



**PREVALENCE OF DIABETES MELLITUS AMONG SUDANESE PATIENTS WITH
CHRONIC KIDNEY DISEASE– KHARTOUM STATE, SUDAN**

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ABSTRACT

Background: Chronic kidney disease (CKD), represent a diagnostic challenge. On the other hand, diabetes mellitus became a worldwide problem and also is considered as the main risk factor for Kidney Disease.

Objectives: The aim of our study was to evaluate the prevalence of CKD among Sudanese patients and its association with diabetes mellitus.

Methods: The study was carried out at Khartoum State, Sudan during the period of July 2017 to August 2017. Three hundred and seventy-five (375) CKD patients aged 18–90; their GFR was estimated using plasma creatinine and calculating kidney function by the Modification of Diet in Renal Disease (MDRD) equation. Patients with an estimated glomerular filtration rate (eGFR) less than 60 mL/min/1.73 m² were considered as having CKD. Plasma creatinine, glucose, and medical history for presence of diabetes were also assessed.

Results: The mean age of the subjects was 51.7 ± 14.4 SD and the prevalence of CKD for the overall percentage was 71 % with CKD and 29% without CKD. Moreover, we have found a high prevalence of CKD in diabetic patients within the male 76.8 % in comparison with female 75%

groups. Regarding the association of diabetes mellitus with age in general, a higher prevalence of diabetes mellitus in younger was 86.5 % in female compared with 66.1 % in male was observed across age categories.

Conclusion: This study showed that chronic kidney disease is widespread in Sudanese patients and is associated with younger and diabetic patients. Further studies should be undertaken to determine why the prevalence of diabetic nephropathy among Sudanese patients in these high-level levels.

Keywords: Chronic Kidney Disease, Diabetes Mellitus, Diabetic Nephropathy, Risk Factors

INTRODUCTION

Chronic kidney disease (CKD) is being realized as a worldwide health challenge that affecting people of all races, classes of ages, and economic groups. The prevalence and incidence of the disease increasingly rise, reflecting the growing elderly population and the increasing numbers of people with diabetes and hypertension [1-3]. Moreover, up to now CKD in Sudan and other African countries is considered the most challenging public health problem, mainly attributed to high-risk factors like diabetes and hypertension. On the other hand, poor data limit the solution and make it more difficult to be solved [4, 5].

CKD is common, being present in as many as 10% of the population and the incidence increases with increasing age. Diabetic nephropathy, hypertension and the elderly are the main leading causes of worldwide [6, 7]. Furthermore, early diagnoses and treatment are needed to avoid progression to

kidney failure and complications such as coronary vascular disease [8].

Although, several epidemiologic studies were conducted to estimate the disease burden in different parts of various countries, the largest being the EGIPT-CKD (Egypt Information, Prevention, and Treatment of CKD) Project. Preliminary data for about 1,000 participants showed the prevalence of proteinuria to be as high as 21%, including 3.9% with elevated serum creatinine levels [9]. Similarly, Stenvinkel (2010) [10] reported that also the prevalence of CKD has increased dramatically in the period of 1999 to 2007 in different countries around the world, developed, as well as developing countries. It has reached epidemic proportions with 10–13% of the populations in Taiwan, Iran, Japan, China, Canada, Saudi Arabia, India and the USA [11-13]. Although there aren't published reports about the prevalence rates of CKD in Sudanese

populations, except in a pilot study of 273 individuals of police housing complexes in Greater Khartoum (comprising three cities; Khartoum, Omdurman, and Khartoum North) carried out by Abu-Aisha [14] found that there is a highly significant rate of the CKD prevalence in their studied population. The only identified independent risk factors were age above 50 years and low-educational level.

CKD is affected by various risk factors, including demographic variables (age, gender and ethnicity), hereditary factors, primary renal disease, and diabetes mellitus [15; 16]. However, Abd El Hafeez (2018) [5] reported that the main risk factors of CKD in Africa are attributed to hypertension and diabetes. However, Vaidya and Aeddula (2019) [17] reported that diabetes mellitus represents one of the leading cause of CKD end-stage by the percentage of 44% of other factors. The poor data quality restricts the validity of the findings and draws attention to the importance of designing future robust studies.

Because patients in early stages of CKD often exhibit few signs and symptoms, tests for screening and diagnosis are critical in nephrology. Directly or indirectly, these tests measure kidney structure and function. Ideally, they should detect abnormalities

early enough to alert patients and physicians to the potential need for therapy that may prevent morbidity and mortality associated with kidney disease [16]. The tests that best detect abnormalities in kidney function are those that measure glomerular filtration rate (GFR). Guidelines developed by the National Kidney Foundation's Kidney Disease Outcomes Quality Initiative (KDOQI) have defined stages of CKD largely on the basis of levels of GFR [16]. All individuals with a Glomerular Filtration Rate (GFR) <60 mL/min/1.73 m² for three months are classified as having CKD; these stages of CKD were categorized according to the following:

Stage I: Kidney with normal GFR (90 mL/min/1.73 m²).

Stage II: Kidney with mild decrease in GFR (60-89 mL/min/1.73 m²).

Stage III: Kidney with moderate decrease in GFR (59-30 mL/min/1.73 m²).

Stage IV: Kidney with severe decrease in GFR (29-15 mL/min/1.73 m²).

Stage V: Kidney failure (GFR less than 15 mL/min/1.73m²) [18].

The GFR can be estimated from the plasma concentration of filtration markers (such as creatinine or urea) [19]. Although, estimating creatinine is not costly, there are limitations of using creatinine in calculating GFR such

as muscle mass, age, gender, ethnic race, and diet. Moreover, these factors result in a complication of its equations that calculate GFR. However, creatinine is not sensitive in CKD early stages [16]. However, in clinical practice, cysC is economically costly, especially during a routine check-up in those living in areas where limited access to primary health care is available [20].

MATERIALS AND METHODS

This cross-sectional and comparative study carried out between July and August 2017. Moreover, the aim of our study was to assess the prevalence of CKD in the in Sudanese patients and its association with diabetes mellitus.

A total of three hundred and seventy-five patients were included for final analysis. They were collected from three different regions of Khartoum, the capital of Sudan of the following renal centers:

- 1- Dr. Selma Center for renal disease (South of Khartoum)
- 2- Military hospital (West of Khartoum)
- 3- Ahmed Gasim Hospital (North of Khartoum)

Level of glomerular filtration rate (eGFR) < 60 ml/min per 1.73 m² have been considered as markers of renal damage or chronic kidney disease according to the classification of the National Kidney

Foundation Kidney/Disease Outcome Quality Initiative guidelines [21, 18].

A diagnosis of CKD was made by the nephrologist based on the National Kidney Foundation Kidney/Disease Outcome Quality Initiative guidelines [21]. CKD subjects aged between 18-90 years were included in the study. Individuals with skeletal muscle atrophy, malnutrition, heart failure, ketoacidosis, hypothyroidism or hyperthyroidism, malignant tumor, and acute inflammatory conditions were excluded from this study.

Venous blood samples were collected and used to measure various biomarkers, including fasting blood glucose (FBG) and serum creatinine concentrations. All assays were performed by well-trained laboratory technicians using reagents from Roche Diagnostics, Swiss.

After the determination of plasma concentrations, glomerular filtration rate (eGFR) was estimated by using the Modification of Diet in Renal Disease (MDRD) equation, GFR is calculated from demographic data and a single plasma creatinine result (in mg/dL) (eGFR = 186 × (plasma creatinine)^{-1.154} × (Age)^{-0.203} × (0.742 if female) × (1.212 if black) [22].

Where, eGFR (estimated glomerular filtration rate) = ml/min/1.732 m²

Plasma creatinine = Standardized plasma creatinine in mg/dl

Age = years

And all individuals with a Glomerular Filtration rate (GFR) <60 mL/min/1.73 m² for 3 months are classified as having CKD [18]. Then subjects divided into 5 stages according to the KDIGO classification of chronic kidney disease [23].

Persons were considered diabetic if fasting blood glucose was more than 128mg/dl or had a medical history or being treated for diabetes [24].

Ethical approval

The ethical approval was obtained from Institutional Ethical Committee and Informed consents were obtained from all the study participants.

Statistical analysis

Statistical analysis was done using SPSSversion 23. Data were represented as mean \pm standard deviation and percentage.

RESULTS

Table 1 shows the demographic and clinical characteristics of the 375 participants. Mean age of the subjects was 51.7 ± 14.7 SD and the prevalence of CKD and diabetes mellitus (DM) percentage were 66.9 % 39.5% respectively.

Patient samples were classified according to the proposed KDIGO classification of

chronic kidney disease [23]. The distribution of the study population by sex and CKD stages is shown in **Table 2** and **Figure 1**, in which male and female participants are compared together. Male percentages in the early stages were higher than the female percentages; oppositely, female numbers and percentages were notably higher in the end stages than male groups.

The Distribution of the population by sex, age (year) and DM of the studied population are shown in Table 3; in which male and female participants are compared with the age that was divided by year into two age-level groups (includes less than 60 years and more than 60-year groups). **Table 3** and **Figure 2** show numbers and percentages for male and female across two age-level groups. The percentages of the male in all groups were higher than female groups with the exception of the elder group that more than 60-year, female 67% notably was higher than male 33%. No notice different between DM 66.1% and non-DM in male groups. Whereas the female subject aged less than 60-year had a notably higher percentage of 86.5 % of DM than the subjects aged more than 60-year 13.3 % and diabetic female subjects 86.5 % were higher than non-diabetic female 78.3 % (**Table 3** and **Figure 2**). In general, a higher prevalence of DM in

younger was 86.5 in female compared with 66.1 in male was observed across age categories.

Adult population prevalence estimates were adjusted into three categories: sex, diabetes mellitus (DM) and chronic kidney disease (CKD). Distribution of the studied population are shown in **Table 4**, in which sex distributed into male and female groups and compared with the DM category (that includes DM and non-DM) and CKD category (that includes CKD and non-CKD) groups. **Table 4** and **Figure 2** show numbers

and percentages for male and female across DM and CKD groups. The overall percentage for the studied population was 29% without CKD and 71 % with CKD. The percentages of non-diabetic subjects without CKD were 52.9 % for the male and 47.1 % for the female groups. In the patients with DN, the percentage of the male 76.8 % was higher than the female 75 % groups. Moreover, we have found a high prevalence of CKD in DM patients within the male 76.8 % in comparison with female 75% groups.

Table 1: Demographic and clinical characteristics of the study population (n = 375)

Variables	Value
Age (years mean \pm SD)	51.7(14.4)
Sex, % (female)	48.5 (182)
Diabetic, %(n)	39.5 (148)
CKD, %(n)	66.9 (251)
Ethnicity	Non-African-American Category

Table 2: Number of CKD patients distributed by sex and CKD stages

Age group	Gender		Total
	Male	Female	
Stage1	32	26	58
Stage2	33	33	66
Stage3	56	45	101
Stage4	38	43	81
Stage5	34	35	69
Total	193	182	375

eGFR, estimated glomerular filtration rate (calculated using the MDRD formula); KDIGO, Kidney Disease, Improving Global Outcomes

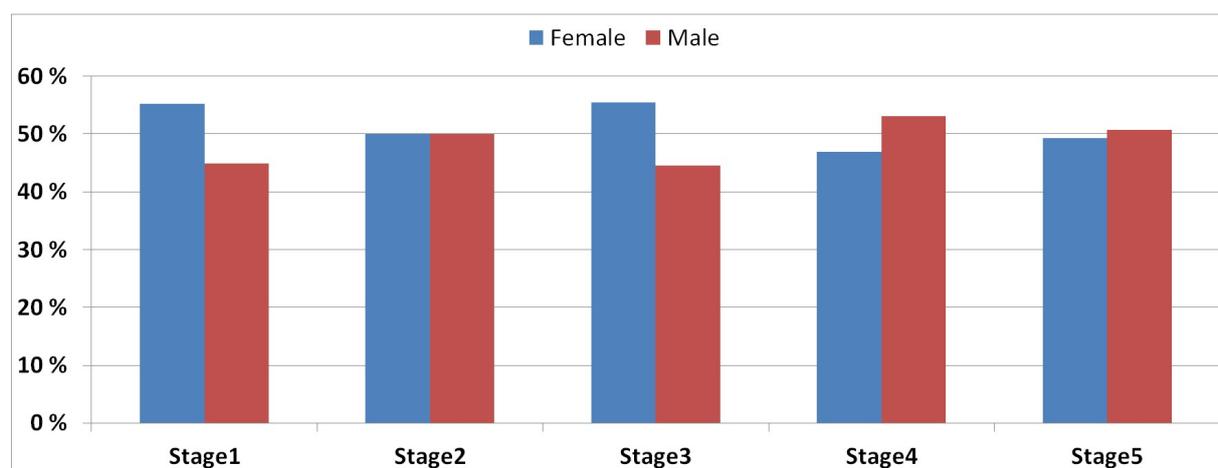


Figure 1: Percentage of CKD patients distributed by sex and CKD stages

Table 3: Distribution of the population by sex, age (year) and DM

Gender		Less than 60 Y	More than 60 Y	Total
Male	Diabetic	37	19	56
	Non-diabetic	64	34	98
	Total	101	53	154
Female	Diabetic	45	7	52
	Non-diabetic	72	20	92
	Total	117	27	144

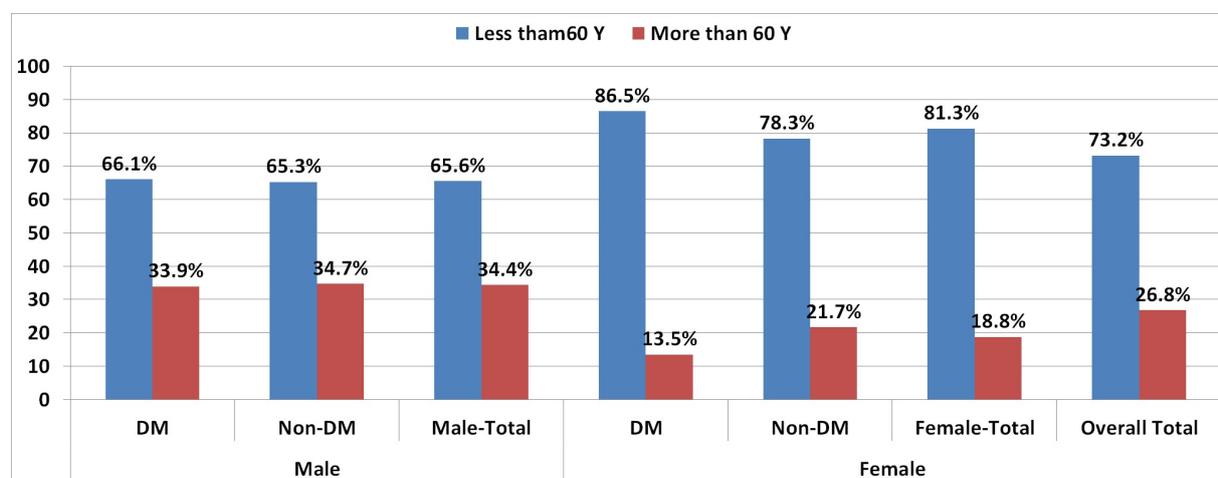


Figure 2: Distribution of the population by sex, age (year) and DM

Table 4: Distribution of the studied population by sex and CKD stages

Gender		Non-CKD	CKD	Total
Male	Diabetic	13	43	56
	Non-diabetics	33	65	98
	Total	46	108	154
Female	Diabetic	13	39	52
	Non-diabetics	28	64	92
	Total	41	103	144

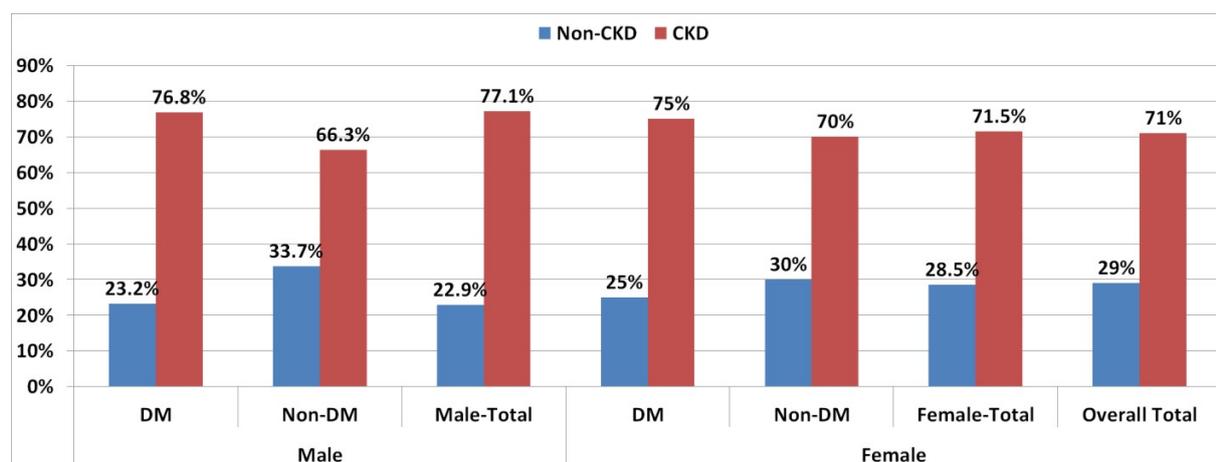


Figure 3: Distribution of the studied population by sex and CKD stages

DISCUSSION

This is one of little surveillance of diabetic nephropathy patients among subjects who visit selected renal centers in Khartoum state and evaluating the epidemiology of CKD and factors associated with it. The study concisely shows that the prevalence of diabetes mellitus in patients with chronic kidney disease, which used a standardized definition of CKD and considered age-, gender, diabetes mellitus and prevalence of CKD. We have found a high prevalence of CKD in diabetic patients within the male 76.8 % in comparison with female 75% groups (**Table 4 and Figure 3**) this finding indicates the high prevalence of diabetic nephropathy among the Sudanese population that gives an alarm for taken more attention, and taking into account that diabetic nephropathy is a major cause of renal morbidity and mortality, and diabetic nephropathy is one of the leading causes of

chronic kidney failure [25]. Moreover, this finding came in agreement with Osman *et al* (1987) [26] who reported that chronic glomerulonephritis, obstructive nephropathy (stone disease), hypertension and diabetes mellitus were the main cause of CKD in Sudanese patients. Overall, the prevalence of DM varied widely among the study populations and decreased clearly with age. In general, males had a higher prevalence of DN than females, especially in less than 60-year groups, this finding disagreed with Olivera *et al* (2016) [27] who found that subjects older than 60 had 1.2 higher risk of having DM, compared to those subjects younger than 60, this difference might be due to the degree of awareness of DM among the young in that country. However, our interpretation also confirmed by the observation of Abu-Aisha *et al* (2009) [14] who denoted that one of the independent risk factors that might be caused the highly

significant rates of the CKD prevalence in Sudanese population was the low-educational level. Also this in line with the neighbor country, Egypt in which Barsoum (2012) [9], reported that preliminary data for about 1,000 participants showed the prevalence of proteinuria to be as high as 21%, including 3.9% with elevated serum creatinine levels.

CONCLUSIONS & RECOMMENDATIONS

In conclusion, this is the first epidemiological survey of CKD in a large renal centers population in Khartoum state, Sudan. The prevalence of CKD was found to be 71 %. Age, gender, and history of diabetes mellitus were independently associated with CKD. The prevalence of CKD may be reduced by controlling the increasing incidence of diabetes in Khartoum state. Preventive policies for the general population are imperative. Rigorously designed studies with longitudinal data are required to confirm our results. Finally, further studies should be undertaken to determine why the prevalence of diabetic nephropathy among Sudanese patients in these high-level.

Competing interests

The author(s) declare that they have no competing interests.

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