**Renal Data from Asia–Africa**

**Prevalence and Risk Factors of Chronic Kidney Disease in Overweight and Obese Population in a Tertiary Care Hospital in North India**

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**ABSTRACT.** Obesity has already been a global epidemic, and its prevalence has been projected to grow by 40% in the next decade. Its increasing prevalence has implications on the epidemiology of chronic kidney disease (CKD), which, in turn, could impact the health system and thereby the society in an adverse manner. Lack of community-based screening programs can lead to missed or late detection of CKD. The current study aims to estimate the prevalence of CKD in overweight and obese general population attending a screening camp in a tertiary care hospital in a North Indian city. In this cross-sectional study, 103 overweight and obese people from a community attending a health camp were screened for serum creatinine, urine analysis, random blood sugar, and uric acid. Demographic and anthropometric parameters were noted. Binary logistic regression analysis was used to find the predictors of CKD in these patients. The median age of the participants was 43 years with a male predominance (68%). More than half (58.4%) of the participants were obese and the remaining 41.6% were overweight. The overall prevalence of CKD was 17.5%. Individuals with obesity and diabetes were more prone to develop CKD (odds ratio = 4.868 and 7.941, respectively). CKD was prevalent in individuals with obesity. Obesity and diabetes were the significant predictors for the development of CKD. All the overweight and obese individuals should be periodically screened for kidney diseases.

**Introduction**

Obesity and its associated comorbidities such as diabetes mellitus (DM), hypertension (HTN), cardiovascular diseases, chronic kidney diseases (CKDs), and cancer have become a major global health concern. The prevalence of overweight and obesity among adults has nearly tripled since 1975.¹ Obesity in India has also reached an epidemic, affecting 5% of associated morbidity of the country’s population.² 

CKD is an emerging noncommunicable disease of public health importance.³ The traditional risk factors for CKD include DM, HTN, and a positive family history of CKD to
list a few. Obesity of late has been described as an independent risk factor for incident CKD and its progression. Thus, the current obesity epidemic has the potential for huge increase in CKD and hence affecting the health-care burden further. Moreover, due to its asymptomatic nature, CKD is generally detected at advanced stages, resulting in the loss of opportunities to influence its future course of outcome. Progression of CKD and its complications can be delayed through early detection and treatment.

End-stage renal disease (ESRD) is the last stage of CKD. The estimated age-adjusted incidence rate of ESRD is 229 per million population, whereas more than 100,000 new patients enter renal replacement programs annually in India. However, due to economic constraints and scarce resources, only 10% ESRD patients receive any form of renal replacement therapy (RRT). In the 2015 Global Burden of Disease Study, kidney disease was the 12th most common cause of death, accounting for 1.1 million deaths worldwide.

In the year 2002, the Kidney Disease Outcomes Quality Initiative of the National Kidney Foundation developed a practice guideline for CKD, recommending routine testing for the detection of kidney disease during general health checkups for individuals at risk.

The lack of community-based screening programs for CKD results in patient detection at advanced stages. Hence, this study was designed through camp-based screening of focused group (overweight and obese) at a tertiary care hospital in Varanasi, a North Indian city, on the occasion of the World kidney day, 2017, to assess the prevalence patterns of some known risk factors of CKD in unidentified overweight and obese general population along with the extent of its contribution.

Materials and Methods

Data characteristics

The study was conducted in the Department of Nephrology at Opal hospital, Varanasi, celebrating the World Kidney day (March 9, 2017). Considering 7% prevalence of CKD in obese individuals with 95% confidence interval (CI) and 5% precision, the sample size was estimated to be 101; hence, a total of 103 overweight and obese individuals who consented verbally to participate in the study were considered. Opal Hospital’s Ethics Committee approval was taken before starting the present study. The study participants had a body mass index (BMI) ≥25 kg/m². Individuals symptomatic for acute kidney injury were excluded from the study. Demographic (i.e., age and sex) and clinical characteristics, history of smoking and alcohol consumption, history of DM and HTN, and familial history of kidney disease were noted. Anthropometric parameters, i.e., height, weight, and waist hip ratio (WHR), were recorded by the standard methods. A random venous blood sample was drawn and was analyzed for serum creatinine, random blood sugar (RBS), and uric acid. Finally, a urinalysis was done for each participant.

Variable definitions

Some of the variables were converted into categories for appropriate clinical interpretation. Age was divided into two categories, for example, <44 and ≥44 years, based on the median values. Individuals with BMI: 25.00–29.99 (kg/m²) were considered overweight and ≥30.00 as obese.

DM was defined as the use of glucose-lowering medicine, or RBS ≥200 mg/dL, along with the presence of osmotic symptoms. Systolic and diastolic blood pressures (BPs) were measured in a standard way. HTN was defined as the use of antihypertensive medication, or systolic BP ≥140 mm Hg, or diastolic BP ≥90 mm Hg. According to the WHO norms, abdominal obesity was defined as a WHR above 0.90 for males and above 0.85 for females. History of smoking and alcohol consumption, obesity, DM, HTN, family history of renal disease, and albuminuria were dichotomized as present or absent.

Serum creatinine level was divided into two
groups: <1.30 and ≥1.30 (mg/dL). A urine dipstick (Medi-Test Combi 9-Macherey Nagel, Duren, Germany) was performed for each participant. Normal uric acid levels were considered between 2.4 and 6.0 mg/dL and 3.4 and 7.0 mg/dL for females and males, respectively. It was further categorized as normal and abnormal. According to the Kidney Disease: Improving Global Outcomes guidelines, the CKD outcome was identified based on estimated glomerular filtration rate (eGFR) and albuminuria. Albuminuria was regarded as significant if 1+ and above. GFR was calculated using the Modification of Diet in Renal Disease study equation. CKD stages were defined as: Stage 1 if eGFR ≥90 and albuminuria present; Stage 2 if eGFR = 60–89 and albuminuria present; Stage 3 if eGFR = 30–59; Stage 4 if eGFR = 15–29; and Stage 5 if eGFR <15. All individuals with a positive test result for chronic kidney dysfunction in the screening were referred to the nephrologists without any further follow-up.

### Statistical Analysis

All the statistical analyses were performed on Stata/IC V10.1 (StataCorp., College Station, TX, USA). In the descriptive analyses, means ± standard deviations and medians [interquartile range (IQR)] were calculated for continuous data and proportions were calculated for categorical data. The association of each variable with the disease outcome, CKD, was seen separately using Pearson’s Chi-square test and strength of association using Cramer V statistics.

A two-step procedure was used to select the most appropriate predictive model for the occurrence of CKD. Initially, bivariable binary logistic regression analysis was performed and finally multivariable logistic including only those significant at \( P = 0.10 \) in bi-variable logistic regression was performed. Step-wise backward likelihood ratio logistic regression was performed to eliminate insignificant predictors of CKD in multivariable logistic regression, and \( P = 0.05 \) was used as a threshold for predictors to contribute significantly. 95% CIs of the estimated odds ratio (OR) was also obtained along with the corresponding \( P \) values.

### Results

The demographic, clinical, and laboratory data are summarized in Table 1. The median (IQR) age of the participants was 43 (35–53) years. Nearly half (51.5%) of the participants were younger than 44 years. Male predominance (68%) was observed in the cohort. The prevalence of CKD was higher in females (27.3%) compared to that in males (\( P = 0.072 \)). None of the participants reported any history of smoking and alcohol consumption. Family history of kidney disease was reported only by two participants.

DM and HTN were prevalent in approximately one-fifth (21.4%, \( n = 22 \)) and one-third (32.4%, \( n = 33 \)) of the participants in the cohort, respectively. The prevalence of CKD among the groups with diabetes and HTN was 45.5% and 27.3%, respectively. DM was associated with CKD to the extent of 38.4%, and the association was highly statistically significant (\( P <0.001 \)). HTN had a weak association with CKD (17.5%) with statistical insignificance at 5% (\( P = 0.078 \)). Nearly 95.1% had abdominal obesity. More than half (58.4%) of the participants were obese with 25.4% CKD prevalence, whereas in the remaining 41.6% overweight participants, the prevalence of CKD was much less (7.1%), and the statistical difference was highly significant (\( P = 0.018 \)).

The prevalence of CKD was 17.5% (95% CI: 10.0%–24.9%) in the whole cohort, with 5.8% of Stage 1, 4.9% of Stage 2, and 6.8% of Stage 3. Further, in our study, no participants had Stages 4 and 5 CKD because higher CKD stages are usually symptomatic and hence unlikely to remain undetected in most cases. The serum creatinine levels of nearly one-tenth (10.7%) of the participants were ≥1.30 mg/dL, out of which 9.1% were suffering with CKD, but the association was statistically insignificant (\( P = 0.684 \)). Uric acid was found abnormal in nearly one-third of the participants (31.4%). About half (52.4%) of the participants...
were falling in eGFR levels between 60 and 89, 40.8% in higher (≥90), and only 6.8% in lower (30–59) eGFR levels. Almost 14.3% of the participants with eGFR ≥90 and 9.3% participants with eGFR between 60 and 89 were suffering with CKD. Albuminuria was found positive in only 12.6% of individuals. Cramer V statistics indicated that the strength of association of DM and HTN with the degree of proteinuria was highly statistically significant (P <0.05) and to the extent of 48.2% and 31.2%, respectively. Albuminuria and eGFR were highly associated with CKD (P <0.001) but being prelude for CKD occurrence were not considered in the regression model.

Predictors such as age, sex, obesity, DM, HTN, uric acid, and serum creatinine levels were considered for the regression model development. In the bivariable binary logistic
regression analysis (Table 2), obesity and DM (at 5%) and sex and HTN (at 10%) came out to be independent predictors for CKD. Subsequently, these were considered for multivariable binary logistic regression analysis. The predictors were controlled for potential confounding and were checked for possible interaction as well.

Persons with diabetes were at a higher risk of developing CKD (Table 3: OR = 7.941, 95% CI = 2.446–25.774). Nearly 21.4% of the participants had diabetes and among them, 68.2% were aged ≥44 years, 63.6% were obese, 45.5% were hypertensive, 22.7% had abnormal uric acid, 40.9% had proteinuria, and 45.5% had CKD, although diabetes was statistically significantly associated only with aging of individuals and proteinuria (P <0.05). Obese individuals were nearly five times more prone to develop CKD (Table 3: OR = 4.868, 95% CI = 1.197–19.788). In the obese group, 23.7% were diabetic, 37.3% were hypertensive, 13.6% had higher creatinine levels (≥1.30 mg/dL), 18.6% had proteinuria, 35.6% had abnormal uric acid, and finally 25.4% were suffering with CKD.

**Discussion**

Delayed recognition of CKD may predispose patients to adverse future outcomes. In the present study, we estimated the prevalence of CKD in a community-based cohort of overweight and obese individuals. In these high-risk group individuals, we detected a high prevalence of DM, HTN, and abnormal uric acid, which are all significant contributors of CKD.

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### Table 2. Risk factors of chronic kidney disease: A bi-variable binary logistic regression analysis.

| Characteristics                  | Beta  | S.E.  | Wald | Significance | OR    | 95% CI for OR |
|----------------------------------|-------|-------|------|--------------|-------|---------------|
| Age in years (Ref: Up to 43)     |       |       |      |              |       |               |
| ≥4                              | 0.071 | 0.519 | 0.019| 0.892        | 1.073 | 0.388–2.968   |
| Sex (Ref: Male)                  |       |       |      |              |       |               |
| Female                          | 0.933 | 0.529 | 3.105| 0.078        | 2.542 | 0.900–7.174   |
| Obesity (Ref: No)               |       |       |      |              |       |               |
| Yes                             | 1.489 | 0.670 | 4.944| 0.026        | 4.332 | 1.193–16.465  |
| DM (Ref: No)                    |       |       |      |              |       |               |
| Yes                             | 2.029 | 0.567 | 12.780| <0.001      | 7.604 | 2.500–23.125  |
| HTN (Ref: No)                   |       |       |      |              |       |               |
| Yes                             | 0.916 | 0.530 | 2.993| 0.084        | 2.500 | 0.885–7.060   |
| Uric acid (Ref: Normal)         |       |       |      |              |       |               |
| Abnormal                        | 0.109 | 0.553 | 0.039| 0.843        | 1.115 | 0.377–3.297   |
| Serum creatinine (Ref: Up to 1.2)|       |       |      |              |       |               |
| ≥1.3                            | -0.818| 1.083 | 0.571| 0.450        | 0.441 | 0.053–3.683   |

OR: Odds ratio, CI: Confidence interval, DM: Diabetes mellitus, HTN: Hypertension.

### Table 3. Risk factors of chronic kidney disease: A multivariable binary logistic regression analysis.

| Characteristics | B     | S.E.  | Wald | Sig.  | OR    | 95% CI for OR |
|-----------------|-------|-------|------|-------|-------|---------------|
| Obesity (Ref: No) |       |       |      |       |       |               |
| Yes             | 1.583 | 0.716 | 4.892| 0.027 | 4.868 | 1.197–19.788  |
| DM (Ref: No)    |       |       |      |       |       |               |
| Yes             | 2.072 | 0.601 | 11.897| 0.001 | 7.941 | 2.446–25.774  |
| Constant        | -3.308| 0.707 | 21.910| <0.001| 0.037 |               |

CKD: Chronic kidney disease, OR: Odds ratio, CI: Confidence interval, DM: Diabetes mellitus.
In the present study, CKD prevalence was found to be 17.5%, which is in consensus with the global prevalence of CKD, ranging between 8% and 17%. Recently, data from the International Society of Nephrology’s Kidney Disease Data Center Study reported a prevalence of 17%. The reported prevalence of CKD in different Indian regions ranges from <1% to 13%. SEEK India cohort involving 6120 individuals from all over the country also reported similar figures.

The multivariable binary logistic regression model depicted that persons with diabetes were at a very high risk (OR = 7.941, 95% CI = 2.446–25.774) of developing CKD in the study (Table 3). Out of 21.4% of individuals with diabetes, 68.2% were aged ≥44 years and the association was highly statistically significant (P < 0.05). Nearly half (48.5%) of the individuals were middle aged or elderly (≥44 years) and were vulnerable to age-related decline in renal function because age itself is a nonmodifiable risk factor for many of the interlinked chronic diseases such as HTN and glomerulosclerosis. Various comorbidities coherent with aging such as DM and HTN are the significant predictors of CKD. DM has traditionally been described as one of the most important risk factors for the development of CKD. In Western countries, DM accounts for over 2/3\textsuperscript{rd} of the cases of CKD. In India also, DM accounts for 40%–60% cases of CKD.

Epidemiologic studies have demonstrated the role of obesity in incident CKD and its progression. Obesity contributes to the pathogenesis of kidney damage via development of diabetes and HTN. Besides, obesity independently leads to the development and progression of CKD, which is possibly mediated through inflammation, oxidative stress, endothelial dysfunction, prothrombotic state, hypervolemia, and adipokine derangements. Moreover, evidences suggest that weight reduction in CKD reduces proteinuria and BP and may slow decline in renal function.

Obesity came out to be an independent risk factor of CKD in the bivariable analysis (Table 2: OR = 4.432, 95% CI = 1.193–16.465) as well as a significant risk factor after being adjusted in the multivariable model (Table 3: OR = 4.868, 95% CI = 1.197–19.788). Both in bivariable and multivariable analyses, the risk of CKD development was more than four times higher in obese compared to overweight individuals. Obesity was associated with GFR as well and hence, there was a clear-cut implication for CKD occurrence.

Henceforth, lack of community-based screening programs can lead to missed or late detection of CKD. As obesity is also a priori to CKD and other complications, early screening for CKD along with DM will reduce the load of health-care delivery system that are involved in RRT and treatment of cardiovascular diseases.

The two major limitations of the study were: (1) as the study was conducted at a hospital-based health camp, the results may not be generalized for the community-based settings and (2) the participants were screened for CKD in a cross-sectional way on a single day and there was no follow-up.

Conclusions

Obesity is a potent risk factor for the development of CKD. Diabetes in association with obesity accelerates the occurrence of CKD. All overweight and obese individuals should be periodically screened for renal function abnormalities.

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