Assessment of CKD Knowledge Among Internal Medicine Residents in Saudi Arabia, A Multi-Centric Cross-Sectional Study

Adublrahman Mohammed Alanazi,MD* Sulaiman Mohammed Al-Zamel, MBBS** Mashael Khalid Al-Ghanem, MBBS*** Badr abdulatif alobaida,MD**** Salman Khalid Almutairi,MD***** Majed Abdulrahman Alsharidah,MD****** Yazeed Naif Alabbadi,MD****** Talal Hamad Alanazi,MD******* Mohammad A. Alhajery,MD******** Enad Alsolami,MD ********* Eysa Alsolamy,MD**********

ABSTRACT

Background: Chronic Kidney Disease (CKD) is a significant public health concern, that demands comprehensive understanding and management from healthcare professionals. This study aimed to assess the knowledge levels of internal medicine residents regarding CKD clinical practice guidelines, considering demographic and practice characteristics as potential influencing factors.

Methodology: A cross-sectional survey was conducted among 159 internal medicine residents. The survey included questions related to demographic information, clinical exposure, educational experiences, and awareness of CKD definition, risk factors, and management guidelines. Data were analyzed using appropriate statistical tests to identify associations between knowledge levels and demographic variables.

Results: The demographic characteristics of the participants revealed a diverse sample in terms of gender, residency level, geographical location, and graduation year. Most of residents demonstrated an adequate overall knowledge of CKD clinical practice guidelines. However, variations in knowledge were observed across different demographic and practice characteristics. Gender, residency level, geographical location, graduation year, medical training outside Saudi Arabia, clinical exposure, and nephrology rotations influence knowledge levels. Notably, residents with clinical exposure and those undertaking nephrology rotations demonstrated higher knowledge levels.

Conclusion: This study provides valuable insights into the knowledge levels of internal medicine residents regarding CKD clinical practice guidelines. The findings underscore the impact of demographic and practice characteristics on residents' knowledge and highlight areas where targeted educational interventions may be beneficial. Addressing these knowledge gaps is crucial for enhancing the competency of internal medicine residents in nephrology-related concepts and delivering high-quality care for individuals with CKD. Future research could explore specific educational strategies that prove effective in improving residents' understanding of CKD and assess the long-term impact of enhanced knowledge on clinical practice and patient outcomes.

*	Assistant Professor Department of Internal Medicine, College of Medicine Imam Mohammad Ibn Saud Islamic University, Riyadh, Saudi Arabia. Email :amalanazi@imamu.edu.sa
**	College of Medicine, Imam Mohammad Ibn Saud Islamic University, Riyadh.
***	Medical Student, College of Medicine Imam Mohammad Ibn Saud Islamic University, Riyadh.
****	King Fahad Medical City Internal Medicine Department, Saudi Arabia.
*****	Prince Sultan Military Medical City, Internal Medicine Department
******	King Saud Medical city, Internal Medicine Department
******	King Saud Medical City, Internal Medicine Department
*******	Jordan University of Science and Technology: Irbid, JO
********	Assistant Professor, Department of Internal Medicine College of Medicine, Imam Mohammad Ibn Saud Islamic University Riyadh, Saudi Arabia.
*********	Assistant Professor, Department of Internal Medicine College of Medicine, University of Jeddah, Jeddah, Saudi Arabia.
**********	Assistant Professor, Department of Internal Medicine College of Medicine, Imam Mohammad Ibn Saud Islamic University Riyadh, Saudi Arabia.

INTRODUCTION

Chronic kidney disease, according to the (CDC) is a condition in which the kidney function is impaired and cannot remove waste products from the blood, and affected patients can be vulnerable to complications, such as heart disease, stroke, anemia, risk of infection, electrolyte disturbance, loss or poor appetite, depression[1]. CKD can be diagnosed if the patient has one or more of the following for more than three months: [1] GFR less than 60 ml/min/1.73 m2;[2] albuminuria (i.e., urine albumin ≥ 30mg per 24 hours or urine albumin-to-creatinine ratio (ACR) ≥ 30mg/g;[3] abnormalities in urine sediment, histology, or imaging suggestive of kidney damage; [4] renal tubular disorders;[5] history of kidney transplantation [2]. The prevalence of chronic kidney disease globally is estimated to be 13.4% (11.7 – 15.1%), and end-stage kidney disease patients who require renal replacement therapy are estimated to be between 4.9 and 7 million[3]. In Saudi Arabia, the prevalence of CKD among young adults was found to be around 5.7%[4]. The increased prevalence of diabetes, hypertension, obesity, and aging are leading causes that increase the incidence of CKD worldwide[3]. This study aims to measure the awareness and knowledge of clinical practice guidelines for CKD among internal medicine residents and to assess the need for further education regarding CKD management.

METHODOLOGY

In this cross-sectional study, conducted in governmental and private Saudi hospitals, we aimed to assess the awareness and knowledge of chronic kidney disease (CKD) clinical practice guidelines among internal medicine residents. A random sample of current internal medicine residents enrolled in Saudi board programs was included, totaling at least 100 participants with complete and valid questionnaires. The study design involved the distribution of an electronic questionnaire through Google Forms to various internal medicine residency programs. The questionnaire consisted of demographic inquiries, such as education level, gender, province, and hospital type (governmental vs. private), alongside questions addressing residents' interest in nephrology as a future career and the number of nephrology rotations undertaken. Clinical vignettes with multiple-choice questions were incorporated to evaluate participants' knowledge of CKD definition, classification, risk factors, laboratory evaluation, management, complications, and referral practices.

Following email communication and approval, permission was secured from the original authors, Varun Agrawal et al., to adapt the survey instrument. Ethical considerations were paramount., Approval from Imam Mohammad ibn Saud Islamic University's institutional review board (IRB) was obtained, ensuring adherence to IRB standards. Participants were informed of the study's objectives, and explicit consent was obtained. Confidentiality was maintained by storing survey responses in a password-protected electronic format.

Data analysis utilized the Statistical Package for Social Science (SPSS), and statistical significance was set at a p-value less than 0.05. Frequency and percentage were used to describe the categorical variables. Chi t-test, t-test, and ANOVA test were used to assess the relation between demographic factors and level of knowledge. All questions will be scored 1 for correct answers and 0 for wrong ones, resulting in a score between 0 and 36. Those who answered more than two-thirds of the questions correctly were classified as having adequate knowledge. The results were presented in tables and graphs to enhance readability.

RESULTS

The demographic characteristics of the participants are summarized in Table 1. Of the 159 internal medicine residents surveyed, 60.4% were male, and 39.6% were female. The distribution across residency levels revealed that 50.3% were in their first year (R1), 32.7% in the second year (R2), 6.9% in the third year (R3), 4.4% in the fourth year (R4), and 5.7% were attending physicians. Geographically, participants were spread across the Central (33.3%), Eastern (11.3%), Northern (17.0%), Western (17.0%), and Southern (21.4%) provinces. Graduation years ranged from 2015 to 2022, with the majority graduating in 2020 (30.2%) and 2022 (24.5%). Most participants (80.5%) had yet to undergo medical training outside Saudi Arabia. Regarding clinical exposure, 84.9% reported seeing patients in a chronic kidney disease clinic, and 61.6% had undertaken nephrology rotations, with varying durations. A notable 62.3% reported the availability of a nephrology three programs at their hospitals. Elective experiences in nephrology were reported by 23.9% of participants, while 36.5% expressed interest in nephrology as a future career.

Table 2 outlines residents' awareness of CKD definition, risk factors, and laboratory evaluation. In response to a clinical vignette, 45.9% correctly identified the need for repeated urine tests for proteinuria to diagnose CKD, while 30.8% incorrectly associated CKD with a GFR <60. When asked about the estimated GFR in CKD stage III, 39.0% correctly chose 30-60 ml/min/1.73m². The majority correctly identified established CKD risk factors such as age >60, diabetes mellitus, hypertension, obesity, systemic lupus erythematosus (SLE), daily NSAID use, and family history. Regarding laboratory evaluation, 90.5% recognized the importance of urinalysis with microscopic analysis, and 86.1% correctly endorsed using random urine albumin-creatinine or protein-creatinine ratio for assessing individuals at increased risk of CKD.

Table 3 presents the resident's awareness of goal blood pressure (BP), clinical action plans, and chronic kidney disease (CKD) complications. When assessing the goal BP for a 52-year-old woman with type 2 diabetes and microalbuminuria, 40.9% correctly identified the target as <130/80 mmHg, while other responses varied. Regarding appropriate nephrology consultation, 41.5% recommended referral due to uncontrolled BP despite antihypertensive therapy, while 35.2% suggested referral for a GFR <30, and 20.1% for hyperkalemia. A minority (3.1%) deemed nephrology consultation unnecessary. The clinical action plan for the presented case showed notable awareness, with 91.8% choosing to initiate ACE/ARB therapy for CKD. Additionally, respondents recognized the significance of dietary salt restriction (89.2%), lipid control (83.5%), glycemic control (88.6%), weight loss (84.8%), and smoking cessation (84.2%) in managing CKD. When identifying medications to reduce proteinuria independently of blood pressure, 87.4% correctly indicated ACE inhibitors/ARBs, while other options showed lower recognition. Exploring the participants' awareness of potential complications associated with CKD at an eGFR of 60 mL/min/1.73 m², responses varied. Notably, 89.9% identified anemia, 86.2% recognized bone disease, and 84.9% acknowledged malnutrition as a potential complication. Other complications, such as coronary artery disease (76.1%), stroke (79.2%), increased risk of diabetic complications (84.3%), and medication complications (81.8%), were also appropriately recognized by the majority.

Figure 1 provides an overview of the overall knowledge level among participants. A significant proportion, 68.6%, demonstrated adequate knowledge, while 31.4% had inadequate knowledge regarding CKD clinical practice guidelines.

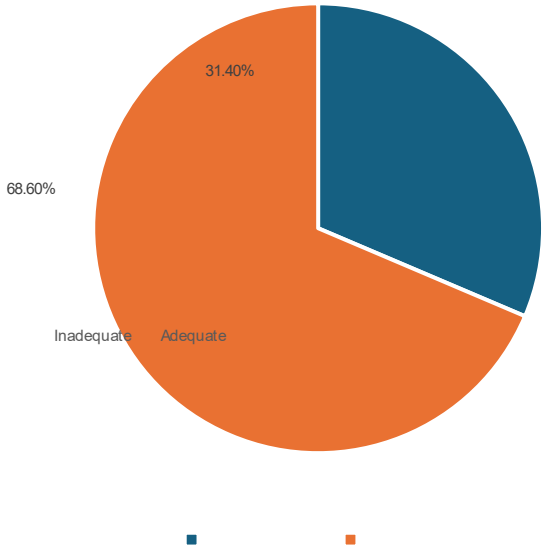

Figure 1. Level of knowledge among the participants

Table 1. Demographic factors of the participants

		Count	Column N %
Gender	Male	96	60.4%
	Female	63	39.6%
Which year of residency are you?	R1	80	50.3%
	R2	52	32.7%
	R3	11	6.9%
	R4	7	4.4%
	Attending	9	5.7%
Where is your center located at?	Central province	53	33.3%
	Eastern province	18	11.3%
	Northern province	27	17.0%
	Western province	27	17.0%
	Southern province	34	21.4%
Graduation year?	2015	1	0.6%
	2016	1	0.6%
	2017	4	2.5%
	2018	8	5.0%
	2019	21	13.2%
	2020	48	30.2%
	2021	37	23.3%
	2022	39	24.5%
Did you have any medical training outside of Saudi Arabia? If yes, mention which level.	No, I have not taken any medical training outside of Saudi Arabia	128	80.5%
	Medical school	10	6.3%
	Fellowship	2	1.3%
	Residency	19	11.9%
Do you see patients in a chronic kidney disease clinic?	No	24	15.1%
	Yes	135	84.9%
Did you take a nephrology rotation?	No	61	38.4%
	Yes	98	61.6%
For how many months did you take your nephrology rotations?	I have not taken any nephrology rotations yet	59	37.1%
	1 months	44	27.7%
	2 months	42	26.4%
	3 months	8	5.0%
	4 months	6	3.8%
Do you have a nephrology 3 program at your hospital?	No	60	37.7%
	Yes	99	62.3%
Have you taken an elective in nephrology?	No	121	76.1%
	Yes	38	23.9%
Are you interested in nephrology as a future career?	No	101	63.5%
	Yes	58	36.5%

Table 2. Resident Awareness of Definition, Risk Factors, and Laboratory Evaluation of CKD

		Count	Column N %
You have a 49-year-old African American male patient in your medicine clinic. He is not hypertensive or diabetic.	He has CKD because he has proteinuria tested twice	26	16.4%
	He needs to have his urine tested again for proteinuria because 3 abnormal urine tests suggest CKD	73	45.9%
	He needs to have GFR <60 to have CKD	49	30.8%
	I don't know	11	6.9%
What is the estimated glomerular filtration rate in a patient with chronic kidney disease (CKD), stage III?	30-60 ml/min/1.73m2	62	39.0%
	15-30 ml/min/1.73m2	32	20.1%
	60-90 ml/min/1.73m2	9	5.7%
	<15 ml/min/1.73m2	56	35.2%
Risk factors for CKD	Age> 60	135	84.9%
	African American/ Hispanic	134	84.3%
	DM	156	98.1%
	Hypertension	157	98.7%
	Obesity	145	91.2%
	systemic lupus erythematosus (SLE)	139	87.4%
	daily NSAIDs	141	88.7%
	family history of CKD	152	95.6%
Laboratory evaluation of persons at increased risk of CKD	Serum creatinine alone	47	29.7%
	Serum creatinine to estimate GFR	134	84.8%
	Urinalysis with microscopic analysis	143	90.5%
	Urine dipsticks to estimate protein or albumin	135	85.4%
	Random urine albumin or protein	126	79.7%
	Random urine albumin-creatinine or protein-creatinine ratio	136	86.1%

Table 3. Resident Awareness of Goal BP, Clinical Action Plan, and Complications of CKD

A 52-year-old Caucasian woman with type 2 diabetes mellitus comes to you with BP of 148/92 mm Hg and the following laboratory test results: serum creatinine, 0.9 mg/dL; eGFR, 70 mL/min/1.73 m2 ; and urine study, microalbuminuria (urine albumin-creatinine ratio, 58 mg/g). What is the goal BP in this patient?

		Count	Column N %
What is the goal BP in this patient?	<130/80 mmHg	65	40.9%
	<135/80 mmHg	29	18.2%
	<125/75 mmHg	10	6.3%
	<135/85 mmHg	27	17.0%
	<140/90 mmHg	28	17.6%
What is the appropriate action regarding nephrology consultation?	Refer to nephrologist as he has GFR <30	56	35.2%
	Refer to nephrologist as he has hyperkalemia.	32	20.1%
	Refer to nephrologist as he has uncontrolled BP despite being on 4 antihypertensives	66	41.5%
	He does not need a nephrology consult	5	3.1%
What is the clinical action plan for this patient?	start her on ACE/ARB for her CKD	145	91.8%
	dietary salt restriction <2.4g/d for her CKD	141	89.2%
	lipid control for her CKD	132	83.5%
	glycemic control for her CKD	140	88.6%
	weight loss for her CKD	134	84.8%
	smoking cessation for her CKD	133	84.2%
Which medications help reduce proteinuria independent of its effect on BP?	ACE inhibitor/ARB	139	87.4%
	Diuretics	115	72.3%
	Non-dihydropyridine calcium channel blocker	107	67.3%
	Dihydropyridine calcium channel blocker	110	69.2%
	B-Blockers	96	60.4%
What are the potential complications of CKD for eGFR 60 mL/min/1.73 m2 ?	Anemia	143	89.9%
	Bone disease	137	86.2%
	Coronary artery disease	121	76.1%
	Stroke	126	79.2%
	Malnutrition	135	84.9%
	Increased risk of such diabetic complications as retinopathy	134	84.3%
	Medication complications (e.g., acute renal failure)	130	81.8%

Table 4. The relation between knowledge level and demographic and practice characteristics

		Knowledge				
		Inadequate		Adequate		P-value
		Count	Row N %	Count	Row N %	
Gender?	Male	34	35.4%	62	64.6%	0.183
	Female	16	25.4%	47	74.6%	
Which year of residency are you?	R1	30	37.5%	50	62.5%	0.019*
	R2	12	23.1%	40	76.9%	
	R3	1	9.1%	10	90.9%	
	R4	1	14.3%	6	85.7%	
	Attending	6	66.7%	3	33.3%	
Where is your center located at?	Central province	24	45.3%	29	54.7%	0.001*
	Eastern province	9	50.0%	9	50.0%	
	Northern province	10	37.0%	17	63.0%	
	Western province	3	11.1%	24	88.9%	
	Southern province	4	11.8%	30	88.2%	
Graduation year?	2015	0	0.0%	1	100.0%	0.002*
	2016	0	0.0%	1	100.0%	
	2017	0	0.0%	4	100.0%	
	2018	2	25.0%	6	75.0%	
	2019	5	23.8%	16	76.2%	
	2020	10	20.8%	38	79.2%	
	2021	9	24.3%	28	75.7%	
	2022	24	61.5%	15	38.5%	
Did you have any medical training outside of Saudi Arabia? If yes, mention which level.	No, I have not taken any medical training outside of Saudi Arabia	45	35.2%	83	64.8%	0.017*
	Medical school	4	40.0%	6	60.0%	
	Fellowship	1	50.0%	1	50.0%	
	Residency	0	0.0%	19	100.0%	
Do you see patients in a chronic kidney disease clinic?	No	11	45.8%	13	54.2%	0.099
	Yes	39	28.9%	96	71.1%	
Did you take a nephrology rotation?	No	35	57.4%	26	42.6%	0.000*
	Yes	15	15.3%	83	84.7%	
For how many months did you take your nephrology rotations?	I have not taken any nephrology rotations yet	34	57.6%	25	42.4%	0.000*
	1 months	5	11.4%	39	88.6%	
	2 months	9	21.4%	33	78.6%	
	3 months	1	12.5%	7	87.5%	
	4 months	1	16.7%	5	83.3%	
Do you have a nephrology 3 program at your hospital?	No	19	31.7%	41	68.3%	0.963
	Yes	31	31.3%	68	68.7%	
Have you taken an elective in nephrology?	No	42	34.7%	79	65.3%	0.114
	Yes	8	21.1%	30	78.9%	
Are you interested in nephrology as a future career?	No	33	32.7%	68	67.3%	0.660
	Yes	17	29.3%	41	70.7%	

Examining gender differences, 35.4% of males had inadequate knowledge compared to 25.4% of females, with no statistically significant difference (p = 0.183). However, significant associations were found when considering the year of residency. Residents in earlier stages, particularly R1 (37.5%), showed a higher proportion of inadequate knowledge compared to R2 (23.1%), R3 (9.1%) and R4 (14.3%), while attending physicians showed the lowest level of knowledge (66.7%) (p = 0.019). Geographical location demonstrated a significant impact on knowledge, with residents in the Western (11.1%) and Southern (11.8%) provinces exhibiting lower inadequate knowledge compared to those in the Central (45.3%), Eastern (50.0%), and Northern (37.0%) provinces (p = 0.001). The graduation year also demonstrated a correlation with knowledge levels. Residents graduating in 2015 (100.0%), 2016 (100.0%), and 2017 (100.0%) exhibited adequate knowledge, while those in later years, notably 2022 (61.5%), had a higher proportion of inadequate knowledge (p = 0.002). Having undergone medical training outside of Saudi Arabia also showed a significant association, with residents without such training demonstrating adequate knowledge (64.8%) than those with training (35.2%) (p = 0.017). Regarding clinical exposure, residents who did not see patients in a CKD clinic tended to have higher rates of inadequate knowledge (45.8%) compared to those who did (28.9%) (p = 0.099). Similarly, those who had not taken a nephrology rotation (57.4%) or had not taken it for a specific duration demonstrated higher rates of inadequate knowledge compared to their counterparts who had taken rotations (p = 0.000). The presence of a nephrology three programs,

elective experience in nephrology, and interest in nephrology as a future career did not show significant associations with knowledge levels.

DISCUSSION

Chronic kidney disease (CKD) is a prevalent and burdensome condition that requires nuanced understanding and management [2,5]. This study aimed to assess the knowledge level of internal medicine residents regarding CKD clinical practice guidelines.

Notably, a significant proportion correctly identified the need for repeated urine tests for proteinuria to diagnose CKD. However, a considerable number incorrectly associated CKD with a GFR <60, indicating potential misconceptions that should be addressed through targeted educational interventions. A survey conducted in Cameroon, found that only 58.8% of physicians correctly defined Chronic Kidney Disease (CKD)[6]. Similar assessments in other developing countries revealed even lower levels of knowledge among physicians. For instance, only 38.8% of respondents from West Africa provided an accurate definition of CKD. In Pakistan, 38% of physicians were aware that the Glomerular Filtration Rate (GFR) could be utilized to identify CKD[7,8]. These findings underscore the need for targeted efforts to improve physicians' understanding of CKD across diverse healthcare settings. Knowledge of methods for early detection of CKD (with such markers of kidney damage as proteinuria) and CKD stages will allow an appropriate clinical action plan to be formulated [9].

Regarding risk factors for CKD, participants showed a commendable understanding of established factors such as age >60, diabetes mellitus, hypertension, obesity, SLE, daily NSAID use, and family history. This is similar to a previous study conducted in Poland, where the most frequently indicated risk factors by physicians include diabetes (98.4%) and hypertension (96.8%)[10]. In the context of the United States, a striking 99% of respondents recognized diabetes and hypertension as significant risk factors for Chronic Kidney Disease (CKD). Conversely, among Pakistani respondents, over 80% acknowledged diabetes (88.4%) and hypertension (80%) as key risk factors for CKD [8,11,12]. Interestingly, only 33.6% of physicians in Karachi identified older age as a risk factor, while 71% of their counterparts in the United States recognized its relevance[7,12]. This discrepancy is noteworthy, especially considering that the elderly are particularly susceptible to CKD due to structural changes in renal vasculature and a reduced number of active glomeruli. The correlation between aging and renal function decline is well-established, with a decrease in Glomerular Filtration Rate (GFR) beginning as early as 40 years of age[10]. This robust awareness is crucial for the early identification and management of CKD risk factors in clinical practice.

Regarding laboratory evaluation, the majority recognized the importance of urinalysis with microscopic analysis and endorsed using random urine albumin-creatinine or protein-creatinine ratio for assessing individuals at increased risk of CKD. However, a notable proportion (29.7%) relied solely on serum creatinine for evaluating persons at risk of CKD, indicating a potential gap in understanding the comprehensive approach recommended by clinical guidelines.

The findings indicate a mixed understanding of the target BP in a patient with type 2 diabetes and microalbuminuria. While a significant proportion correctly identified the target as <130/80 mmHg[13,14], there were variations in responses, suggesting a need to reinforce BP management principles. The clinical action plan for the presented case demonstrated high awareness, with a majority choosing to initiate ACE/ARB therapy for CKD [15,16]. Other aspects of the action plan, including dietary salt restriction, lipid control, glycemic control, weight loss, and smoking cessation [17,18], were also well-recognized, reflecting a comprehensive understanding of the multifaceted management of CKD.

Exploring residents' awareness of potential complications associated with CKD at an eGFR of 60 mL/min/1.73 m² revealed a generally robust understanding. A significant majority correctly identified anemia, bone disease, and malnutrition [19,20]. However, there were variations in the recognition of other complications, such as coronary artery disease, stroke, and increased risk of diabetic complications, indicating potential areas for focused education.

Figure 1 provides an overall snapshot of the knowledge levels among participants, revealing that a substantial proportion (68.6%) demonstrated adequate knowledge of CKD clinical practice guidelines. This is encouraging and suggests that most internal medicine residents surveyed have a foundational understanding of CKD concepts. However, gender did not emerge as a significant factor influencing knowledge levels. This aligns with existing literature, which often finds minimal gender-based disparities in medical knowledge among different populations[21,22]. Residency level emerged as a crucial determinant of knowledge, with residents in their first year (R1) demonstrating a higher proportion of inadequate knowledge than their more advanced counterparts. In disagreement with findings from other studies, our results indicate that older physicians generally have a higher level of knowledge regarding Chronic Kidney Disease (CKD) than specialists [23]. In the literature, an inverse relationship between the age of respondents and their knowledge scores is observed[10]. Such diminishing awareness over time underscores the necessity of continuous education to maintain and enhance the quality of patient care provided by healthcare professionals. This finding underscores the importance of ongoing education throughout the residency, highlighting potential gaps in early exposure to CKD-related concepts. This observation is consistent with studies indicating improved medical knowledge as residents progress through training[24].

Geographical variation in knowledge levels was evident, with residents in the Western and Southern provinces exhibiting lower rates of inadequate knowledge than- those in the Central, Eastern, and Northern regions. Such disparities could be attributed to variations in educational resources, exposure to diverse patient populations, and CKD regional prevalence and management differences, e.g., graduation year demonstrated a correlation with knowledge levels. Residents graduating in recent years, particularly in 2022, exhibited a higher proportion of inadequate knowledge. This could indicate evolving curriculum structures, changes in educational methodologies, or variations in the emphasis on nephrology topics in recent years. Nephrology rotations emerged as a significant factor influencing knowledge, with residents who had not taken rotations demonstrating higher rates of inadequate knowledge. Furthermore, the duration of nephrology rotations correlated with knowledge levels, emphasizing the importance of sustained exposure to nephrology concepts.

CONCLUSION

In conclusion, this study provides valuable insights into the knowledge levels of internal medicine residents regarding CKD clinical practice guidelines. The findings underscore the impact of demographic and practice characteristics on residents' knowledge and highlight areas where targeted educational interventions may be beneficial. The observed variations in knowledge levels across different demographic groups and training experiences emphasize the need for a tailored and comprehensive approach to CKD education during residency. Future research could explore specific

educational strategies that prove effective in improving residents' understanding of CKD and assess the long-term impact of enhanced knowledge on clinical practice and patient outcomes. Addressing these knowledge gaps can ultimately contribute to delivering high-quality care for individuals with CKD and enhance the overall competency of internal medicine residents in nephrology-related concepts.

Authorship Contribution: All authors share equal effort contribution towards (1) substantial contributions to conception and design, acquisition, analysis and interpretation of data; (2) drafting the article and revising it critically for important intellectual content; and (3) final approval of the manuscript version to be published. Yes

Potential Conflicts of Interest: None

Competing Interest: None

Acceptance Date: 04-04-2024

REFERENCES

1. Prevention. C for DC and. Chronic Kidney Disease Basics. Centers for Disease Control and prevention. doi:Chronic Kidney Disease Basics
2. Chen TK, Knicely DH, Grams ME. Chronic Kidney Disease Diagnosis and Management. JAMA. 2019;322(13):1294.
3. Lv J-C, Zhang L-X. Prevalence and Disease Burden of Chronic Kidney Disease. In: ; 2019:3-15.
4. Alsuwaida AO, Farag YMK, Al Sayyari AA, et al. Epidemiology of chronic kidney disease in the Kingdom of Saudi Arabia (SEEK-Saudi investigators) - a pilot study. Saudi J Kidney Dis Transpl. 2010;21(6):1066-1072.
5. Kovesdy CP. Epidemiology of chronic kidney disease: an update 2022. Kidney Int Suppl. 2022;12(1):7-11.
6. Choukem S-P, Nchifor PK, Halle M-P, et al. Knowledge of physicians on chronic kidney disease and their attitudes towards referral, in two cities of Cameroon: a cross-sectional study. BMC Res Notes. 2016;9(1):29.
7. Agaba EI, Agaba PA, Dankyau M, et al. Specialist physician knowledge of chronic kidney disease: A comparison of internists and family physicians in West Africa. African J Prim Heal Care Fam Med. 2012;4(1).
8. Yaqub S, Kashif W, Raza M, et al. General practitioners′ knowledge and approach to chronic kidney disease in Karachi, Pakistan. Indian J Nephrol. 2013;23(3):184.
9. Levey AS, Coresh J, Balk E, et al. National Kidney Foundation Practice Guidelines for Chronic Kidney Disease: Evaluation, Classification, and Stratification. Ann Intern Med. 2003;139(2):137.
10. Jazienicka-Kiełb A, Babicki M, Krajewska M, Oko A, Kłoda K, et al. Assessment of primary care physicians' knowledge of chronic kidney disease in Poland. Front Public Heal. 2022;10.
11. Agrawal V, Ghosh AK, Barnes MA, et al. Awareness and Knowledge of Clinical Practice Guidelines for CKD Among Internal Medicine Residents: A National Online Survey. Am J Kidney Dis. 2008;52(6):1061-1069.
12. Agrawal V, Agarwal M, Ghosh AK, B et al. Identification and Management of Chronic Kidney Disease Complications by Internal Medicine Residents: A National Survey. Am J Ther. 2011;18(3):e40-e47.
13. Kim Y, Kim W, Kim J-K, et al. Blood Pressure Control in Patients with Diabetic Kidney Disease. Electrolytes Blood Press. 2022;20(2):39.
14. Jerums G, MacIsaac RJ. Treatment of Microalbuminuria in Patients with Type 2 Diabetes Mellitus. Treat Endocrinol. 2002;1(3):163-173.
15. Zhang Y, He D, Zhang W, et al. ACE Inhibitor Benefit to Kidney and Cardiovascular Outcomes for Patients with Non-Dialysis Chronic Kidney Disease Stages 3–5: A Network Meta-Analysis of Randomised Clinical Trials. Drugs. 2020;80(8):797-811.
16. Mukoyama M, Kuwabara T. Role of renin-angiotensin system blockade in advanced CKD: to use or not to use? Hypertens Res. 2022;45(6):1072-1075.
17. Satirapoj B, Adler SG. Comprehensive approach to diabetic nephropathy. Kidney Res Clin Pract. 2014;33(3):121-131.
18. Iseki K, Yamagata K. A practical approach of salt and protein restriction for CKD patients in Japan. BMC Nephrol. 2016;17(1):87.
19. Thomas R, Kanso A, Sedor JR. Chronic Kidney Disease and Its Complications. Prim Care Clin Off Pract. 2008;35(2):329-344.
20. Iorember FM. Malnutrition in Chronic Kidney Disease. Front Pediatr. 2018;6 (1): 1-3.
21. Hödlmoser S, Winkelmayer WC, Zee J, et al. Sex differences in chronic kidney disease awareness among US adults, 1999 to 2018. Kronenberg F, ed. PLoS One. 2020;15(12):e0243431.
22. Emmanuel Gapira B, Chironda G, Ndahayo D,et al. Knowledge related to Chronic Kidney Disease (CKD) and perceptions on inpatient management practices among nurses at selected referral hospitals in Rwanda: A non-experimental descriptive correlational study. Int J Africa Nurs Sci. 2020;13:100203.
23. Wolide AD, Kumela K, Kerga F, et al. Knowledge, attitude, and practices toward chronic kidney disease among care providers in Jimma town:cross-sectional study. BMC Public Health. 2020;20(1):1079.
24. Densen P. Challenges and opportunities facing medical education. Trans Am Clin Climatol Assoc. 2011;122:48-58.