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ORIGINAL RESEARCH

Knowledge of Chronic Kidney Disease Among the Population of Saudi Arabia Evaluated Using a Validated Questionnaire: A Cross-Sectional Study

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Introduction: Public knowledge and awareness regarding chronic kidney disease (CKD) is an important factor influencing the successful implementation of CKD prevention and screening programs. To the best of our knowledge, there are no studies conducted among the Saudi population to explore the public knowledge of CKD using a validated questionnaire. Hence, we explored the knowledge of CKD among the population of the Kingdom of Saudi using a validated questionnaire to determine the level of knowledge regarding CKD as well as the predictors of CKD knowledge.

Materials and Methods: This was a cross-sectional online survey study conducted between 12 January 2020 and 11 February 2021. A structured study questionnaire in the Google™ platform, with socio-demographic variables and questions assessing CKD knowledge, was used to collect data. A snowball sampling technique was used to recruit participants.

Results: A total of 983 people accessed the survey and 951 provided a complete response. Respondents belonging to the age group 41–55 years, having masters or PhD level education, having monthly income >15,000 SR, married, doing >150 minutes/week physical activity had significantly higher kidney disease knowledge. There were significant differences in the mean kidney disease knowledge total score between participants with and without: a history of kidney disease (5.63, df = 895, $p<0.001$), diabetes mellitus (2.34, df = 949, $p = 0.019$), hypertension (3.25, df = 949, $p = 0.001$), and family history of kidney failure (4.60, df = 949, $p<0.001$).

Conclusion: The study revealed a lack of awareness among the Saudi population regarding knowledge about CKD. However, a significantly higher level of knowledge prevailed among respondents from higher educational and higher economic backgrounds. Those with risk factors for CKD also held a greater knowledge about the disease.

Keywords: knowledge, CKD, Saudi population, validated questionnaire

Introduction

Chronic kidney disease (CKD) is a non-communicable disease characterized by persistent abnormality in the structure or function of kidneys for more than 3 months.[1] The prevalence of CKD has been on the rise over the past several decades making it a significant burden on healthcare systems worldwide at present.[2] A recent meta-analysis has estimated the worldwide prevalence of CKD at 13.4%.[3] The global prevalence of CKD was estimated to be 9.1% in 2017 and 1.2 million deaths were attributed to it.[4] Studies reported 17-fold higher mortality

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among patients with end stage kidney disease (ESKD) compared with age- and gender-matched healthy individuals.[5] The number of deaths due to CKD has been projected to be 2–4 million by 2040.[4] Apart from the potential to lead to ESKD and premature death, CKD has also been recognized as an independent risk factor for cardiovascular disease; 7% of the total cardiovascular disease burden being attributed to impaired kidney function.[5] In the Kingdom of Saudi Arabia, CKD has been recognized as a major health problem in recent decades due to the growing incidence and prevalence of ESKD among the Saudi population.[6] The three very important risk factors for CKD – diabetes, hypertension and obesity – are highly prevalent in the Saudi population.[5] An epidemiological study conducted in 2010 in the Kingdom of Saudi Arabia found that the overall prevalence of CKD was 5.7%.[7] There were around two million cases of CKD and 3818 deaths due to CKD in Saudi Arabia in 2017.[4] A recent study also reported the overall prevalence of CKD stages 3 to 5 was 4.4% among the Saudi population.[8] However, there is a clear lack of attention from policymakers and researchers regarding this emerging challenge in the Arab world, especially Saudi Arabia, and limited resources are being allocated towards the prevention and management of CKD and its risk factors.[5]

Considering the significant morbidity and very high rate of mortality among patients with ESKD, efforts are made worldwide in the prevention and early detection of CKD. Prevention, early detection and adequate treatment of major risk factors of CKD such as diabetes, hypertension and obesity together constitute an important public health strategy in this regard and it is critically important in the Arab world where these risk factors are highly prevalent.[5] It has been estimated that successful prevention of these risk factors by public health interventions at population level can result in a reduction of up to 40% in the incidence of CKD.[9] Screening of individuals with risk factors to detect and treat CKD early is another important strategy adopted by various countries for delaying of CKD disease progression.[10] Alsuwaida et al. conducted a pilot community-based screening program to detect CKD in Saudi Arabia and demonstrated that it is feasible and relatively inexpensive.[7]

It goes without saying that public knowledge and awareness regarding CKD is an important factor influencing the successful implementation of CKD prevention and screening programs. Higher rate of early identification of individuals with undetected/early CKD or those at risk of developing CKD might be possible among populations with high levels of knowledge and awareness about CKD.[11] Studies conducted in both developed and developing countries have shown that the public understanding of CKD and its risk factors are relatively poor.[12] A recent Australian study found limited knowledge among participants regarding the physiological role of the kidneys, and less than half of the participants correctly identified hypertension as a risk factor.[12] A study conducted during 2010 among the population of Saudi Arabia showed that less than 7.1% of patients with early CKD reported awareness of their CKD status and there was poor awareness regarding CKD symptoms among the study cohort.[7] However, another recent study from Saudi Arabia exploring knowledge and awareness about CKD using a non-validated questionnaire found that more than half of the participants correctly identified HTN and DM as risk factors of CKD, indicating that the knowledge regarding CKD among the Saudi population is relatively increasing.[11] To the best of our knowledge, there are no studies conducted among the Saudi population to explore the public knowledge of CKD using a validated questionnaire. Hence, we explored the knowledge of CKD among the population of the Kingdom of Saudi using a validated questionnaire to determine the level of knowledge regarding CKD as well as the predictors of CKD knowledge.

Methodology

This was a cross-sectional online survey study conducted between 12 January 2020 and 11 February 2021. A structured study questionnaire in Google™ platform, having socio-demographic variables and the questions assessing CKD knowledge, was used to collect data (Supplementary File 1). Snowball sampling technique was used to recruit participants. We used the CKD knowledge questionnaire developed and validated by Gheewala et al. 2018.[12] The CKD knowledge questionnaire consists of 24 questions with the multiple-choice options "True", "False" and "I don't know". Correct responses were given a score of 1 and incorrect responses were given a score of 0. The option "I don't know" was considered as lack of knowledge and given a score of 0. The questionnaire was developed through a systematic literature review of existing public and related questionnaires. The questionnaire was validated by applying the final version of the questionnaire among 27 students, 28 nephrologists and 121 participants from the public. The analysis showed that the questionnaire had good internal consistency; the

Cronbach's alpha was 0.88 (95% CI: 0.86–0.91).[12] The questionnaire was shared with contacts of the researcher through social media across the Kingdom of Saudi Arabia and each recipient was asked to share the link with at least 5 other contacts. The questionnaire started with consent for voluntary participation, from the Saudi population of >15 years, followed by socio-demographic details and the CKD knowledge questions. All participants were informed about the purpose of the study. The study was conducted in accordance with the Declaration of Helsinki.

Statistical Analysis

The collected data were analyzed using Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, version 26.0 for Windows) software. The characteristics of the respondents were described using frequencies, percentages, averages and standard deviations. Univariate analysis using chi-square tests was used to assess relationships between variables. Bivariate analysis was conducted to study the relationship between socio-demographic variables and the CKD knowledge score, using independent *t*-tests and one-way ANOVA. A two-tailed P value of <0.05 was considered as statistically significant.

Results

A total of 983 people accessed the survey and 951 provided a complete response. The majority of the respondents were aged 26–55 years (71%) and 50.9% were males. 63.1% of the respondents were graduates and 45% were not working currently. 64.5% of the respondents were married, and 25% were earning >15,000 SR per month. 89 (9.4%) respondents reported a history of kidney disease. 13.4% of the participants had DM, 20.7% had HTN, 3.7% had cardiac disorder, 17.9% had osteoarthritis, and 1.2% had stroke. 46.8% of the respondents had a family member working in the healthcare sector, and 21% had a family history of kidney failure. 22.9% of the respondents reported a smoking habit, and only 14.2% reported physical activity >150 minutes/week. 20.7% of the respondents reported usage of pain killers, 24.6% reported usage of herbal medicines. The details are summarized in Table 1.

The mean (SD) kidney disease knowledge score of the study population was 11.99 (± 4.70), with scores ranging from 0 to 22. 42.9% of the respondents had knowledge scores less than 11. Most of the participants answered the

Table 1 Participant Characteristics

Characteristics	Participants	
	N	%
Total	951	100
Age (years)		
15–25	161	17
26–40	412	43.5
41–55	261	27.5
56–70	109	11.5
>70	5	0.5
Gender		
Female	467	49.1
Male	484	50.9
Education		
High school or less	244	25.7
Bachelor	600	63.1
Masters or PhD	107	11.3
Occupation		
Not currently working	428	45
Government sector	222	23.3
Military	30	3.2
Private sector	271	28.5
Income		
<5000 SR	371	39
5000–15,000 SR	342	36
>15,000 SR	238	25
Marital status		
Single	275	28.9
Married	613	64.5
Divorced/separated/widowed	63	6.6
Presence of kidney disease		
Yes	89	9.4
No	808	85
Do not know	54	5.7
Presence of Diabetes		
Yes	127	13.4
No	824	86.6
Presence of HTN		
Yes	197	20.7
No	754	79.3
Presence of Heart Disease		
Yes	35	3.7
No	916	96.3
Presence of Stroke		
Yes	11	1.2
No	940	98.8

(*Continued*)

Table 1 (Continued).

Characteristics	Participants	
	N	%
Health care worker in the family		
Yes	445	46.8
No	506	53.2
Family History of kidney failure		
Yes	200	21
No	751	79
Presence of Osteoarthritis		
Yes	170	17.9
No	781	82.1
Smoker		
Yes	218	22.9
No	599	63
Passive smoker	72	7.6
Ex-smoker	62	6.5
Physical activity		
None	484	50.9
<150 minutes/week	332	34.9
>150 minutes/week	135	14.2
Use of pain killers		
Yes	197	20.7
No	754	79.3
Use of herbal medicines		
Yes	234	24.6
No	717	75.4

following questions correctly: urine test (87.9%) and blood test (80.4%) are used commonly to determine health of the kidneys, a person can lead a normal life with a single kidney (80.5%), the kidneys clean blood (79.8%), diabetes is a risk factor for kidney disease (69.2%), and water retention (79.8%) and increased fatigue (68.8%) are signs of kidney disease. However, only few respondents reported correct answers for the following questions: nausea/vomiting (44.7%) and loss of appetite (43.7%) are signs of kidney disease, the kidneys help to maintain blood pressure (46.8%) and bone health (28.9%). The majority of the respondents reported wrong answers for the following questions: the kidneys help to keep blood sugar level (74.2%) and breakdown of the proteins (81%), being female (78%), having heart disease (70.9%) and having excess stress (78.4%) are risk factors of kidney disease, and fever is a sign of kidney disease (84.1%). The percentage of correct responses to individual items of the kidney disease knowledge questionnaire are summarized in Table 2.

Table 2 Percentage of Correct Response to Individual Items on the Questionnaire

Question	Correct Response (%)
A person can lead a normal life with one healthy kidney	80.5
Herbal supplements can be effective in treating chronic kidney disease	33.1
Certain medications can help to slow down the worsening of chronic kidney disease	49.9
What functions do the kidneys perform in the body?	
The kidneys make urine	59.4
The kidneys clean blood	79.8
The kidneys help to keep blood sugar level normal	25.8
The kidneys help to maintain blood pressure	46.8
The kidneys help to break down protein in the body	19
The kidneys help to keep the bones healthy	28.9
Which of the following are commonly used to determine health of the kidneys?	
A blood test	80.4
A urine test	87.9
A faecal (poo) test	51.4
Blood pressure monitoring	56.6
What are the risk factors for chronic kidney disease?	
Diabetes	69.2
Being female	22
High blood pressure	54.3
Heart problems such as heart failure or heart attack	29.1
Excess stress	21.6
Obesity	51.1
What are the signs and symptoms that a person might have if they have advanced chronic kidney disease or kidney failure?	
Water retention (excess water in the body)	79.8
Fever	15.9
Nausea/vomiting	44.7
Loss of appetite	43.7
Increased fatigue (tiredness)	68.8

The bivariate analysis performed using one-way ANOVA tests showed that there are significant associations between kidney disease knowledge score and age (3.14, $p = 0.014$), educational level (4.03, $p = 0.018$),

income (5.87, p = 0.003), marital status (3.78, p = 0.023), and frequency of physical activity (4.49, p = 0.011). Respondents belonging to the age group 41–55 years, having masters or PhD level education, having monthly income >15,000 SR, married, doing >150 minutes/week physical activity had significantly higher kidney disease knowledge. The results of the bivariate analysis performed using one-way ANOVA test between individual participant characteristics and total score are summarized in Table 3. The results of the bivariate analysis performed using independent *t*-tests between individual respondent characteristics and kidney disease knowledge total score showed that there were significant differences in the mean kidney disease knowledge total score between participants with and without a history of kidney disease (5.63, df = 895, p<0.001), diabetes mellitus (2.34, 949, p = 0.019), hypertension (3.25, df = 949, p = 0.001), and family history of kidney failure (4.60, df = 949, p<0.001). The details of the independent *t*-tests are summarized in Table 4.

Table 3 Results of the Bivariate Analysis Performed Using Independent *t*-test Between Individual Participant Characteristic and Total Score

	Total Score Mean (SD)	t	Df	p-value
Gender		1.20	949	0.230
Male	12.18(5.00)			
Female	11.81(4.37)			
Presence of kidney disease		5.63	895	<0.001
Yes	14.66(3.69)			
No	11.74(4.74)			
Diabetes Mellitus		2.34	949	0.019
Yes	12.90(3.82)			
No	11.85(4.81)			
Hypertension		3.25	949	0.001
Yes	12.96(4.28)			
No	11.75(4.78)			
Heart disease		1.21	949	0.226
Yes	12.94(4.35)			
No	11.96(4.71)			
Stroke		1.36	949	0.175
Yes	13.91(3.48)			
No	11.98(4.71)			
Kidney failure		4.60	949	<0.001
Yes	13.35(4.00)			
No	11.64(4.81)			
Osteoarthritis		−0.08	949	0.933
Yes	11.97(4.32)			
No	12.00(4.79)			
Smoker		−1.72	815	0.085
Yes	11.42(4.98)			
No	12.07(4.69)			
Use of pain killer		1.15	949	0.252
Yes	12.34(4.20)			
No	11.90(4.83)			
Use of herbal medicines		−0/12	949	0.904
Yes	11.97(4.46)			
No	12.00(4.79)			

Discussion

This study conducted among the Saudi population to explore the public knowledge about CKD revealed that the studied population had an overall poor knowledge in the subject. The respondents held a poor knowledge about the functions of the kidney, especially in blood pressure regulation and maintenance of bone health, similar to a recent study among the Australian public.[12] However, the respondents had a relatively good knowledge about the role of blood and urine testing in determining the health of the kidneys. More than half of the respondents correctly identified DM, HTN, and obesity as risk factors of CKD, yet the majority wrongly identified female sex, and stress as risk factors of CKD. Albujays et al. explored CKD knowledge among diabetic patients in Al-Ahsa Governorate, Kingdom of Saudi Arabia, and found that 52.7% of the participants identified DM as a risk factor of CKD, similar to our study.[13] Almutary et al. explored CKD knowledge among non-dialysis CKD patients in the Kingdom of Saudi Arabia, and found significant gaps in their understanding of kidney functioning and clinical presentation of CKD.[14] Another study among the Saudi population by Ahmed et al. reported that out of 940 participants, about 60% correctly identified DM and HTN as risk factors of CKD.[11] However, a recent study among the Australian public reported that 60.6% of the participants identified DM as a risk factor for CKD, but only 38.3% identified HTN as a risk factor for CKD.[12] Similar to our study, lower identification of DM and HTN as risk factors of CKD was also reported from Hong Kong, Nigeria, Singapore and Iran.[15–18]

In our study, 80.5% of the respondents knew that only one kidney is required to maintain a normal life, which is

Table 4 Results of the Bivariate Analysis Performed Using One-Way ANOVA Test Between Individual Participant Characteristics and Total Score

	Total Score Mean (SD)	Df*	F	p-value	Post-Hoc Comparison^
Total	11.99(4.70)				
Age range (years) 15–25 26–40 41–55 56–70 >70	 11.59(4.95) 11.62(4.77) 12.81(4.54) 12.10(4.18) 10.60(5.22)	4, 943	3.14	0.014	41–55 years >26–40 years
Education High school or less Bachelor Masters or PhD	 11.66(4.39) 11.92(4.82) 13.16(4.61)	2, 948	4.03	0.018	Masters or PhD > Bachelor or high school or less
Occupation Not working Government sector Military Private sector	 11.84(4.43) 12.53(4.86) 12.33(5.82) 11.77(4.86)	3, 947	1.38	0.249	
Income Below 5000 SR 5000–15,000 SR >15,000 SR	 11.46(4.72) 12.04(4.82) 12.78(4.40)	2, 948	5.87	0.003	>15,000 SR> below 5000 SR
Marital status Single Married Divorced/separated/widowed	 11.61(4.98) 12.28(4.57) 10.88(4.54)	2, 948	3.78	0.023	Marries > single
Frequency of physical activity None <150 min/week >150 min/week	 11.73(4.67) 11.95(4.75) 13.09(4.61)	2, 948	4.49	0.011	> 150 min/week > none or < 150 min/week

Notes: *Df values (between groups, within groups); ^Tukey HSD post hoc comparison ($p<0.05$).

significantly higher when compared with another study among primary care patients from Singapore which reported that around 50% of the participants knew this.[17] However, another study among the Australian public reported that 85.6% of the participants knew that only one kidney is required to maintain a normal life.[12]

In our study, 50.1% of the respondents did not know that medications can help to slow down the worsening of CKD, and 66.9% wrongly believed that herbal supplements can be effective in treating CKD, indicating poor understanding of the studied population regarding CKD treatment. Similar results were also observed among the Australian public by Gheewala et al., in which 51.2% of the respondents knew that medications can help to slow down the worsening of CKD, and 76.6% wrongly believed in the effectiveness of herbal supplements in treating CKD.[12] There are various safe and cost-effective therapies that can slow down the progression of CKD, and our study highlights the importance of disseminating information related to these effective treatments.[19] In the absence of such public and patient outreach activities, there is a real chance that many patients with CKD might end up in taking herbal medications for the treatment of CKD, which might cause more harm to them.[20]

Screening for CKD among a high-risk population is an effective public health approach to detect and treat CKD early in its course. Public understanding of CKD, especially about the screening methods, can enhance the penetration and effectiveness of such interventions. Our study results are encouraging due to the fact that >80% of the

respondents rightly identified blood test and urine test as methods to identify kidney diseases and 56.6% also knew that BP assessment can be used to identify kidney diseases. The rate of correct identification of tests for kidney functioning was significantly higher in our study when compared with studies from other parts of the world, including developed countries. A recent study among the Australian public reported that around 35% of the respondents did not know that blood and urine tests can be used to determine kidney health, and only 20.3% of the respondents knew that BP assessment can be used to determine kidney functioning.[12]

Our study results also showed significantly higher CKD knowledge score among participants with higher age, higher educational attainments, higher economic status, who were married, and those indulging in physical activities for >150 min/week. Gheewala et al. also found that respondents with higher educational attainment had a significantly higher CKD knowledge score.[12] Moreover, they also reported significantly higher CKD knowledge score among married participants, similar to our study.[12] Chow et al. also reported a higher CKD knowledge score among participants with higher education level.[15] Our study results also showed significantly higher CKD knowledge score among participants with kidney disease, DM, HTN, and family history of kidney failure. Previous studies also reported significantly higher CKD knowledge scores among participants with personal history of DM and participants with a family history of kidney failure.[12,15,16] However, higher CKD knowledge score among patients with personal history of HTN was not reported in the past. Our study results suggest that individuals with lower educational attainments, lower economic status, unmarried, leading a sedentary lifestyle, having no risk factors such as DM, HTN and having no family history of kidney disease should be specifically targeted for CKD education as they reported significantly poor CKD knowledge score.

There are a few limitations of this study that need to be considered before interpreting the study results. We conducted an online cross-sectional study based on an online questionnaire that was distributed via various social media platforms, which can lead to selection bias. Moreover, our study sample is not representative of the general Saudi public, limiting generalizability of the study findings.

To conclude, this study evaluated the CKD knowledge among the Saudi population using a validated questionnaire. The CKD knowledge of the Saudi population was poor overall. However, significantly higher CKD knowledge was found among respondents with higher educational and economic status. There was significantly higher CKD knowledge among respondents with CKD risk factors. Our study results highlight the need for conducting targeted CKD educational activities among those in the population with lower educational and economic status.

Data Sharing Statement

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics Approval and Consent to Participate

The project was approved by the institutional ethical committee, University of Jeddah. Consent to participate was obtained from all the participants.

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Disclosure

The author reports no conflicts of interest in this work.

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