;1(2):1-7.