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Prevalence of Chronic Kidney Disease and it's Risk Factors in Patients with Prediabetes in Saudi Population

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Abstract

Background and Objective: Chronic Kidney Disease (CKD) is a growing public health problem. Prediabetes is a high-risk state for the development of diabetes and its associated complications. Therefore, the present study was designed to evaluate the prevalence and potential risk factors of CKD in Saudi patients with prediabetes.

Methods: For the present study, 850 participants were analyzed between the ages 18 to 98 years. All patients were from the population of the primary health centre at King Fahad Armed Forces Hospital, Jeddah, Saudi Arabia. All data were collected on the basis of a review of electronic medical data and through a personal interview. Weight (kg) and height (cm) were measured were recorded. Body Mass Index (BMI) values classified as overweight or obese (BMI ≥ 25.0 kg/m^2). Participants were defined as having prediabetes if HbA1c 5.7-6.4. Hypertension (HTN) was defined when the systolic blood pressure was ≥ 130 mmHg and/or diastolic blood pressure was ≥ 85 mmHg in addition to receiving any medication for hypertension. The total numbers of cohort were separated on basis of age values into five groups: <30 years, 30-39 years, 40-49 years, 50-59 years and ≥ 60 years.

Results: Out of 850 participants, there were 461 (54.2%) patients with prediabetes. Out of 461 patients with prediabetes, CKD was present in 52 (11.3%) cases. 20 (24.1%) cases were male and 32(8.5%) cases were female, p<0.0001. Patients with CKD were significantly older than patients without CKD, (55.0 ± 15.9 *vs.* 47.1 ± 14.0 respectively, p<0.0001). Mean BMI was not significantly different in patients with than without CKD (31.7 ± 5.6 *vs.* 31.6 ± 7.7 respectively, p=0.9). Moreover, patients with CKD have significantly higher prevalence of HTN and non-significantly less frequent of smoking prevalence than patients without CKD. Mean HbA1c was not significantly higher in patients with than without CKD (6.0 ± 0.1 *vs.* 5.9 ± 0.3, p=0.2). The multivariable logistic regression model examined the magnitude of associations between CKD presence in individuals with prediabetes and potential demographic and clinical factors showed hypertensive patients with prediabetes were significantly 4-fold to possess CKD (OR=4.4; 95% Confidence Interval [CI]=2.2, 9.0), p<0.0001). Moreover, male patients with prediabetes were significantly 2-fold to possess CKD (OR=2.8; 95% CI=1.4, 5.4), p=0.003). There were non-significant association of CKD prevalence with increasing age (p=0.09) with male predominant across old age groups

Conclusion: The prevalence of CKD in prediabetic Saudis is relatively high. Older age, male gender, HTN can be regarded as related factors.

Keywords

Prevalence; Chronic Kidney Disease (CKD); Prediabetes

Conflict of Interest

The authors have no conflict of interest to disclose.

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Introduction

Chronic Kidney Disease (CKD) is a growing public health problem that is important not only because of its own burden, but because it is also recognized as an independent risk factor for Cardiovascular Disease (CVD); even early stage CKD causes an estimated 40-100% increase in risk of cardiovascular events. CKD is defined as a gradual loss of kidney function for more than three months with or without kidney damage [1]. It is common, progressive, and usually asymptomatic and can co-exist with other conditions [2]. A prospective cohort study conducted in England and Wales found the hazard of developing CKD in patients aged 35–74 years was five times higher in women and six times higher in men with diabetes than in those with normal glucose tolerance [3]. Prediabetes is a high-risk state for the development of diabetes and its associated complications [4]. Prediabetes is an intermediate state between normal glucose homeostasis and diabetic hyperglycaemia. Individuals with prediabetes have glucose levels higher than normal but not high enough for a diagnosis of diabetes [5]. There is some evidence that the incidence of CKD is elevated in individuals with prediabetes, but this is confined to specific populations [5,6]. Moreover, data from cross-sectional studies show that alterations in glucose metabolism and hyperinsulinemia are associated with impaired kidney function [7-9]. Cross sectional studies show that albuminuria, an early marker of CKD, was approximately three times more common in patients with prediabetes than in those with normoglycaemia [10-12].

It is not clear whether the risk of CKD is elevated in patients with prediabetes or whether any increased risk only occurs after patients develop diabetes [13]. The finding that declines in kidney function are present early on among subjects with glucose intolerance could help direct therapeutic interventions to prevent the progression of kidney disease. However, only limited information is available on prevalence of CKD among Saudi Arabia population with prediabetes. Therefore, the present study was designed to evaluate the prevalence and potential risk factors of CKD among Saudi patients with prediabetes.

Methods

For the present study, 850 participants were analyzed between the ages 18 to 98 years. All patients were from the population of the primary health centre at King Fahad Armed Forces Hospital, Jeddah, Saudi Arabia. All data were collected on the basis of a review of electronic medical data and through a personal interview. All patients in the present study fulfilled the revised National Kidney Foundation criteria for the diagnosis of CKD. Weight (kg) and height (cm) were measured were recorded. Body Mass Index (BMI) values classified as overweight or obese (BMI ≥ 25.0 kg/m^2) [14]. Participants were defined as having prediabetes if HbA1c 5.7-6.4 [15]. HTN was defined when the systolic blood pressure was ≥ 130 mmHg and/or diastolic blood pressure was ≥ 85 mmHg in addition to receiving any medication for hypertension [5]. The total numbers of cohort were separated on basis of age values into five groups: <30 years, 30-39 years, 40-49 years, 50-59 years and ≥ 60 years [16]

Statistical analysis

Unpaired *t*-test analysis and Chi square (χ^2) test (categorical data comparison) were used between variables to estimate the significance of different between groups for demographic and clinical laboratory. The independent relationship between the stratified risk factors and the odds ratio of having CKD were analyzed using logistic regression. All statistical analyses were performed using SPSS Version 23.0. The difference between groups was considered significant when p<0.05.

Results

Out of 850 participants, there were 461 (54.2%) patients with prediabetes. Basic characteristics of patients under study are shown in Table 1. Out of 461 patients with prediabetes, CKD was present in 52 (11.3%) cases (Table 2). 20 (24.1%) cases were male and 32 (8.5%) cases were female with male to female ratio 2.8:1, p<0.0001. Patients with CKD were significantly older than patients without CKD, (55.0 ± 15.9 *vs.* 47.1 ± 14.0 respectively, p<0.0001). Mean BMI was not significantly different in patients with than without CKD (31.7 ± 5.6 *vs.* 31.6 ± 7.7 respectively, p=0.9). Moreover, Patients with CKD have significantly higher prevalence of HTN and nonsignificantly less frequent of smoking prevalence than patients without CKD. Mean HbA1c was not significantly higher in patients with than without CKD (6.0 ± 0.1 *vs.* 5.9 ± 0.3, p=0.2). The multivariable logistic regression model examined the magnitude of associations between CKD presence in individuals with prediabetes and potential demographic and clinical factors (Table 3). Hypertensive patients with prediabetes were significantly 4-fold to possess CKD (OR=4.4; 95% confidence interval [CI]=2.2, 9.0), p<0.0001). Moreover, male patients with prediabetes were significantly 2-fold to possess CKD (OR=2.8; 95% CI=1.4, 5.4), p=0.003). There were non-significant association of CKD prevalence with increasing age (p=0.09) with male predominant across old age groups (Figures A and B)

Discussion

CKD is emerging as an important problem worldwide. Worldwide prevalence is estimated to be between 8% and 16%. Up to 14% of

Parameters		Total
Number		850
Gender	Male	143 (16.8)
	Female	707 (83.2)
Age (years)		46.1 ± 14.7
Body mass index (kg/m^2)	Mean ± SD	31.3 ± 7.3
	≥ 25	691 (81.3)
HbA1c		5.6 ± 0.5
Hypertension		232 (27.3)
Smoking		69 (8.1)
Chronic kidney disease		86 (10.1)
Prediabetes		461 (54.2)

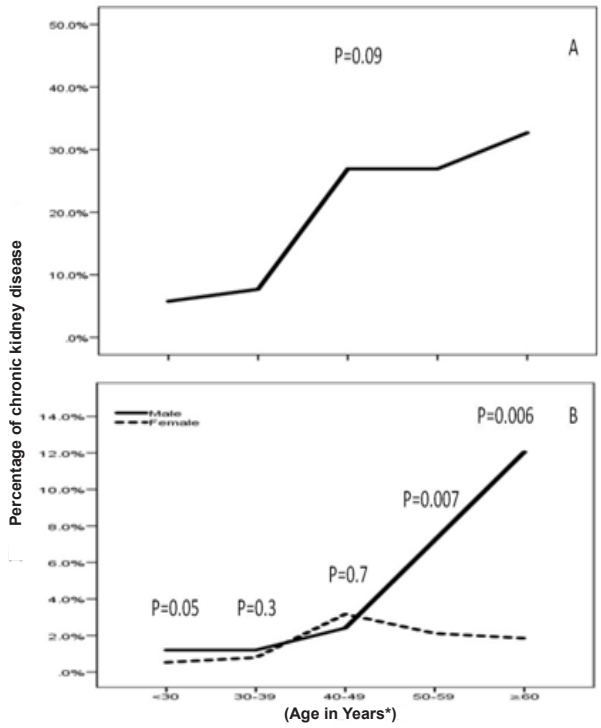
Table 1: Basic characteristics of patients under study [means ± SD or number (%)]

Parameters		Chronic kidney disease		*p*-value
		Present 52 (11.3)	Absent 409 (88.7)	
Gender	Male	20(24.1)	63(75.9)	<0.0001
	Female	32(8.5)	346(91.5)	
Age (years)		55.0 ± 15.9	47.1 ± 14.0	<0.0001
Body mass index (kg/m^2)	Mean ± SD	31.7 ± 5.6	31.6 ± 7.7	0.9
	≥ 25	48(92.3)	335(81.9)	0.06
HbA1c		6.0 ± 0.1	5.9 ± 0.3	0.2
Hypertension		34(65.4)	105(25.7)	<0.0001
Smoking		1(1.9)	35(8.6)	0.09
Serum creatinine (µmol/L)		83.4 ± 38.5	62.5 ± 15.3	<0.0001

Table 2: Comparison of features of patients with prediabetes with and without chronic kidney disease [mean ± standard deviation or number (%)]

Parameters	Odd Ratio	*p*-value
Male gender	2.8 (1.4-5.4)	0.003
Age (years)	1.01 (0.99-1.04)	0.3
Body mass index (kg/m^2) ≥ 25	1.0 (0.95-1.04)	0.8
HbA1c	1.04 (0.3-3.9)	0.9
Hypertension	4.4 (2.2-9.0)	<0.0001
Smoking	0.3 (0.03-2.0)	0.2

Table 3: The regression analysis of odd ratio of risk factors for patients with chronic kidney disease in patients with prediabetes



Figures A and B: Percent of chronic kidney disease of patients with prediabetes among age groups and in correlation to gender

adults in the United States were found to have some degree of CKD in 2007–2010 [1,17]. CKD was common present in approximately 1 in 7 persons in Australia [18]. In addition to being common in developed nations, CKD is also highly prevalent in developing countries [19]. A cross-sectional study indicated prevalence of CKD in China was 10.8% while prevalence of CKD in Saudi population is around 5.7% [20-22].

In our study, the overall prevalence of CKD in patients with prediabetes was 11.3% (OR=1.3; 95% CI=0.8, 2.1), p=0.2. Kim et al. [23] reported followed 2,666 Pima Indian young adults aged with IGT during a follow-up period of 25 years for the development of macro albuminuria and assess the risk of CKD in young adults with IGT compared with T2DM. The annual incidence of CKD was 0.13% per person-year compared with 2.4% in those with T2DM. Cross sectional study showed that CKD was approximately three times more common in patients with IGT than in those with normoglycaemia. These data are subject to some limitations, as it is unclear whether CKD precedes impaired glucose metabolism or vice versa [13]. A retrospective matched cohort analysis found that young adults with IGT were four times more at risk of developing CKD than individuals with normoglycaemia. 1.7% of IGT cases were diagnosed with CKD compared to 0.4% in the normoglycaemia cohort. In the adjusted analysis there was an increased incidence of CKD for each additional year of age at IGT diagnosis [Incident Relative Risk (IRR): 1.1; 95% CI, 1.0 to 1.1, p<0.001] and an increased incidence in patients with a diagnosis of HTN [IRR: 3.1; 95% CI, 2.3 to 4.2, p<0.001] [24]. After adjusting for age, sex, ethnic group, deprivation quintile, BMI categories, cardiovascular disease, heart failure, atrial fibrillation and HTN, the effect of CKD risk was attenuated but was still 2.6 times higher in individuals with IGT/IFG than those with normoglycaemia. Among the modifiable risk factors, HTN was consistently linked to higher incidence of CKD. Niigata Preventive Medicine Study examined the risk of CKD in individual components of metabolic syndrome; found the incidence of IGT was approximately twice as high in subjects with IGT as those with normoglycaemia [24]. A retrospective study, using data from the Framingham Offspring cohort study examined the risk of CKD development in non-diabetic patients [25], found that patients with IGT were approximately two times more likely to develop CKD and those with diabetes were approximately four times more at risk of CKD.

The risk of developing chronic kidney disease associated with pre-diabetes and newly diagnosed diabetes is largely accounted for by coexisting vascular disease risk factors [26]. Similarly, vascular disease risk factors attenuated most of the relationship between insulin resistance and CKD. Gradation of risk for CKD appears to be linear across the spectrum of glycemic status, and known diabetes is a strong and independent risk factor for CKD. Fliser et al. [27] evaluated 50 renal patients with IgA glomerulonephritis or adult polycystic kidney disease in different stages of renal failure. These authors observed hyperinsulinemia and insulin resistance of the same degree throughout the range of renal function considered, including renal patients with Glomerular Filtration Rate (GFR) in the normal range, suggesting that abnormal glucose metabolism may be part of the phenotype of these two specific pathological conditions, independent of renal function. This possibility was supported by another study that observed insulin resistance and hyperinsulinemia in 15 patients with adult polycystic kidney disease and GFR in the normal range. Different mechanisms may contribute to the abnormal glucose metabolism in chronic renal failure, including decreased sensitivity to insulin [28], inadequate insulin secretion, and increased hepatic gluconeogenesis. In addition to some conditions intrinsically related to renal failure such as anemia and metabolic acidosis [29], accumulation of some toxic substance(s), including free fatty acids, hormones with antagonistic actions to insulin, pseudouridine, nitrogenous substances derived from protein metabolism, and acute phase reactants, may contribute to the impaired insulin-mediated glucose metabolism occurring after a certain degree of renal function loss. Cross-sectional studies demonstrating that alterations of glucose metabolism and hyperinsulinemia are associated with impaired kidney function [29-35]. Data from NHANES III demonstrated an increased odds of CKD by increasing HOMA-IR across the spectrum of nondiabetic participants [36-38]. The most striking results come from those with HOMA-IR values in the upper quartile compared with those in the lower quartile (OR 2.65).

The findings of the study, however, represent important additions to the literature on CKD in Saudi Arabia and can begin to inform practice and policy, Compliance with screening for CKD by primary care providers is low. Data from 2001 to 2004 revealed that in the Netherlands only 33% of patients with hypertension or diabetes are screened yearly for serum creatinine [39], and only 10% of patients with diabetes are screened for albuminuria. Possibly, absence of scientific data on the prevalence of CKD in primary care patients with HTN or prediabetes may contribute to these low screening uptake rates and subsequent underdiagnosis and undertreatment.

This study was a retrospective and not longitudinal, preventing determination of whether any risk factors were the cause or result of CKD. Moreover, our study was confined to only patients with prediabetes in the primary care clinics in a local hospital, and hence the findings cannot be generalized to the general prediabetes patient population. It can be concluded from this study that the prevalence of CKD among prediabetic Saudis is relatively high. Older age, male gender, HTN can be regarded as related factors.

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