

Knowledge and Practices of Family Medicine Residents in Saudi Arabia who are on Saudi Board of Family Medicine Regarding Chronic Kidney Disease and their Attitudes toward Referral

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Abstract

Background: Chronic kidney disease (CKD) is a well-known cause of death worldwide, and recently prevalence of the condition increased dramatically. Many of non-diagnosed CKD patients are seen by family physicians and internists. Undetected and by far untreated CKD patients may end up with the end-stage renal disease, in which it's associated with various comorbidity and mortality.

Objectives: The objectives of the study were to assess the knowledge, attitude, and practices of family medicine (FM) residents regarding CKD and referral to nephrologists.

Materials and Methods: A cross-sectional study was done using a self-administered anonymous online questionnaire, distributed among a convenient sample of FM residents who are currently on Saudi Board of FM from various regions of Kingdom of Saudi Arabia. The questionnaire used in this study is based on the Kidney Disease Outcome Quality Initiative Guidelines 2002.

Results: A total of 315 physicians have participated in the study with a response rate of 92%. 68.9% of residents were able to define CKD correctly. However, only half of the participants (51.1%) recognized CKD classification correctly. Majority of participants were aware of common CKD risk factors (diabetes mellitus 99.4%, hypertension 97.8%, and certain drugs 95.9%). Most complications identified by participants were uremia and edema, followed by anemia (95.9%, 95.9%, and 95.6%, respectively). Most of the participants (90.5%) were able to identify hemodialysis, renal transplant, and peritoneal dialysis as forms of renal replacement therapy. 94.3% of physicians agreed that routine screening should be done for high-risk patients. More than one-third of physicians (38.4%) chose to refer at a late stage or did not know when to refer.

Conclusion: Considerable lack of knowledge and late of referring CKD patients by FM residents were noted. Prevention and early detection are the cornerstones of CKD management. Our study helps to focus on demanding areas in CKD management, where we should work on to improve the outcome for our patients in Saudi Arabia.

Key words: Chronic kidney disease, Knowledge, Attitude, Physicians, Referral, Saudi Arabia

BACKGROUND

Globally, chronic kidney disease (CKD) is one of the most common causes of death and currently its prevalence

increased worldwide.^[1,2] Data on the burden of CKD in Asia countries generally remain poorly understood and underestimated. In the Kingdom of Saudi Arabia (KSA), there is one pilot study conducted in 2010 to estimate the prevalence of CKD and its associated risk factors in the Saudi population.^[3] According to this study, the overall estimated prevalence of CKD was 5.7% and 5.3% using the Modification of Diet in Renal Disease-3 and CKD-Epidemiology glomerular filtration equations, respectively. CKD was significantly higher in the older age groups, higher serum glucose, waist/hip ratio, and blood

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pressure. However, additional studies are needed to assess the prevalence of CKD in KSA precisely.

Saudi Arabia has a major burden of hypertension (HTN), diabetes mellitus (DM), and obesity,^[4-6] which are by far common identified causes of CKD. Presence of one or more of these risk factors increases the risk of developing CKD. On the other hand, late diagnosis and referral to nephrologists have been shown to increase the rate of death up to 36% compared with early referral according to a study published in Journal of the American Society of Nephrology.^[7] It's, therefore, vitally important and reasonable to screen those individuals with high risk and detect CKD in early stages, as the initiation of management in early stages slows down and halting the progression to end-stage renal disease. This strategy plan can be applied if the physicians are qualified enough to identify the condition, its risk factors, and appropriate time of patient referral.

In Cameron, primary care physicians were found to have lack of awareness on the kidney disease outcome quality initiative (KDOQI) guidelines. Furthermore, they displayed poor attitude regarding diagnosis and timing of referral to the nephrologist.^[8]

Another study was conducted in the United States of America in 2006 showed that there was lacking awareness regarding KDOQI guidelines and delaying of referral to the nephrologist.^[9]

In Pakistan in 2013, a cross-sectional study was published showed that there were considerable deficiencies and gaps in attitudes and knowledge of general practitioners in Karachi regarding diagnosis and management of CKD. Furthermore, it showed significant uncertainty among the GPs about when to refer to a nephrologist.^[10]

Assessing the level of knowledge and the attitudes of non-nephrology physicians regarding CKD guidelines for diagnosis and appropriate time of referral are needed to assess their ability of proper management of this disease.

After reviewing the previously related researches, we have found that there is a considerable lack of awareness regarding applying of evidence-based guidelines in the diagnosis of CKD and appropriate time of referral. As there is a lack of similar studies in our area, we found it an important issue to conduct this study to assess the knowledge of family physicians about CKD and their attitudes toward referral.

MATERIALS AND METHODS

Study Area

The study has been conducted in October 2018 addressing family medicine (FM) residents across the major regions of Saudi Arabia, including central, northern, southern, eastern, and western regions.

Inclusion Criteria for the Study Participants

Saudi and non-Saudi FM residents who are on Saudi Board of FM (SBFM) Residency were included in this study.

Exclusion Criteria for the Study Participants

- FM specialists, consultants, are excluded.
- General practitioners who are not on SBFM residency are excluded from the study.

Study Variables

Dependent variables

- Definition of CKD
- Selected risk factors of CKD:
 - DM
 - Drugs
 - HTN
 - Glomerulonephritis
 - HIV
 - Hepatitis.
- Selected complications of CKD:
 - Anemia
 - Hyperkalemia
 - Uremia
 - HTN
 - Osteodystrophy
 - Edema
 - Nausea/vomiting
 - Coma.
- Knowledge of renal replacement therapy (RRT) forms
 - Peritoneal dialysis
 - Kidney transplant
 - Hemodialysis.
- Attitudes of physicians regarding care of high-risk patients for CKD
 - Appropriate action toward the high-risk patient
 - The frequency of screening CKD high-risk patients
 - Most appropriate marker to assess kidney function.
- Routinely needed workup to diagnose a CKD patient
- Appropriate time of referring CKD patient to the nephrologist.

Independent variables

- Age
- Gender
- Level of training residency
- Years of experience

Procedure

The target population was invited to participate by email to fill out a self-administered anonymous online questionnaire. The questionnaire used for this study was structured and built up based on the KDOQI guidelines of the National Kidney Foundation. The questionnaire assessed knowledge on the definition, risk factors, stages of CKD, possible consequences of CKD, markers of kidney function, types of RRT, and laboratory investigations and when to refer for a nephrologist. The same questionnaire was used in a similar study conducted in Cameron 2015,^[8] where it was validated and reviewed by a team including an internist-nephrologist and an internist-endocrinologist, and pilot-tested in 10 physicians was done to check of reliability.

Sample Size and Technique

The total population of FM residents who are on SBFM is (1112) residents. This number based on the last census from the general statistical yearbook of Saudi commission for health specialties 2017.^[11]

Based on the total number of population, considering a 95% confidence interval, and a 5% margin of error, the most appropriate estimated sample size is (286) participants. The sample was obtained through both stratified and simple random sampling techniques.

Data Management and Analysis

Data were entered using a personal computer, and all statistical analyses were conducted using the Statistical Package for the Social Sciences SPSS (Version 19.0).

Statistical Methods

Frequency distribution of demographic data, knowledge assessment, and attitude was constructed and expressed as numbers and percentages.

Chi-squared test was used to assess the relationship between the demographic data (including age and gender) and knowledge with attitude variables where a $P < 0.05$ used as an indicator of statistical significance.

Logistic regression has been used to assess the relationship between the dependent variables (knowledge of CKD definition, classification, risk factors, complications, forms of RRT, appropriate action toward high-risk patient, frequency of screening CKD high-risk patients, most appropriate marker to assess kidney function,

routinely needed workup to diagnose a CKD patient, and appropriate time of referring patient to nephrologist) and the independent variables (gender, age, level of training residency, and years of experience) that were statistically significant in the cross-tabulation.

Ethical Considerations

- We obtained verbal consent from each participant and confidentiality was assured.
- All data were used only for research purpose.

RESULTS**Demographic and Professional Characteristics of the Sample**

A total of 315 (92%) residents were approached to complete the study. The analysis of demographic and professional variables is summarized in Table 1. The majority of participants were females (59%). The mean age for the total sample was 29.2 ± 3.2 years, 60% of them are <30-year-old [Figure 1]. The last qualification for most of the respondents was Bachelor of Medicine and Surgery (91.7%), and 60% of participants have 3 years of clinical practice or more. Regarding their level of residency training on SBFM program, almost two-thirds of participants involved are senior residents (67.9%), their level of training is either 3rd or 4th out of four levels, and remaining of them are junior residents (1st or 2nd level of residency) (32.1%).

Table 1: Frequency of demographic and professional data among a sample of FM residents on SBFM in Saudi Arabia

Variable	Frequency	%
Gender		
Male	129	41
Female	186	59
Age		
Less than 30 years	189	60
30 years or more	126	40
Last Qualification		
Bachelor of Medicine and Surgery	289	91.7
Saudi Diploma of family medicine	13	4.1
Arab board of family medicine	10	3.2
The Royal College of General Practitioners (MRCGP)	3	1
Level of residency training		
Junior Resident (R1, R2)	101	32.1
Senior Resident (R3, R4)	214	67.9
Years of experience		
Less than 3 years	126	40
3 years or more	189	60

Definition and Classification of CKD

Out of 315 physicians, 217 (68.9%) of them selected the right definition of CKD according to KDOQI guidelines [Table 2]. However, regarding the classification of CKD, only 161 (51.1%) selected the right answer (5 stages). 23.5% of participants thought that its four stages, and 17.5% of them admitted that they do not know it [Table 3 and Figure 2].

Risk Factors and Complications of CKD

Regarding risk factors, most of the respondents agree that DM, HTN, certain drugs, and glomerulonephritis are well-known factors contribute in developing of CKD (99.4%, 97.8%, 95.9%, and 87.6%, respectively) [Table 4]. HIV and hepatitis were less recognized (41% and 28.3%, respectively). In respect to the complications that may occur as a result of CKD, most of the participants were aware of them. Osteodystrophy was less identified (62.5%) [Table 5].

Forms of RRT

Majority of participants were able to identify hemodialysis, renal transplant, and peritoneal dialysis as forms of RRT (93.7%, 93.7%, and 84.1%) [Table 6].

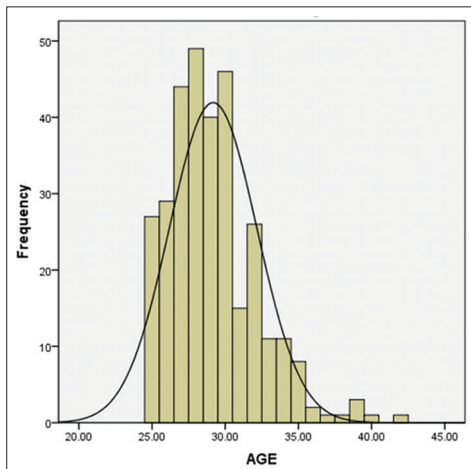


Figure 1: Age distribution among participants

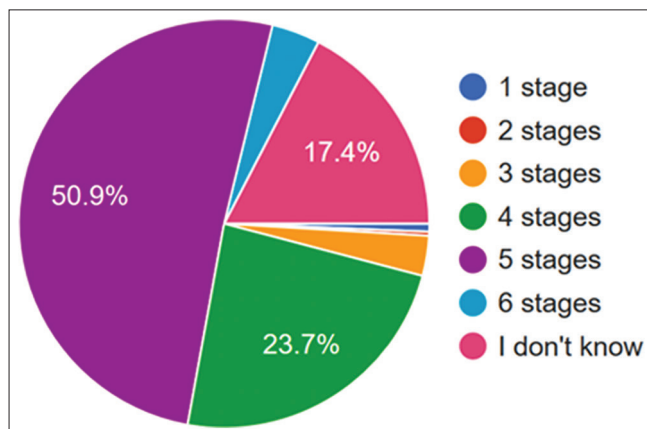


Figure 2: Participants responds to question of chronic kidney disease classification

Attitude toward Patients who are at High Risk of Developing CKD

In respect to the attitude of physicians toward patients who are at high risk of developing CKD, 94.3% agreed that routine screening should be done for them and their risk factors should be managed when it possible. However, there is a diversity regarding time interval for screening, 52.1% prefer to screen those patients annually, while 38.4% prefer to screen them every 6 months [Table 7 and Figure 3]. Majority of physicians agree that the most appropriate marker for kidney function is creatinine clearance/estimated glomerular filtration rate (eGFR) (92.7%) [Table 8].

Diagnosis of CKD and Timing of Referral

In respect to making a diagnosis of CKD, only 1 participant (0.3%) chose to use serum creatinine alone. 74 of participants (23.5%) chose to rely on both serum creatinine and eGFR. 108 (34.3%) chose to combine the serum creatinine, eGFR, urinalysis, and abdominal ultrasound scan to make the diagnosis of CKD. Overall, 97.8% selected the eGFR alone or with other tests as the appropriate means of diagnosis [Tables 9 and 10].

Table 2: Participants responds to the question CKD definition

Variable	Frequency	%
A condition of chronically elevated serum creatinine and urea which is usually reversible with appropriate management	26	8.3
Structural or functional kidney damage that can lead to impaired kidney function that persists for 3months or more with or without alteration of GFR	217	68.9
Irreversible and permanent elevation of serum creatinine	63	20
I don't know	9	2.9

GFR: glomerular filtration rate

Table 3: Participants responds to the classification according to KDOQI

Variable	Frequency	%
1 stage	2	0.6
2 stages	2	0.6
3 stages	9	2.9
4 stages	74	23.5
5 stages	161	51.1
6 stages	12	3.8
I don't know	55	17.5

Table 4: Physician's knowledge of chronic kidney disease risk factors

Variable	Frequency	%
Diabetes mellitus		
No	1	0.3
Yes	313	99.4
I don't know	1	0.3
Drugs		
No	6	1.9
Yes	320	95.9
I don't know	7	2.2
Hypertension		
No	2	0.6
Yes	308	97.8
I don't know	5	1.6
Glomerulonephritis		
No	14	4.5
Yes	276	87.6
I don't know	25	7.9
human immunodeficiency virus (HIV)		
No	44	14
Yes	129	41
I don't know	142	45
Hepatitis		
No	92	29.2
Yes	89	28.3
I don't know	134	42.5

Regarding the appropriate time of referral, 38.4% of physicians chose to refer at a late stage or did not know when to refer [Table 11 and Figure 4].

Variables Related to Knowledge about the Definition and Classification of CKD

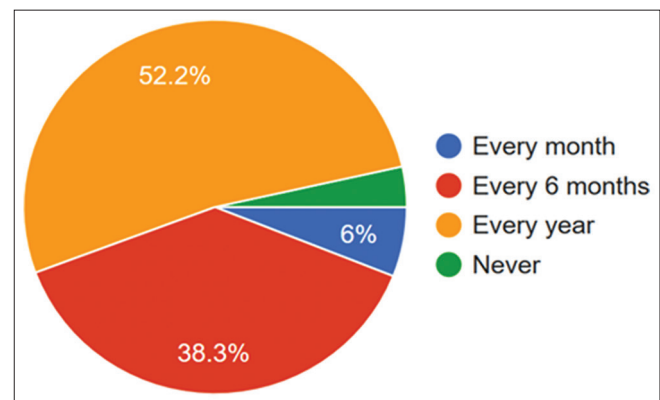
Demographic and professional data were cross-tabbed with the appropriate definition of CKD as a dependent variable; no significant association was found [Table 12]. Regarding the classification of CKD, there was a significant association with the level of residency training and years of experience ($P = 0.01$, 0.017 , respectively) [Table 13].

Variables Related to Knowledge about Risk Factors and Complications of CKD

Regarding of CKD risk factors, cross-tabulation model was done with demographic and professional data, and it showed a significant association between certain drugs as risk factor and years of experience ($P = 0.034$), between glomerulonephritis as a risk factor and gender ($P = 0.006$), between HIV and age, level of residency training, and years of experience ($P = 0.000$, 0.000 , and 0.001 , respectively), and between hepatitis as a dependent variable with gender and age ($P = 0.015$ and 0.002 , respectively). There was no significant association between DM, HTN, and independent variables [Tables 14-19].

Table 5: Physician's knowledge of complications of chronic kidney disease

Variable	Frequency	%
Anemia		
No	7	2.2
Yes	301	95.6
I don't know	7	2.2
Hyperkalemia		
No	6	1.9
Yes	281	89.2
I don't know	28	8.9
Uremia		
No	5	1.6
Yes	302	95.9
I don't know	8	2.5
Hypertension		
No	10	3.2
Yes	290	92.1
I don't know	15	4.7
Osteodystrophy		
No	17	5.4
Yes	197	62.5
I don't know	101	32.1
Edema		
No	4	1.3
Yes	302	95.9
I don't know	9	2.8
Nausea/vomiting		
No	25	7.9
Yes	240	76.2
I don't know	50	15.9
Coma		
No	12	3.8
Yes	257	81.6
I don't know	46	14.6

**Figure 3: Participants responds to the appropriate screening frequency of high-risk chronic kidney disease individuals**

In respect to CKD complication, cross-tabulation model showed a significant association between anemia as a CKD complication and level of residency training, and years of experience ($P = 0.000$ and 0.014 , respectively), between uremia as a CKD complication and age ($P = 0.015$), between

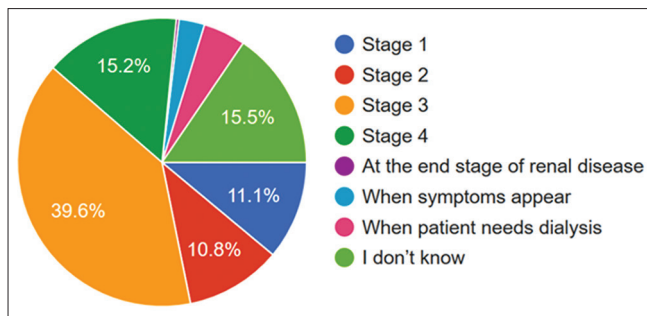


Figure 4: Participants' responses to the appropriate time of referring diagnosed chronic kidney disease patients to the nephrologist

Table 6: Participants' knowledge regarding forms of RRT

Variable	Frequency	%
Peritoneal Dialysis		
No	22	7
Yes	265	84.1
I don't know	28	8.9
Kidney Transplant		
No	14	4.4
Yes	295	93.7
I don't know	6	1.9
Hemodialysis		
No	11	3.5
Yes	295	93.7
I don't know	9	2.9

Table 7: Participants' responses to the classification according to KDOQI

Variable	Frequency	%
Attitude towards a patient at risk of developing CKD?		
-Routine screening for CKD and management of risk factors	297	94.3
-Watchful waiting/No change in attitude	6	1.9
-I don't know	12	3.8
How often do you screen them?		
Every month	19	6
Every 6 months	121	38.4
Every year	164	52.1
Never	11	3.5

CKD: chronic kidney disease

osteodystrophy as a CKD complication and age ($P = 0.008$), between edema as a CKD complication and level of residency training, and years of experience ($P = 0.003$ and 0.28 , respectively), nausea/vomiting as a CKD complication and years of experience. There was no significant association

Table 8: Participants' responses to the question of the most appropriate marker for Kidney function

Variable	Frequency	%
Serum Creatinine	18	5.7
Creatinine clearance/GFR	292	92.7
Blood Urea Nitrogen	3	1
Urine volume	2	0.6

GFR: Glomerular Filtration Rate

Table 9: Summary of participants' responses to investigations needed to make the diagnosis of CKD

Variable	Frequency	%
Serum creatinine		
No	8	2.5
Yes	307	97.5
Urinalysis		
No	134	42.5
Yes	181	57.5
Glomerular Filtration Rate		
No	7	2.2
Yes	308	97.8
Abdominal Ultrasound		
No	153	48.6
Yes	162	51.4

Table 10: Summary of participants' responses to the appropriate workup needed to make the diagnosis of CKD

Variable	Frequency	%
Serum creatinine alone	1	0.3
Serum creatinine with eGFR	74	23.5
Combining of serum creatinine, eGFR, Urine analysis, and abdominal ultrasound scan	108	34.3
eGFR alone or with other tests	308	97.8

eGFR: estimated Glomerular Filtration Rate

between hyperkalemia, HTN, coma as CKD complications, and independent variables [Tables 20-27].

Variables Related to Knowledge about Various Forms of RRT

There was no significant association found between various forms of RRT and demographic/professional characteristics [Tables 28-30].

Table 11: Frequency of participants' responds to the appropriate time of referring diagnosed CKD patients to the nephrologist

Variable	Frequency	%
Stage 1	35	11.1
Stage 2	34	10.8
Stage 3	125	39.7
Stage 4	46	14.6
At the end stage of renal disease	1	0.3
When symptoms appear	9	2.9
When patient needs dialysis	17	5.4
I don't know	48	15.2

Table 12: Relation of CKD definition variable with demographic and professional characteristics

Variable	Right definition		Wrong definition		P-value
	Frequency	%	Frequency	%	
Gender					
Male	89	69	40	31	.974
Female		68.8	58	31.2	
Age					
Less than 30	130	68.8	59	31.2	.960
30 years or more	87	69	39	31	
Level of residency training					
Junior Resident (R1, R2)	67	66.3	34	33.7	.501
Senior Resident (R3, R4)	150	70.1	64	29.9	
Years of experience					
Less than 3 years	80	63.5	46	36.5	.091
3 years or more	137	72.5	52	27.5	

Table 13: Relation of CKD classification variable with demographic and professional characteristics

Variable	5 stages		other answers*		P-value
	Frequency	%	Frequency	%	
Gender					
Male	67	51.9%	62	48.1%	0.807
Female	94	50.5%	92	49.5%	
Age					
Less than 30	94	49.7%	95	50.3%	0.550
30 years or more	67	53.2%	59	46.8%	
Level of residency training					
Junior Resident (R1, R2)	41	40.6%	60	59.4%	0.010
Senior Resident (R3, R4)	120	56.1%	94	43.9%	
Years of experience					
Less than 3 years	54	42.9%	72	57.1%	0.017
3 years or more	107	56.6%	82	43.4%	

* Other definitions:

- A condition of chronically elevated serum creatinine and urea which is usually reversible with appropriate management
- Irreversible and permanent elevation of serum creatinine
- Elevation of serum urea
- I don't know

Table 14: Relation of physicians' knowledge about diabetes mellitus as a risk factor for CKD with demographic and professional characteristics

Variable	Yes		No or I don't know		P-value
	Frequency	%	Frequency	%	
Gender					
Male	129	100.0%	0	0.0%	0.237
Female	184	98.9%	2	1.1%	
Age					
Less than 30	188	99.5%	1	0.5%	0.772
30 years or more	125	99.2%	1	0.8%	
Level of residency training					
Junior Resident (R1, R2)	100	99.0%	1	1.0%	0.586
Senior Resident (R3, R4)	213	99.5%	1	0.5%	
Years of experience					
Less than 3 years	125	99.2%	1	0.8%	0.772
3 years or more	188	99.5%	1	0.5%	

Table 15: Relation of physicians' knowledge about certain drugs as a risk factor for CKD with demographic and professional characteristic

Variable	Yes		No or I don't know		P-value
	Frequency	%	Frequency	%	
Gender					
Male	127	98.4%	2	1.6%	0.056
Female	175	94.1%	11	5.9%	
Age					
Less than 30	180	95.2%	9	4.8%	0.488
30 years or more	122	96.8%	4	3.2%	
Level of residency training					
Junior Resident (R1, R2)	96	95.0%	5	5.0%	0.614
Senior Resident (R3, R4)	206	96.3%	8	3.7%	
Years of experience					
Less than 3 years	112	88.9%	14	11.1%	0.034
3 years or more	180	95.2%	9	4.8%	

Variables Related to Attitude toward Screening of Individuals with High-risk of CKD

Cross-tabulation model showed a significant association between creatinine clearance and eGFR as the most appropriate markers for kidney function and level of residency training and years of experience ($P = 0.009$ and 0.034 , respectively). In respect to proper action toward a patient at high risk for developing of CKD and appropriate screening frequency, no significant association was found [Tables 31-33].

Variables Related to the Needed Investigations for Diagnosis of CKD and Appropriate Time for Referral

With using of cross-tabulation model on the variables of needed investigations for diagnosis of CKD, only urine analysis showed a significant association with gender as an independent variable ($P = 0.001$) [Tables 34-37]. Regarding

Table 16: Relation of physicians' knowledge about hypertension as a risk factor for CKD with demographic and professional characteristic

Variable	Yes		No or I don't know		P-value
	Frequency	%	Frequency	%	
Gender					
Male	128	99.2%	1	0.8%	0.147
Female	180	96.8%	6	3.2%	
Age					
Less than 30	185	97.9%	4	2.1%	0.876
30 years or more	123	97.6%	3	2.4%	
Level of residency training					
Junior Resident (R1, R2)	97	96.0%	4	4.0%	0.151
Senior Resident (R3, R4)	211	98.6%	3	1.4%	
Years of experience					
Less than 3 years	122	96.8%	4	3.2%	0.349
3 years or more	186	98.4%	3	1.6%	

Table 17: Relation of physicians' knowledge about glomerulonephritis as a risk factor for CKD with demographic and professional characteristics

Variable	Yes		No or I don't know		P-value
	Frequency	%	Frequency	%	
Gender					
Male	121	93.8%	8	6.2%	0.006
Female	155	83.3%	31	16.7%	
Age					
Less than 30	162	85.7%	27	14.3%	0.209
30 years or more	114	90.5%	12	9.5%	
Level of residency training					
Junior Resident (R1, R2)	89	88.1%	12	11.9%	0.853
Senior Resident (R3, R4)	187	87.4%	27	12.6%	
Years of experience					
Less than 3 years	110	87.3%	16	12.7%	0.889
3 years or more	166	87.8%	23	12.2%	

Table 18: Relation of physicians' knowledge about HIV as a risk factor for CKD with demographic and professional characteristics

Variable	Yes		No or I don't know		P-value
	Frequency	%	Frequency	%	
Gender					
Male	53	41.1%	76	58.9%	0.968
Female	76	40.9%	110	59.1%	
Age					
Less than 30	180	95.2%	9	4.8%	0.000
30 years or more	122	96.8%	4	3.2%	
Level of residency training					
Junior Resident (R1, R2)	27	26.7%	74	73.3%	0.000
Senior Resident (R3, R4)	102	47.7%	112	52.3%	
Years of experience					
Less than 3 years	38	30.2%	88	69.8%	0.001
3 years or more	91	48.1%	98	51.9%	

Table 19: Relation of physicians' knowledge about hepatitis as a risk factor for CKD with demographic and professional characteristics

Variable	Yes		No or I don't know		P-value
	Frequency	%	Frequency	%	
Gender					
Male	122	94.6%	7	5.4%	0.481
Female	179	96.2%	7	3.8%	
Age					
Less than 30	179	94.7%	10	5.3%	0.372
30 years or more	122	96.8%	4	3.2%	
Level of residency training					
Junior Resident (R1, R2)	90	89.1%	11	10.9%	0.000
Senior Resident (R3, R4)	211	98.6%	3	1.4%	
Years of experience					
Less than 3 years	116	92.1%	10	7.9%	0.014
3 years or more	185	97.9%	4	2.1%	

Table 20: Relation of physicians' knowledge about anemia as a CKD complication with demographic and professional characteristics

Variable	Yes		No or I don't know		P-value
	Frequency	%	Frequency	%	
Gender					
Male	122	94.6%	7	5.4%	0.481
Female	179	96.2%	7	3.8%	
Age					
Less than 30	179	94.7%	10	5.3%	0.372
30 years or more	122	96.8%	4	3.2%	
Level of residency training					
Junior Resident (R1, R2)	90	89.1%	11	10.9%	0.000
Senior Resident (R3, R4)	211	98.6%	3	1.4%	
Years of experience					
Less than 3 years	116	92.1%	10	7.9%	0.014
3 years or more	185	97.9%	4	2.1%	

Table 21: Relation of physicians' knowledge about hyperkalemia as a CKD complication with demographic and professional characteristics

Variable	Yes		No or I don't know		P-value
	Frequency	%	Frequency	%	
Gender					
Male	119	92.2%	10	7.8%	0.147
Female	162	87.1%	24	12.9%	
Age					
Less than 30	167	88.4%	22	11.6%	0.553
30 years or more	114	90.5%	12	9.5%	
Level of residency training					
Junior Resident (R1, R2)	90	89.1%	11	10.9%	0.969
Senior Resident (R3, R4)	191	89.3%	23	10.7%	
Years of experience					
Less than 3 years	112	88.9%	14	11.1%	0.882
3 years or more	169	89.4%	20	10.6%	

Table 22: Relation of physicians' knowledge about uremia as a CKD complication with demographic and professional characteristics

Variable	Yes		No or I don't know		P-value
	Frequency	%	Frequency	%	
Gender					
Male	125	96.9%	4	3.1%	0.446
Female	177	95.2%	9	4.8%	
Age					
Less than 30	177	93.7%	12	6.3%	0.015
30 years or more	125	99.2%	1	0.8%	
Level of residency training					
Junior Resident (R1, R2)	95	94.1%	6	5.9%	0.266
Senior Resident (R3, R4)	207	96.7%	7	3.3%	
Years of experience					
Less than 3 years	120	95.2%	6	4.8%	0.644
3 years or more	182	96.3%	7	3.7%	

Table 23: Relation of physicians' knowledge about hypertension as a CKD complication with demographic and professional characteristics

Variable	Yes		No or I don't know		P-value
	Frequency	%	Frequency	%	
Gender					
Male	122	94.6%	7	5.4%	0.170
Female	168	90.3%	18	9.7%	
Age					
Less than 30	171	90.5%	18	9.5%	0.202
30 years or more	119	94.4%	7	5.6%	
Level of residency training					
Junior Resident (R1, R2)	93	92.1%	8	7.9%	0.994
Senior Resident (R3, R4)	197	92.1%	17	7.9%	
Years of experience					
Less than 3 years	115	91.3%	11	8.7%	0.670
3 years or more	175	92.6%	14	7.4%	

Table 24: Relation of physicians' knowledge about osteodystrophy as a CKD complication with demographic and professional characteristics

Variable	Yes		No or I don't know		P-value
	Frequency	%	Frequency	%	
Gender					
Male	78	60.5%	51	39.5%	0.526
Female	119	64.0%	67	36.0%	
Age					
Less than 30	107	56.6%	82	43.4%	0.008
30 years or more	90	71.4%	36	28.6%	
Level of residency training					
Junior Resident (R1, R2)	61	60.4%	40	39.6%	0.589
Senior Resident (R3, R4)	136	63.6%	78	36.4%	
Years of experience					
Less than 3 years	75	59.5%	51	40.5%	0.367
3 years or more	122	64.6%	67	35.4%	

Table 25: Relation of physicians' knowledge about edema as a CKD complication with demographic and professional characteristics

Variable	Yes		No or I don't know		P-value
	Frequency	%	Frequency	%	
Gender					
Male	126	97.7%	3	2.3%	0.181
Female	176	94.6%	10	5.4%	
Age					
Less than 30	178	94.2%	11	5.8%	0.064
30 years or more	124	98.4%	2	1.6%	
Level of residency training					
Junior Resident (R1, R2)	92	91.1%	9	8.9%	0.003
Senior Resident (R3, R4)	210	98.1%	4	1.9%	
Years of experience					
Less than 3 years	117	92.9%	9	7.1%	0.028
3 years or more	185	97.9%	4	2.1%	

Table 26: Relation of physicians' knowledge about nausea and vomiting as CKD complications with demographic and professional characteristics

Variable	Yes		No or I don't know		P-value
	Frequency	%	Frequency	%	
Gender					
Male	103	79.8%	26	20.2%	0.205
Female	137	73.7%	49	26.3%	
Age					
Less than 30	137	72.5%	52	27.5%	0.059
30 years or more	103	81.7%	23	18.3%	
Level of residency training					
Junior Resident (R1, R2)	74	73.3%	27	26.7%	0.403
Senior Resident (R3, R4)	166	77.6%	48	22.4%	
Years of experience					
Less than 3 years	86	68.3%	40	31.7%	0.007
3 years or more	154	81.5%	35	18.5%	

Table 27: Relation of physicians' knowledge about coma as a CKD complication with demographic and professional characteristics

Variable	Yes		No or I don't know		P-value
	Frequency	%	Frequency	%	
Gender					
Male	109	84.5%	20	15.5%	0.267
Female	148	79.6%	38	20.4%	
Age					
Less than 30	153	81.0%	36	19.0%	0.722
30 years or more	104	82.5%	22	17.5%	
Level of residency training					
Junior Resident (R1, R2)	78	77.2%	23	22.8%	0.170
Senior Resident (R3, R4)	179	83.6%	35	16.4%	
Years of experience					
Less than 3 years	98	77.8%	28	22.2%	0.154
3 years or more	159	84.1%	30	15.9%	

Table 28: Relation of physicians' knowledge about peritoneal dialysis as a form of RRT with demographic and professional characteristics

Variable	Yes		No or I don't know		P-value
	Frequency	%	Frequency	%	
Gender					
Male	107	82.9%	22	17.1%	0.633
Female	158	84.9%	28	15.1%	
Age					
Less than 30	158	83.6%	31	16.4%	0.753
30 years or more	107	84.9%	19	15.1%	
Level of residency training					
Junior Resident (R1, R2)	84	83.2%	17	16.8%	0.749
Senior Resident (R3, R4)	181	84.6%	33	15.4%	
Years of experience					
Less than 3 years	103	81.7%	23	18.3%	0.345
3 years or more	162	85.7%	27	14.3%	

Table 29: Relation of physicians' knowledge about kidney transplant as a form of RRT with demographic and professional characteristics

Variable	Yes		No or I don't know		P-value
	Frequency	%	Frequency	%	
Gender					
Male	119	92.2%	10	7.8%	0.395
Female	176	94.6%	10	5.4%	
Age					
Less than 30	176	93.1%	13	6.9%	0.637
30 years or more	119	94.4%	7	5.6%	
Level of residency training					
Junior Resident (R1, R2)	92	91.1%	9	8.9%	0.200
Senior Resident (R3, R4)	203	94.9%	11	5.1%	
Years of experience					
Less than 3 years	115	91.3%	11	8.7%	0.157
3 years or more	180	95.2%	9	4.8%	

of appropriate time for referring a diagnosed CKD patient, level of residency training showed a significant association ($P = 0.022$), and other variables showed no significance [Table 38].

Logistic Regression Analysis of Variables Related to Classification of CKD

In respect to the classification of CKD variable that showed a significant association with level of residency training and years of experience in cross tabulation, when they analyzed through regression model, no significant correlation was detected [Table 39].

Logistic Regression Analysis of Variables Related to Risk Factors and Complications of CKD

Among the risk-factor variables that showed significant association in cross tabulation with, when they analyzed

Table 30: Relation of physicians' knowledge about hemodialysis as a form of RRT with demographic and professional characteristics

Variable	Yes		No or I don't know		P-value
	Frequency	%	Frequency	%	
Gender					
Male	120	93.0%	9	7.0%	0.704
Female	175	94.1%	11	5.9%	
Age					
Less than 30	178	94.2%	11	5.8%	0.637
30 years or more	117	92.9%	9	7.1%	
Level of residency training					
Junior Resident (R1, R2)	93	92.1%	8	7.9%	0.432
Senior Resident (R3, R4)	202	94.4%	12	5.6%	
Years of experience					
Less than 3 years	116	92.1%	10	7.9%	0.346
3 years or more	179	94.7%	10	5.3%	

Table 31: Relation of physicians' attitude toward a patient at risk of developing CKD with demographic and professional characteristics

Variable	Right answer*		wrong answers**		P-value
	Frequency	%	Frequency	%	
Gender					
Male	121	93.8%	8	6.2%	0.756
Female	176	94.6%	10	5.4%	
Age					
Less than 30	178	94.2%	11	5.8%	0.921
30 years or more	119	94.4%	7	5.6%	
Level of residency training					
Junior Resident (R1, R2)	94	93.1%	7	6.9%	0.523
Senior Resident (R3, R4)	203	94.9%	11	5.1%	
Years of experience					
Less than 3 years	118	93.7%	8	6.3%	0.692
3 years or more	179	94.7%	10	5.3%	

*Right answer: Routine screening for CKD and management of risk factors.

**Wrong answers:

-Watchful waiting/No change in attitude

-I don't know

through a regression model, glomerulonephritis as a risk factor showed a significant association with gender (OR: 3.03, $P = 0.008$), HIV as a risk factor with age (OR: 2.6, $P = 0.000$), and hepatitis with age (OR: 2, $P = 0.009$) [Tables 40-43].

Regarding complication variables that showed a significant association with using of cross-tabulation model, after using of regression model, anemia as a CKD complication showed a significant association with level of residency training (OR: 9.522, $P = 0.011$), uremia with age (OR: 8.5, $P = 0.041$), osteodystrophy with age (OR: 1.9, $P = 0.008$), and nausea/vomiting with years of experience (OR: 2.05, $P = 0.007$) [Tables 44-48].

Table 32: Relation of physicians' responds to a question of screening frequency for a patient at risk of developing CKD with demographic and professional characteristics

Variable	annually		other answers*		P-value
	Frequency	%	Frequency	%	
Gender					
Male	65	50.4%	64	49.6%	0.620
Female	99	53.2%	87	46.8%	
Age					
Less than 30	96	50.8%	93	49.2%	0.581
30 years or more	68	54.0%	58	46.0%	
Level of residency training					
Junior Resident (R1, R2)	49	48.5%	52	51.5%	0.386
Senior Resident (R3, R4)	115	53.7%	99	46.3%	
Years of experience					
Less than 3 years	65	51.6%	61	48.4%	0.890
3 years or more	99	52.4%	90	47.6%	

*Other answers:

--every month

-every 6 months

-never

Table 33:: Relation of physicians' responds regarding the most appropriate marker for Kidney function with demographic and professional characteristics

Variable	creatinine clearance		other tests*		P-value
	Frequency	%	Frequency	%	
Gender					
Male	117	90.7%	12	9.3%	0.256
Female	175	94.1%	11	5.9%	
Age					
Less than 30	172	91.0%	17	9.0%	0.157
30 years or more	120	95.2%	6	4.8%	
Level of residency training					
Junior Resident (R1, R2)	88	87.1%	13	12.9%	0.009
Senior Resident (R3, R4)	204	95.3%	10	4.7%	
Years of experience					
Less than 3 years	112	88.9%	14	11.1%	0.034
3 years or more	180	95.2%	9	4.8%	

Logistic Regression Analysis of Variables Related to Physicians' Attitudes toward Patients with High-risk of CKD

With using of regression analysis model on the variables that showed a significant association with the most appropriate kidney function marker through cross tabulation, no significant correlation was detected [Table 49].

Logistic Regression Analysis of Variables Related to the Needed Workup for Establishing CKD Diagnosis and Appropriate Time for Referral

In respect to the variables that showed a significant association with the needed investigations to diagnose CKD,

Table 34: Relation of physicians' responds to the need for serum creatinine as a routine workup test for CKD diagnosis

Variable	Yes		No		P-value
	Frequency	%	Frequency	%	
Gender					
Male	127	98.4%	2	1.6%	0.353
Female	180	96.8%	6	3.2%	
Age					
Less than 30	183	96.8%	6	3.2%	0.380
30 years or more	124	98.4%	2	1.6%	
Level of residency training					
Junior Resident (R1, R2)	97	96.0%	4	4.0%	0.271
Senior Resident (R3, R4)	210	98.1%	4	1.9%	
Years of experience					
Less than 3 years	122	96.8%	4	3.2%	0.559
3 years or more	185	97.9%	4	2.1%	

Table 35: Relation of physicians' responds to the need for urine analysis as a routine workup test for CKD diagnosis

Variable	Yes		No		P-value
	Frequency	%	Frequency	%	
Gender					
Male	88	68.2%	41	31.8%	0.001
Female	93	50.0%	93	50.0%	
Age					
Less than 30	103	54.5%	86	45.5%	0.193
30 years or more	78	61.9%	48	38.1%	
Level of residency training					
Junior Resident (R1, R2)	57	56.4%	44	43.6%	0.800
Senior Resident (R3, R4)	124	57.9%	90	42.1%	
Years of experience					
Less than 3 years	67	53.2%	59	46.8%	0.209
3 years or more	114	60.3%	75	39.7%	

only urine analysis showed an association with gender, and when it analyzed through regression model, it also showed a significant correlation (OR: 2.1, $P = 0.001$) [Table 50].

According to the appropriate time for referring CKD patient to the nephrologist, level of residency training showed a significant association with using cross-tabulation model, and it's confirmed with using of the regression model (OR: 1.749, $P = 0.023$) [Table 51].

DISCUSSION

The results of our study revealed that almost two-thirds (68.9%) of the physicians interviewed were able to appropriately define CKD. Nearly half (51.1%) recognized that CKD has five stages.

Table 36: Relation of physicians' responds to the need for urine analysis as a routine workup test for CKD diagnosis

Variable	Yes		No		P-value
	Frequency	%	Frequency	%	
Gender					
Male	125	96.9%	4	3.1%	0.378
Female	183	98.4%	3	1.6%	
Age					
Less than 30	184	97.4%	5	2.6%	0.533
30 years or more	124	98.4%	2	1.6%	
Level of residency training					
Junior Resident (R1, R2)	97	96.0%	4	4.0%	0.151
Senior Resident (R3, R4)	211	98.6%	3	1.4%	
Years of experience					
Less than 3 years	122	96.8%	4	3.2%	0.349
3 years or more	186	98.4%	3	1.6%	

Table 37: Relation of physicians' responds to the need for the ultrasound as a routine workup test for CKD diagnosis

Variable	Yes		No		P-value
	Frequency	%	Frequency	%	
Gender					
Male	71	55.0%	58	45.0%	0.286
Female	91	48.9%	95	51.1%	
Age					
Less than 30	98	51.9%	91	48.1%	0.854
30 years or more	64	50.8%	62	49.2%	
Level of residency training					
Junior Resident (R1, R2)	59	58.4%	42	41.6%	0.088
Senior Resident (R3, R4)	103	48.1%	111	51.9%	
Years of experience					
Less than 3 years	68	54.0%	58	46.0%	0.462
3 years or more	94	49.7%	95	50.3%	

Based on data analysis, we observed that: The vast majority of physicians (>94%) were able to recognize, the major listed risk factors of CKD, HIV, and hepatitis infections as risk factors were less familiar by participants (41% and 28.3%, respectively). Regarding of CKD complications, the majority of physicians (89%) were aware of main complications of CKD, except for osteodystrophy which was recognized by only 62.5% of physicians.

Majority of participants (total average 90.5%) were able to identify hemodialysis, renal transplant, and peritoneal dialysis as forms of RRT.

As per the attitude toward high-risk patients for CKD, most of the physicians (94.3%) agreed that routine screening should be done, and risk factors should be managed when

Table 38: Relation of physicians' responds to the appropriate time of referring CKD patient to the nephrologist

Variable	early referral		late referral		P-value
	Frequency	%	Frequency	%	
Gender					
Male	77	59.7%	52	40.3%	0.564
Female	117	62.9%	69	37.1%	
Age					
Less than 30	114	60.3%	75	39.7%	0.570
30 years or more	80	63.5%	46	36.5%	
Level of residency training					
Junior Resident (R1, R2)	53	52.5%	48	47.5%	0.022
Senior Resident (R3, R4)	141	65.9%	73	34.1%	
Years of experience					
Less than 3 years	72	57.1%	54	42.9%	0.185
3 years or more	122	64.6%	67	35.4%	

Table 39: Logistic regression of variables affecting the classification of CKD

Variable	Odds ratio	p-value	95% confidence interval	
Level of residency training	1.531	0.195	0.343	1.244
Years of experience	1.326	0.366	0.719	2.447

Table 40: Logistic regression of variables affecting physicians' knowledge about certain drugs as CKD risk factor

Variable	Odds ratio	p-value	95% confidence interval	
Years of experience	1.794	0.304	0.589	5.469

Table 41: Logistic regression of variables affecting physicians' knowledge about glomerulonephritis as a CKD risk factor

Variable	Odds ratio	p-value	95% confidence interval	
Gender	3.025	0.008	1.342	6.819

Table 42: Logistic regression of variables affecting physicians' knowledge about HIV as a CKD risk factor

Variable	Odds ratio	p-value	95% confidence interval	
Age	2.629	0.000	1.55	4.440
Level of residency training	1.863	0.074	0.271	1.063
Years of experience	0.955	0.893	0.487	1.872

it possible. The highest percentage of physicians (92.7%) agrees that the most appropriate marker for kidney function is creatinine clearance/eGFR.

Table 43: Logistic regression of variables affecting physicians' knowledge about hepatitis as a CKD risk factor

Variable	Odds ratio	p-value	95% confidence interval	
Gender	1.560	0.091	0.931	2.612
Age	1.994	0.009	1.191	3.337

Table 44: Logistic regression of variables affecting physicians' knowledge about anemia as a CKD complication

Variable	Odds ratio	p-value	95% confidence interval	
Level of residency training	9.522	0.011	0.019	0.594
Years of experience	0.866	0.860	0.175	4.292

Table 45: Logistic regression of variables affecting physicians' knowledge about uremia as a CKD complication

Variable	Odds ratio	p-value	95% confidence interval	
Age	8.475	0.041	1.088	66.015

Table 46: Logistic regression of variables affecting physicians' knowledge about osteodystrophy as a CKD complication

Variable	Odds ratio	p-value	95% confidence interval	
Age	1.916	0.008	1.183	3.102

Table 47: Logistic regression of variables affecting physicians' knowledge about edema as a CKD complication

Variable	Odds ratio	p-value	95% confidence interval	
Level of residency training	4.250	0.089	0.044	1.245
Years of experience	1.310	0.751	0.247	6.966

In respect to the attitude of physicians toward making a diagnosis of CKD and referring of patient when it needed, only one participant (0.3%) chose to depend on serum creatinine alone, 23.5% chose to rely on only serum creatinine and eGFR, (34.3%) chose to combine the serum creatinine, eGFR, a urinalysis, and abdominal ultrasound scan to make the diagnosis of CKD. Overall, 97.8% selected the eGFR alone or with other tests as the appropriate means of diagnosis. However, concerning the appropriate time of referral, more than one-third of physicians (38.4%) chose to refer at the late stage or did not know when to refer.

There is a highly estimated prevalence of CKD in KSA,^[3] which may be explained by higher prevalence and incidence of the major risk factors of CKD: DM, HTN, and obesity

Table 48: Logistic regression of variables affecting physicians' knowledge about nausea/vomiting as a CKD complication

Variable	Odds ratio	p-value	95% confidence interval	
Years of experience	2.047	0.007	1.211	3.459

Table 49: Logistic regression of variables affecting physicians' choice of most appropriate marker for Kidney function

Variable	Odds ratio	p-value	95% confidence interval	
Level of residency training	2.415	0.150	0.125	1.375
Years of experience	1.373	0.609	0.407	4.631

Table 50: Logistic regression of variables affecting physicians' choice of using urine analysis as a routine workup test for CKD diagnosis

Variable	Odds ratio	p-value	95% confidence interval	
Gender	2.146	0.001	1.343	3.431

Table 51: Logistic regression of variables affecting physicians' choice about appropriate of referral time

Variable	Odds ratio	p-value	95% confidence interval	
Level of residency training	1.749	0.023	0.353	0.926

in our area.^[4-6] Many of undiagnosed CKD patients are seen by family physicians and internists. Undetected and by far untreated CKD patients may end up with the end-stage renal disease, in which it's associated with increased cardiovascular morbidity and all-cause mortality. Being aware of the KDOQI definition of CKD is required to be able to make the diagnosis of CKD.^[12] Different studies related to CKD diagnosis showed low rates in other countries varying from 38.8% among non-nephrology specialists in Nigeria,^[13] 48.8% in Pakistan,^[14] and 58.8% among non-nephrology physicians in Cameroon.^[8] In our study, the rate was relatively better (68.9%), but still, it suggests there is a knowledge gap about this point.

On the other hand, being familiar with the classification of CKD into five stages based on KDOQI guidelines (or other convenient guidelines) is vitally important and required in the management of CKD patients. Our study reveals that only half (51.1%) of family physicians in our area were able to identify correct classification. Rates reported in other studies varying from 42% in Nigeria,^[13] 44% in Cameroon,^[8] and 73% in Pakistan.^[14] A systematic review published in 2011 showed that calculation of eGFR

automatically through laboratory systems and staging of condition accordingly may improve early identification of CKD patients and increase physicians' awareness on CKD staging.^[15] It's, therefore, reasonably should be applied to enhance CKD outcomes.

Awareness of physicians about CKD risk factors is important and necessary for identification and screening patients who are at increased risk for CKD. Majority FM residents (>94%) in our area were able to identify common of these risk factors. Similar rates have been reported in Nigeria^[13] and American physicians.^[16] According to logistic regression analysis, female physicians were 3 times more likely to be aware of glomerulonephritis as a CKD risk factor than male physicians, and physicians who are older than 30 years more likely to be aware of HIV and hepatitis infections as CKD risk factors than who are younger. This could be explained by personal experiences and differences in the rate of exposure. Similarly, most physicians were able to identify the common complications of CKD. According to our study results, senior residents are 9 times more likely to recognize anemia as a CKD complication than junior residents, and physicians with age of >30 years are more likely to recognize uremia and osteodystrophy than who are younger by 8.5 and 2 times, respectively. Physicians who have a clinical practice experience for 3 years or more are 2 times more likely to know about nausea/vomiting as progressive consequences of CKD than those with fewer years of experience. Again, this could be related to the differences in personal experiences and rate of exposure to patients.

A further important aspect related to diagnosing and management of CKD is the attitude of physicians toward patients who are at high risk for CKD. Results of this study show that the majority of FM residents agreed routine screening for CKD is needed, and risk factors should be managed when it possible. According to KDOQI guidelines, the appropriate time interval for regular screening of these patients is annually.^[12] Our results show that 52% of FM residents chose the appropriate interval (annually), while 38.4% chose to screen high-risk patients every 6 months.

The creatinine clearance should be estimated based on eGFR according to the KDOQI guidelines.^[12] The vast majority of FM residents (97.8%) in our area consider using of eGFR to make a diagnosis of CKD which is a positive clinical implication. Only 0.3% of our admitted relying on serum creatinine only for diagnosis of CKD physicians, compared to 12.7% reported in other areas.^[8] This is an important indicator related to early diagnosing of CKD, as the serum creatinine may be related to significant false negatives in the purpose of CKD identification. According

to our results, female physicians are 2 times more likely to order urine analysis in the purpose of CKD diagnosis than male physicians.

Evidence suggests that early detecting, referring diagnosed patients with CKD for nephrology consultation, and start treatment with ACE inhibitors and angiotensin receptor blockers may decrease some of the adverse outcomes related to CKD and by far improve the prognosis of the condition.^[17,18] The reported rate of late referral defined as eGFR <30 ml/min/1.73 m² according to KDOQI guidelines.^[12] Results of our study showed more than one-third (38.9%) of FM residents in our area chose to either refer patients late or did not know when to refer.

Results show that senior residents are 1.8 times more likely to refer CKD patients earlier than junior residents. This may explain why the rate of delaying is relatively high, as one-third of participants are junior residents, and lack of knowledge and experience regarding diagnosing and management of CKD could have a role.

CONCLUSION AND RECOMMENDATIONS

Prevention and early detection are the cornerstones of CKD management. Our study helps to focus on demanding areas in CKD management, where we should work on to improve the outcome for our patients in Saudi Arabia. In general, FM residents have good knowledge regarding CKD risk factors and complications, appropriate action toward high-risk patients for CKD, different forms of RRT, and appropriate markers to diagnose and assess of kidney function. However, important knowledge gaps related to the definition, classification, and timing of referring are noted. Our study recommends that continuous medical education is needed to fulfill these knowledge gaps. Furthermore, automated eGFR calculation and staging accordingly by laboratories based on serum creatinine result may contribute in raising up of physicians' awareness toward CKD classification and by far promote early referral of patients.

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