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Full Length Research Paper

Population screening for chronic kidney disease and its associated risk factors: a survey in Hail region, KSA

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Early identification of chronic kidney disease (CKD) provides valuable opportunities for effective interventions that reduce the risk of outcomes particularly renal failure and cardiovascular disease. The aim of this study was to screen the local population for CKD to identify potential risk factors for its development. Screening for CKD was performed involving 299 individuals aged over 15 year-old subjects in a cross sectional survey. Participants completed a questionnaire, clinical examination (diabetes and hypertension) and were then referred for laboratory investigations (creatinine, urea, uric acid and urine protein) for CKD and other potential risk factors (including diabetes and hypertension). CKD was identified in 70/299 (24%), of whom 27/70 (38.6%) were males and 43/70 (61.4%) were females, 49/70 (70%, P=0.001) were cases of diabetes, while 45/70 (64.3%, P=0.001) were with hypertension. This preliminary study provided information on the frequency of CKD and its associated risk factors in the Hail region. However, larger population needs to be screened to establish the role of these risk factors in the etiology of CKD in Hail region.

Key words: Hail, chronic kidney disease (CKD), hypertension, diabetes, congestive heart failure (CHF).

INTRODUCTION

Chronic kidney disease (CKD) is defined by the National Kidney Foundation (2002) as either a decline in glomerular filtration rate (GFR) to <60 ml/min/1.73 m^2 or the presence of kidney damage for at least 3 months. Signs of kidney damage classically include proteinuria, but other markers of damage, such as persistent glomerulonephritis or structural damage from polycystic kidney disease can also be present (Murphree and Thelen, 2010).

Early identification of CKD is a legitimate enterprise if it provides meaningful opportunities for effective and safe interventions that reduce the risk of death, end-stage renal disease, or complications of renal dysfunction (Richard and Christopher, 2008). Progression of CKD in the presence of definite disease, particularly in the presence of certain diseases such as micro albuminuria, can be modified by interventions with the use of inhibitors of angiotensin II; however, the evidence that such approaches can alter the progression of stage 3 CKD in the absence of other definitive features of kidney damage has not yet been proven (Richard and Christopher, 2008).

Regardless of the underlying etiology of the CKD, the family physician can make a significant impact in slowing the progression of chronic kidney disease through strict blood pressure control, tight glycemic control, reduction in the degree of proteinuria, and smoking cessation. All chronic kidney disease patients are at significantly increased risk of cardiovascular events; therefore, additional cardiovascular risk factors such as hyperlipidemia shall also be managed aggressively (Murphree and Thelen, 2010).

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With the adoption of Western lifestyle in addition to the genetic factors, the population in Hail which has the maximum percentage of obesity in the Kingdom (Othaimeen et al., 1993), and could pose greater risk of developing diabetes mellitus (DM) hypertension and CKD. In the present study, the population for CKD and its associated risk factors have been screened preliminary.

MATERIALS AND METHODS

This is a cross sectional survey that included data from 299 Saudis from general population during the period of October 2012 to December 2012. A team of professionals and volunteers assisted in collection of data from two cities (Om-Alglban and Al-Qaed) in the Hail region, KSA.

Before CKD screening campaign, the professionals were given instructions to standardize data collection and procedures. Data were collected by the qualified physicians utilizing a standard questionnaire, which included demographic information, previously diagnosed diseases (hypertension, kidney and cardiovascular diseases, diabetes and others) and familial history of hypertension, diabetes, kidney, kidney stones, urinary tract infection, cardiovascular diseases, analgesic abuse and herbal use.

After the questionnaire, each participant underwent a physical examination with the measurement of height and weight for counting the body mass index (BMI). The results of diagnostic tests performed at that time (urine dipstick, capillary blood glucose) as well as blood pressure levels were also recorded.

Regardless of urinary abnormalities (such as infection, etc) or risk factors for CKD, these people with such conditions were referred to local health centres and they were identified and informed about the planned screening for their consent.

A dipstick test (ChoiceLine 10; Roche Diagnostics Ltd, UK) was performed to check the presence of albumin and erythrocytes/ haemoglobin in the urine samples. This procedure was performed immediately after the urine sample was brought by each participant. Dipstick was read manually by a group of professionals trained for this purpose, and final result of each reagent strip was confirmed by two of them, as they worked in pairs. They followed a standardized procedure, according to the instructions provided by the manufacturer, including the use of a stopwatch with countdown timer. In addition, traces of proteinuria were not considered as an abnormal result for this study purpose, and a supervisor was available whenever there was any doubt. In fact, proteinuria and haematuria were defined by a reading of 1+ or more of protein or blood on dipstick.

Diagnosis of hypertension was based on the observation of blood pressure levels superior to 140/90 mmHg. Prehypertension is considered to be blood pressure readings with a systolic pressure from 120 to 139 mmHg or a diastolic pressure from 80 to 89 mmHg.

Diagnosis of diabetes in this survey was based on the information provided by the participant of being under treatment for diabetes due to a previous well-established diagnosis, then confirmed with new blood glucose estimation. We considered the participants as suspicious of having diabetes if non-fasting results of blood glucose were >200 mg/dl. Creatinine, urea, and uric acid were subsequently measured.

GFR was calculated using GFR calculator (Safe Kidney Care, available at: http://www.safekidneycare.org/healthcare_provider_gfr_calc.php). All individuals with a GFR <60 ml/min/1.73 m^2, were regarded as having KCD and further classified into the following stages: stage I: mild reduction in GFR (30 to 59 ml/min/1.73 m^2); stage II: moderate reduction in GFR (16 to 29 ml/min/1.73 m^2), and stage III: severe reduction in GFR (30 to 59 ml/min/1.73 m^2).

RESULTS

In the present study, 299 apparently healthy individuals were investigated for the presence of CKD and its related risk factors. The age of the participants ranged from 15 to 100 years with a mean age of 43±5 years. The male female ratio was 1.00:1.85. Of the 299 full respondents, 70/299 (24%) were found with different stages of CKD. High levels of CKD risk factors were identified in varying proportion among the study population. Systolic blood pressure (BP), diastolic BP, DM, creatinine, urea, and uric acid were identified in 111/299 (37%), 79/299 (26.4%), 77 (26%), 15/299 (5%), 23/299 (8%) and 12/299 (4%), respectively, as indicated in Figure 1.

Of the 70 cases of CKD, stage III, stage II and stage I were identified in 5/70 (7.14%), 21/70 (30%) and 44/70 (62.86%), respectively. According to gender, CKD did not show statistically significant difference, as indicated in Table 1. For the age, CKD was found to increase with the increase of age and this was found to be statistically (P=0.000), as shown in Table 1. For the education, CKD was found to be inversely associated with level of education. Most affected were among less educated participants (P=0.000), indicated in Table 1. CKD was found to be statistically significant with all occupations except for the students. Notably, the more advanced stages of CKD were frequently seen among housewives followed by employees, as indicated in Table1.

Figure 2 describes the association between risk factors for CKD and different stages of CKD. Hypertension was identified among 4 (80%), 14 (67%) and 13 (30%) of those with stage III, stage II and stage I CKD, respectively (P<0.00001). DM was identified among 3 (60%), 14 (67%) and 15 (36%) of those with stage III, stage II and stage I CKD, respectively (P<0.00001). Stroke was identified among 2 (40%), 3 (14%) and 2 (4.5%) of those with stage III, stage II and stage I CKD, respectively (P<0.00001). Heart attack was experienced among 1 (20%), 6 (28%) and 4 (9%) of those with stage III, stage II and stage I CKD, respectively (P<0.00001). CHF was found among 1 (20%), 2 (10%) and 1 (2.3%) of those with stage III, stage II and stage I CKD, respectively (P<0.002). Recurrent Urinary tract infection (UTI) was found among 1 (20%), 8 (38%) and 26 (59%) of those with stage III, stage II and stage I CKD, respectively (P<0.004). Renal stone was identified among 1 (20%), 0 (0%) and 9 (20%) of those with stage III, stage II and stage I CKD, respectively (P<0.328). These results showed no statistical difference between the findings and the population without CKD.

As summarized in Table 2, for systolic BP, prehypertensive and hypertensive cases were identified among (2 and 3), (4 and 9), (20 and 20) and (34 and 19) of stage III, stage II, stage I CKD, and non-CKD in this order (P<0.008), hence, for diastolic BP, prehypertensive and hypertensive cases were identified among (0 and 3), (3 and 7), (7 and 36) and (10 and 13) of stage III, stage II, stage I CKD, and non-CKD in this order (P<0.03).

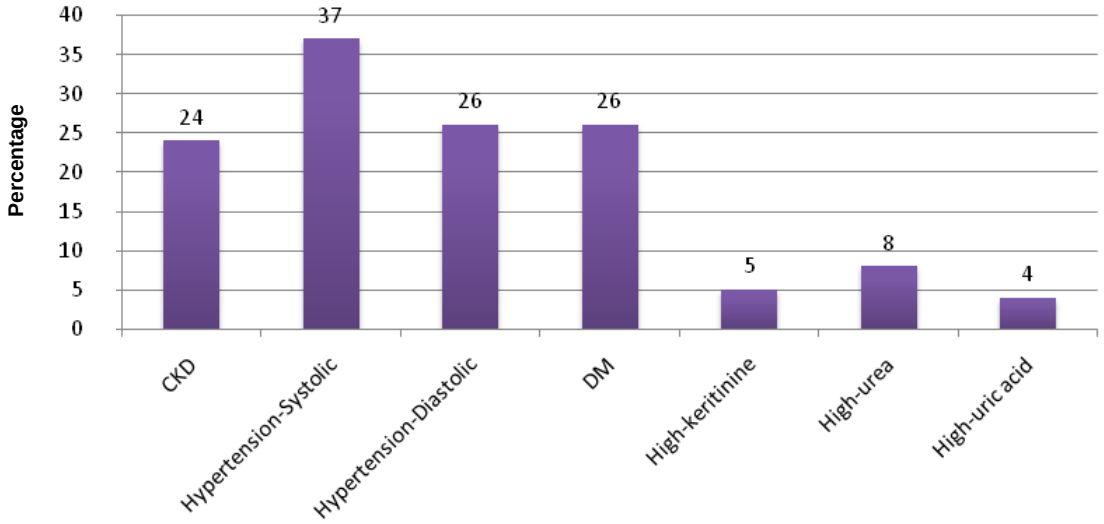

Figure 1. Description of the study population by CKD, hypertension, DM, creatinine, urea and uric acid.

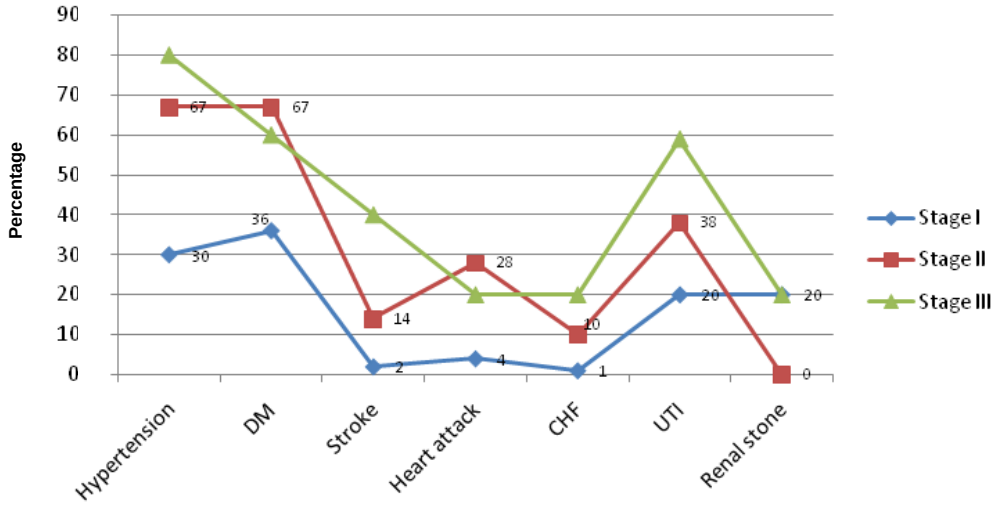

Figure 2. Description of risk factors by CKD.

Furthermore, high creatinine, urea and uric acid were found among (5, 5 and 5), (10, 9 and 5), (0, 4 and 1) and (0, 3, and 2) of stage III, stage II, stage I, and non-CKD, respectively with P values of 0.04,0.06 and 0.321 for creatinine, urea and uric acid correspondingly, as indicated in Table 2.

As shown in Figure 3, majority of individuals with CKD have shown increased percentages of CKD risk factors and the proportional increase was related with the increasing of severity of the stage of CDK.

DISCUSSION

CKD is progressively more frequent in public health concern related to considerable morbidity and mortality. Evaluation of the problem magnitude, through identification of individuals at risk provides a useful clinical and research framework for adverse proceedings and stratifying patients with CKD according to risk; conversely, precise complete risk prediction requires careful complex measures (Fischer et al., 2013).

Screening for disease in apparently healthy individuals in the expectation that early identification can lead to more successful intervention strategies is a very practical objective (Jaar et al., 2008). Therefore, this study screened apparently healthy individuals to make available absent data about CKD and its major associated risk factors, and to the best of our knowledge this is the first report from KSA in general and Hail region in particular,

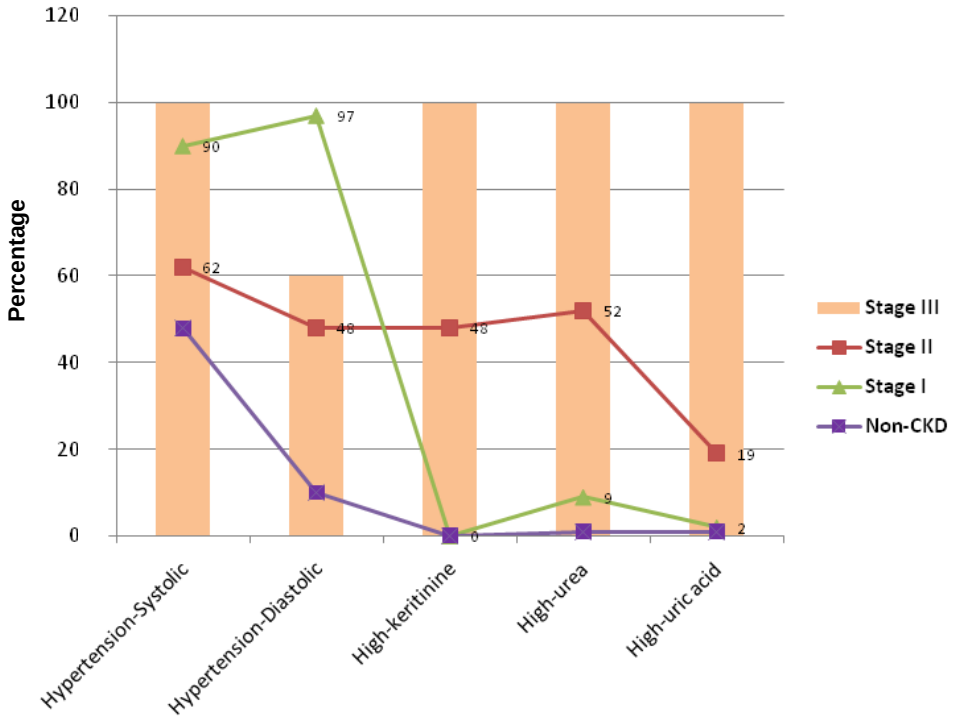

Figure 3. Description of blood pressure (BP), creatinine, urea and uric acid by the status of CKD within entire stage.

Table 1. Distribution of demographic characteristics by CKD.

Variable	Category	GFR<15	GFR=16-29	GFR=30-59	GFR=60+	Total	P value
		Sage III CKD	Sage II CKD	Sage I CKD	Non-CKD		
Frequency		5 (1.8%)	21 (7%)	44 (14.6%)	229 (76.6%)	299 (100%)	-
Gender	Male	3	9	15	78	105	0.379
	Female	2	12	29	151	194	
Age	<25 years	0	1	0	80	81	0.0001
	26-35	0	0	9	54	63	
	36-45	1	0	10	49	60	
	46-55	0	2	9	22	33	
	56-65	3	7	9	14	33	
	66+	1	11	7	10	29	
Education	Illiterate	3	19	24	52	98	0.0001
	Primary	1	2	10	59	72	
	Secondary	0	0	4	53	57	
	Higher	1	0	6	65	72	
Occupation	Employee	2	3	9	56	70	0.0001
	Housewife	2	9	21	54	86	0.0001
	Student	0	0	3	58	61	0.2
	Free-work	0	3	7	38	48	0.0001
	Others	1	6	4	23	34	0.0001

Table 2. Distribution of blood pressure (BP), creatinine, urea and uric acid by the stages of CKD.

Variable	Category	GFR<15	GFR=16-29	GFR=30-59	GFR=60+	Total	P value
		Sage III CKD	Sage II CKD	Sage I CKD	Non-CKD		
Frequency		5 (2.2%)	21 (9.1%)	44 (14.6%)	229 (76.6%)	299 (100%)	-
Systolic BP	Prehypertensive	2	4	20	34	60	0.008
	Hypertensive	3	9	20	19	51	
Diastolic PB	Prehypertensive	0	3	7	10	20	0.03
	Hypertensive	3	7	36	13	59	
Creatinine	High	5	10	0	0	15	0.04
	Normal	0	11	44	229	284	
Urea	High	5	11	4	3	23	0.06
	Normal	0	10	40	226	276	
Uric acid	High	5	4	1	2	12	0.321
	Normal	0	17	43	227	287	

that screened apparently healthy population for the presence of CKD and its related risk factors. Conversely, the intervention based on early detection can improve the long-term outcome of CKD.

However, the prevalence of CKD (24%) in the present studied population is very high as compared to reports from many other countries. In a report from Taiwan, the prevalence of an estimated GFR <60 ml/min/1.73 m^2 was 7% (Hsu et al., 2006). In another study, the overall prevalence of CKD in Norway was 10.2%, which is similar to that reported in the United States (Hallan et al., 2006).

Studies from Saudi Arabia and other Gulf countries, have only dealt with end stage renal disease (ESRD), as well as, the risk factors associated with CKD, such as, DM, hypertension, and other cardiovascular diseases. A recent review of 44 studies, have described the epidemiology of ESRD in the countries of the Gulf Cooperation Council (GCC; which consist of Saudi Arabia, the United Arab Emirates, Kuwait, Qatar, Bahrain, and Oman), showed that the incidence of ESRD has increased while the prevalence and mortality rate of ESRD in the GCC has not been reported sufficiently (Amal et al., 2012).

The modification of diet in renal disease study (Hunsicker et al., 1997) followed chronic kidney disease patients at all stages for a 2-year period and concluded that 85% of patients had a decline in their GFR, with the average rate of decline (4 ml/min) annually regardless of the baseline GFR. There are modifiable and non-modifiable factors that contribute to this decline. These factors have been shown to be significant regardless of the underlying etiology of the chronic kidney disease. In general, the non-modifiable risk factors associated with more rapid decline in kidney disease include increased age, African-American race, and male sex. The modifiable risk factors are the focus of treatment to halt disease progression and include higher levels of proteinuria, a lower serum albumin level, higher blood pressure, poor glycemic control, and smoking (National Kidney Foundation, 2002).

Diabetes is the most prominent cause of CKD, accounting for 33% of adult CKD cases (National Kidney Foundation, 2002). Conversely, 20 to 40% of diabetics will develop diabetic nephropathy during the course of their disease (American Diabetic Association, 2008); therefore, as the number of diabetic patients increases, the incidence of CKD can be expected to follow.

In the current study, diabetes accounted for 26% of the study population and 46% of the cases of CKD. Meta-analysis of 6 GCC studies showed that the summarized estimate of diabetes prevalence is 47.85% (Shohaib et al., 1999; Shakuntala et al., 1992; El-Reshaid et al., 1994; Al Nasser et al., 1992; Kumar, 1997; Khan et al., 2002).

Vascular disease (primarily hypertension) is the second most common cause of CKD (it causes 21% of adult CKD cases) (Duaine et al., 2010). Hypertensive nephrosclerosis is associated with addition signs of hypertensive end-organ damage, because of long periods of poorly controlled hypertension. In the present study, the frequency of hypertension was high approximately 37% and the individuals with hypertension represent 44.3% of cases of CKD. The summarized estimate of hypertension prevalence among ESRD in GCC study was 77.88% (Amal et al., 2012).

Cardiovascular diseases including stroke, heart attack and CHF were identified in a reasonable number of cases of CKD. In 6 GCC studies, the summarized estimate of

cardiovascular disease prevalence is 14.51% (Khan et al., 2002; Al-Haddad et al., 2003; Al Wakeel et al., 2002; Alsuwaida et al., 2007; Hussein et al., 1994; Gabr et al., 2004; Al-Ali et al., 2008).

UTI and renal stones were also found in a number of CKD cases. The risk of UTI might be increased by CKD factors (e.g., papillary necrosis, nephrolithiasis, neurogenic bladder). There is evidence of increased risk for UTI in female patients with diabetes (Nicolle, 2005). Asymptomatic bacteriuria in women with diabetes is roughly three-fold greater than in women without diabetes, regardless of the degree of control of the hypergly-cemia (Kunin, 1997). Several studies have found stone formers to be at increased risk for CKD and ESRD, but more research is needed. There may be significant heterogeneity in the risk for CKD, and better characterization of the stone types and clinical factors that identify stone formers at most risk for developing CKD are needed (Andrew et al., 2011).

The strengths of this study firstly, it presents adequate information based on epidemiological survey for multiple outcomes related to CKD. It provides evidence of the burden of CKD and defines the high-risk factors in the Hail regions. This information is extremely valuable for public health planners and administrators to allocate healthcare resources in Hail region, KSA, since most of such studies in KSA investigated the burden of potential risk factors for CKD.

LIMITATIONS

This study includes the cross sectional settings and the relatively small size, and we have argued earlier that a high percentage of older individuals, many of whom are females, will have a GFR less than 60 ml/min/1.73 m^2. Screening for CKD, based on GFR alone, will identify a largely older population (mostly female), many of whom will not have any corroborative evidence of “kidney disease.” Thus, it can be assumed that eGFR-based screening will generate a large number of “false positives,” using current criteria. Also, selected individuals with CKD should be followed up for at least 3 month, which we will do in the next phase. The frequency of CKD and its associated risk factors are very high in Hail region. Larger study population will be required to establish the role of these risk factors in the etiology of CKD in Hail region.

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