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Estimation of chronic kidney disease among diabetic patients using the CKD-EPI equation

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Abstract

Background: One of the most serious chronic microvascular consequences of diabetes is diabetic nephropathy (DN), which has also been linked to hypertension and DN as the main causes of end-stage renal disease (ESRD). A large majority of patients with diabetic kidney disease DKD will die from cardiovascular disease before they reach ESRD, and it causes mortality in people with diabetic kidney disease to be about 30 times higher than that in diabetic patients without nephropathy.

AIM: By measuring GFR using the CKD-EPI creatinine equation, DN in patients with diabetes and diabetic hypertensive is measured.

Method: Descriptive A cross-sectional study that was done in Alfredo's primary healthcare from December 2020 to February 2021 included 145 participants who had been diagnosed with diabetes or diabetic hypertension with diabetic kidney disease. Checked serum creatinine level at least once in the last three months. Dialysis patients were not allowed. A questionnaire was used to collect personal information. Blood was drawn, and a colorimeter was used to estimate the serum creatinine level. A mercury sphygmomanometer was used to measure blood pressure. The Kidney Disease Epidemiology Collaboration (CKD-EPI) Equation was used to calculate the estimated Glomerular Filtration Rate (eGFR). The statistical program for the social sciences (SPSS) version 20 was used for data analysis.

Result: According to the CKD EPI equation, eGFR, of the total of 145 participants (63.4 %) female and (36.6 %) male, 85 (58.6 %) participants have normal/ high stage 1 CKD, 48(33.1 %) with mildly decreased kidney function stage 2, (4.8 %) mildly to moderately decrease in kidney function stage 3a, 4 (1.4 %) were in stage 3b moderately to severely decreased kidney function, 2 (1.4 %) severely decreased kidney function and 1(0.7 %) with ESRD. Hypertension and a longer duration of diabetes showed a significant association with CKD.

Conclusion: Duration of diabetes has a direct effect on the progression of CKD stages and all participants with stages 4 & 5 CKD were diabetic hypertensive. The majority of participants were classified in stages 1 and II.

Keywords: Diabetic nephropathy, Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) Equation, Sudan.

Abbreviations: CKD-EPI= chronic kidney disease epidemiology; **DN=** diabetic nephropathy; **ESRD**= end stage renal disease; **eGFR**= estimated glomerular filtration rate.

Introduction

In the absence of another renal disease, diabetes-related kidney damage is indicated by albuminuria of 30–300 mg in a 24-hour urine sample or by an eGFR of less than 60 mL/min/1.73 m2. Diabetes affected 422 million people in 2014, up from 108 million in 1980. In persons over 18 years old, the prevalence of diabetes increased globally from 4.7 % in 1980 to 8.5 % in 2014. **[1]**. In all kinds of diabetes, a clinically silent phase of renal function decrease precedes the development of irreversible chronic kidney disease (CKD) **[10]**.

Lower than 60 mL/min/1.73 m2 eGFR was used to define CKD. For prediction models of the occurrence of CKD in diabetic populations, the CKD-EPI equation is a preferable choice. Age, a history of cardiovascular disease, and having lower levels of eGFR were significant risk variables in both equations **[5]**. The clinical usage is less precise than the CKD-EPI creatinine equation. The CKD-EPI equation, expressed as a single equation, is GFR = 141 × min(Scr/κ, 1)α × max(Scr/κ, 1)-1.209 × 0.993Age × 1.018 [if female] _ 1.159 [if

black], where Scr is serum creatinine, κ is 0.7 for females and 0.9 for males, α is -0.329 for females and -0.411 for males, min indicates the minimum of Scr/κor 1, and max indicates the maximum of Scr/κ or 1. In this **Table**, the multiplication factors for race and sex are incorporated into the intercept, which results in different intercepts for age and sex combinations **[6]**.

For the early diagnosis of mild and moderate renal function impairment in the diabetic and hypertensive populations, eGFR-based equations were more reliable and sensitive than serum creatinine and its eGFR-based equations **[10]**. Patients with type 2 diabetes were evaluated for all diabetic complications, including renal impairment (eGFR 60 ml/min/1.73 m2), stages 3-5 of chronic kidney disease (CKD) based on the modification of diet in renal disease MDRD-GRF equation, and CKD-EPI equations, among others **[16]**. **[2,3]**. When compared to healthy people, patients with Type 2 diabetes had a 2.5-fold higher bias in the CKD-EPI equation, making it less reliable **[15]**. An observational descriptive clinic-based cross-sectional study which was conducted in Sudan found that nephropathy was the most frequent with a prevalence of 38.8 percent, followed by retinopathy and neuropathy with a frequency of 23.9 and 22.5 percent, respectively in type 2 diabetes mellitus **[4]**. This study was performed because no exact records of causes and standard procedures for detection cases in Sudan regarding DN.

Material and Methods:

Study design, area, and period: Descriptive Cross-sectional study conducted in Alferdos primary health care center from December 2020-February 2021). Include 145 diabetic patients; 65 were diabetic and 80 were diabetic hypertensive.

Inclusion criteria include diagnosed patients with diabetes with or without hypertension with serum creatinine levels checked at least once in the last 3 months and were accepted to participate and the excluded were under dialysis.

Data collection tools and methods:

The information was manually collected by the researcher using a questionnaire, and the blood sample was collected and estimated for serum creatinine using a colorimeter. For diagnosed diabetic and diabetic hypertensive patients blood pressure was measured using a mercury sphygmomanometer. All participants were taking different types of antihypertensive drugs.

The eGFR was estimated by Kidney Disease Epidemiology Collaboration (CKD-EPI).

Data analysis: Data analysis& interpretation was performed using the statistical package for the social sciences (SPSS) software version 20, using the Chi-Squire test was used to find the distributionof study participants according to variables. A p-value of 0.5 or less is considered statistically significant.

Ethical consideration: Ethical clearance and approval for conducting this research was obtained by the ethical committee at the research unit of the educational developmental center and Khartoum state primary health care medical director.

Results

This is a descriptive cross-sectional study, that covered 145 participants. 92(63.4%), were female while 53(36.6 %) were male. (65) 44.80 % were diabetic and (80) 55.20 % were diabetic hypertensive. 60 % of participants were in the age group (50-70 years), 25.5 % were in the age group (30-49 years), and 14.50 % are older than 70 years. Duration of diabetes is more than 10 years in 42.8 %, and (5-10 years) in 34.4 %, and less than 5 years in 22.8 % of the participants. Regarding the treatment of diabetes, 49.7 % of the participants were on the oral anti-diabetic drug, while 35.9 % were on insulin and only 4.1 % were on diet control. The result of estimated GFR using (CDK-EPI) equation was GFR >90) (58.6 %) stage 1 normal or high GFR, and theestimated GFR is (60-89) by (33.1 %) stage 2 , the estimated GFR is(45-59) by (4.8 %) stage 3 a , the estimated GFR is (30- 44) (1.4 %) stage 3b. The proportion of CDK: The majority of participants were classified in stage 1(58.6 %), (and 33.1 %) were in stage II **table1**.

Table 1: Distribution of variables among the study group

Variable	**Characteristics**	**Frequency\ Percentage**
Gender	Male	(53) 36.6
	Female	(92) 63.4
Age\yrs.	30-49	(87) 60
	50-70	(37) 25.5
	70-more	(21) 14.50
Duration of diabetes	< 5yrs.	(33) 22.80
	5-10 yrs.	(50) 34.40
	>10 yrs.	(62) 42.80

Treatment of diabetes	Dietary control	(6) 4.10
	Hypoglycemic tablets	(72) 49.70
	Insulin	(52) 35.90
	Hypoglycemic tablets+ insulin	(15)10.30
Hypertension	Yes	(80) 55.20
	No	(65) 44.80
Serum Creatinine	0.1-0.7	(52) 35.90
	0.7-1.3	(84) 57.90
	>1.3	(9) 6.20
Serum Creatinine (CDK-EPI) equation	>15	(1) 0.70
	15-29	(2) 1.40
	30-44	(2) 1.40
	45-59	(7) 4.80
	60-89	(48) 33.10
	> 90	(85) 58.60

Chi- Squire was done to assess the possible association between several factors. The analysis found that there had significant difference between duration of diabetes and CKD stages with p- value =0.021.

Table 2: Relationship between duration of diabetes and CDK stages

CKD stage	**Duration of diabetes**			**Total**	**Sig.**
	> 5 years	**5 – 10**	**More than 10**		
I	25(29.4 %)	30 (35.3 %)	30(35.3 %)	85(100 %)	
II	6(12.5 %)	17(35.4 %)	25(52.1%)	48(100 %)	
III a	2(28.6 %)	1(14.3 %)	4(57.1 %)	7(100 %)	**.0021**
III b	0(0.0 %)	1(50 %)	1(50 %)	2(100 %)	
IV	0(0.0 %)	1(50 %)	1(50 %)	2(100 %)	
V	0(0.0 %)	0(0.0 %)	1(100 %)	1(100 %)	
Total	33(22.8 %)	50(34.5 %)	62(42.8 %)	145(100 %)	

55.2 % of the participants were diabetic hypertensive. All participants with stage 4 & 5 CKD are diabetic hypertensive p-value is significant < 0.0001.

Table 3: Relationship between Diabetic hypertensive and CDK stages

CKD stage	**Diabetic hypertensive**		**Total**	**Sig.**
	Yes	**No**		
I	43(50.9 %)	42(49.1 %)	85(100 %)	
II	27(56.3 %)	21(43.7 %)	48(100 %)	**< 0.0001**
III a	6(85.7 %)	1(14.3 %)	7(100 %)	
III b	1(50 %)	1(50 %)	2(100 %)	
IV	2(100 %)	0(0.0 %)	2(100 %)	
V	1(100 %)	0(0.0 %)	1(100 %)	
Total	80(55.2 %)	65(44.8 %)	145(100 %)	

Discussion

Chronic kidney disease (CKD) is a major public health problem and its prevalence is increasing. Estimation of the GFR is essential for the evaluation and screening for CKD for patients with diabetes mellitus and hypertension allowing detection of early impairment of kidney function and preventing further deterioration and complications.

The general characteristic of the study participants was that 92 (63.4 %) were female, in the age group (50-70 years) indicating that almost half of all deaths attributable to high blood glucose occur before the age of 65years and older **[9]**. Renal impairment is frequent in aged diabetic patients, notably with type 2 diabetes. It results from a multifactorial pathogeny, particularly the combined actions of hyperglycemia, arterial hypertension, and aging **[8]**. This is in line with our findings in the current study that all participants with stage 4 & 5 CKD were diabetic hypertensive with a significant p-value < 0.0001. Moreover, the longer the duration of diabetes the higher risk of DN with a p-value=0.021. The study proved that there was a strong relationship between the duration of diabetes and the onset of renal complications; the recording data showed that 42.8 % of complicated diabetic and diabetic hypertensive patients with a duration of more than 10 years. This finding was consistent with that of Tapp RJ, et al. 2004; Cederholm J, et al. 2005 who demonstrated that patients with a longer duration of diabetes have a higher risk for developing nephropathy, because elevated blood pressure is another important independent risk factor for nephropathy **[12,13]**. Another study noted that the prognosis of DN has improved during the past decade largely because of effective antihypertensive treatment **[11]**. The US Renal Data System Annual Report reveals that 57 % of new cases of end-stage renal disease are attributed to hypertensive nephropathy and DN **[7]** which was in line with current findings in that all participants with stages 4 & 5 CKD are diabetic hypertensive with significant p-value < 0.0001.

Limitation of The Study: Covid-19 pandemic crisis.

Conclusion: Duration of diabetes has a direct effect on the progression of CKD stages and all participants with stages 4 & 5 CKD were diabetic hypertensive. The majority of participants were classified in stages I and II.

Recommendation: federal Ministry of health should establish the National Kidney Disease Education Program to provide resources to the public, patients, and healthcare professionals to reduce morbidity and mortality from kidney disease complications.

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