



Prevalence And Associated Factors Of Chronic Renal Failure In Southern Region In Saudi Arabia

Saeed Hameed Rami^{1*}

^{1*}Assistant professor of emergency medicine, Department of Emergency Medical Services, College of Health Sciences in Al-Qunfudhah, Umm Al-Qura University, Makkah Al-Mukaramah, Kingdom Saudi Arabia.

***Corresponding Author:** Saeed Hameed Rami

*Consultant & Assistant professor of emergency medicine, Medical Emergency Services Department, College of Health Sciences Al- Qunfudhah, Umm Al-Qura University, Al-Qunfudhah 214221 P.O Box 715 Kingdom of Saudi Arabia

Abstract:

Background: Chronic kidney disease (CKD) affects adults' population and has a high morbidity and mortality rate. CKD represents an important public health problem that affects cardiovascular disease and impacts the quality of life. CKD is defined as the presence of kidney damage or an estimated glomerular filtration rate (eGFR) less than 60 ml/min/1.73 mt², persisting for 3 months or more, irrespective of the cause.

Aim: This paper aimed to explore the prevalence of chronic renal failure and its related factors in the Southern region of KSA.

Methodology: An observational descriptive retrospective study was conducted between September and November 2023. Patients suffering from chronic renal failure in the South region of KSA were the target respondents. Data collection included socio-demographics characteristics of the patients, history of chronic renal failure disease, and history of other chronic disease as well.

Results: All of 163 patients diagnosed with CKD had hypertension, 70.4% of them were diagnosed with hypertension for almost more than 10 years, 36% suffered from diabetes, 98.8% did not suffer from allergies, and 10.4% did suffer from ischemic heart disease.

Conclusion: The associated risk factors of chronic renal failure among Saudi patients in the Southern region mainly endangered those aged from 50 to 70 years old. As people age, screening for risk factors of CKD becomes a priority for all healthcare professionals; screening will achieve earlier detection and provide greater possibility to control predisposing risk factors to delay further deterioration in kidney function. Among the several identified risk factors, hypertension has been the most common, classically in essential hypertension.

CC License
CC-BY-NC-SA 4.0

Keywords: Chronic renal failure, factors, survival rate, renal transplant

Introduction

Chronic kidney disease (CKD) or chronic renal failure (CRF) is defined as the presence of kidney damage or an estimated glomerular filtration rate (eGFR) less than 60 ml/min/1.73 m², persisting for 3 months or more, irrespective of (Decreased, 2013; Kopple, 2001). CKD is currently recognized as an important health problem worldwide. In developed countries, the progressive increase in numbers of CKD patients and those requiring renal replacement therapy (RRT) is reaching epidemic levels, growing by 5–8% annually (El Nahas & Bello, 2005). The escalating prevalence of chronic renal failure (CRF) underpins an urgent need to understand its associated factors, and more crucially, those influencing patient survival (US Renal Data System, 2013).

In Riyadh, Saudi Arabia, a pilot community-based screening program was conducted amongst 491 adults in commercial centers. Participants were classified into different stages of chronic kidney disease (CKD) based on their estimated Modification of Diet in Renal Disease (MDRD3) equation, the new Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation, and the presence of albuminuria. The overall prevalence of CKD was 5.7% using the MDRD-3 equation and 5.3% using the CKD-EPI glomerular filtration equation. The findings discovered that 39.3% of individuals diagnosed with CKD had diabetes, and the same percentage of CKD patients suffered from hypertension (Alsuwaida et al., 2010).

The estimated prevalence and annual incidence of End Stage Renal Disease (ESRD) were validated using data from Fresenius Medical Care, Germany, and previously reported data, respectively. Information was collected from 142 countries, representing 97.3% of the global population. The results revealed that 31.5% of individuals with CKD also had diabetes (Cheng et al., 2021). In another study involving patients with renal disease, 1,795 individuals were initially screened. Out of this cohort, 83% of patients were identified as hypertensive, while the remaining 39% were classified as non-hypertensive (Buckalew et al., 1996).

Review of literature

The prevalence of chronic kidney disease (CKD) is rising sharply worldwide, and since it is linked to serious morbidity and death, it warrants special attention as one of the expanding issues in public health. Studies in the general population show that 13.4% of people have chronic kidney disease (CKD) (Hill et al., 2016). In contrast to the general population, which has a pooled prevalence of CKD of 24.7%, individuals with hypertension had a higher documented frequency of CKD (Goro et al., 2019). In addition, the prevalence was greater than in the population as a whole since hypertension is the primary contributing factor and trigger for chronic renal disease (Alzamanan et al., 2018).

In Saudi Arabia, Alsuwaida et al. found that the young Saudi population (mean age of 37.4 years) had a high prevalence of chronic kidney disease (CKD). Using the modification of diet in renal disease (MDRD)-3 equation and the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation, this study assessed the prevalence of chronic kidney disease (CKD) in this subset of the Saudi population to be 5.7% and 5.3%, respectively (Alsuwaida et al., 2010).

Furthermore, almost 5000 first-degree relatives of Saudi patients receiving hemodialysis were screened by Mousa et al. The subjects were distributed equally between males and girls and came from each of Saudi Arabia's four geographical areas in equal numbers. 13.8% of the relatives who were examined had CKD, which is 2.6 times higher than the Saudi population's reported rate for the same age range. With a mean age of 34.3 years, the relatives screened for the research tended to be young. It's possible that when they become older, a significantly larger percentage of them will have CKD (Mousa et al., 2021).

According to Zhang et al. (2016), approximately half of the patients with chronic kidney disease (CKD) were 60 years of age or older, according to the China Kidney Disease Network's 2015 Annual Data Report. Levey et al. also noted that over 50% of those over 70 had chronic kidney disease (CKD). According to both studies, those over 65 are at a higher risk of developing chronic kidney disease (Levey et al., 2009). In addition, older adults are more likely to have problems and mortality in the early stages of chronic kidney disease (CKD). Consequently, in order to lessen the burden of CKD on the aged population, careful attention must be paid to them (Hill et al., 2016).

According to a cross-sectional study done in Ethiopia at Jimma University and Tigray Teaching Hospital, the prevalence of CKD among hypertension patients was 26% and 22.1%, respectively (Hunegnaw et al., 2021). In another study, Alemu et al., in Ethiopia reported that the prevalence of CKD, defined by estimated glomerular filtration rate $<60 \text{ mL/min/1.73 m}^2$, was determined to be 17.3% and 14.3% by modification of diet in renal disease and chronic kidney disease epidemiology equations, respectively. In the renal disease equation, the percentage of stage 3 CKD caused by dietary modifications was 14.7%, whereas the percentages of stage 4 and stage 5 CKD were 2.2% and 0.4%, respectively. 85.1% of individuals with CKD had hypertension prior to diagnosis (Alemu et al., 2021).

Age, sex, educational level, place of residence, marital status, body mass index, comorbidity, kind of antihypertensive medication, smoking, alcohol use, and sedentary lifestyle were the characteristics linked to chronic kidney disease (CKD), according to research published in the Glob (Hunegnaw et al., 2021). According to data from the North and West Bank of Palestine, the prevalence of chronic kidney disease among individuals with diabetes was found to be 23.6% (95% CI: 19.4–28.1%), split as follows: 19.7%, 2.6%, and 1.3% of patients, respectively, had stage 3, stage 4 CKD and stage 5 CKD. Multivariable logistic regression revealed a significant relationship between CKD and smoking [adjusted OR: 2.3, 95% CI: 1.3–4.2], age ≥ 60 years and hypertension (Nazzal, et al., 2020).

In Egypt, the largest proportion of patients (31.9%), both male and female, were found to be between the ages of 50 and 60. Of the ESRD patients, over one-third (38.7%) lived in cities, while more than half (61.3%) lived in rural areas. The two main triggers of ESRD were high blood pressure and diabetes. In ESRD patients, the prevalence of diabetes mellitus was 15.5%, hypertension was 31.8%, kidney stones were 8.4%, urinary tract infections were 8.8%, congenital abnormalities were 4.6%, and primary glomerulonephritis was 3.7%. Hypertension and diabetes are the primary risk factors for renal disorders, with unknown causes accounting for a large portion of all causes (17.7%). In El-Sharkia Governorate, Egypt, primary glomerulonephritis is the least common cause of chronic kidney disease (Ghonemy et al., 2018).

This inpatient group in Kenya had a significant prevalence of chronic kidney disease. A CKD diagnosis might be aided by haematuria and proteinuria. 38.6% of the patients had CKD; 74 (62.7%) of them were men. The age difference between respondents with and without CKD was 4.4 years. The patients were divided into 56 (47.5%) with stage G1 or G2, 17 (14.4%) with end-stage renal disease, 64 (54.2%) with hemoglobin below 10g/dl, and 33 (28.0%) with sodium levels below 135 mmol/l. The use of herbal medications, proteinuria, hematuria, hypertension, and a history of unexplained anemia were all independently linked to CKD (Mwenda et al., 2019).

Significance of the study

Chronic kidney disease (CKD) is a serious illness linked to early death, a worse quality of life, and higher medical costs. Untreated chronic kidney disease (CKD) can lead to end-stage renal disease and need kidney transplantation or dialysis. This chronic condition is now far more common, and its frequency has skyrocketed. While the prevalence of KD has been documented before, the population with hypertension and DM has not been the subject of many investigations.

Aim of the study

This study aims to assess prevalence and associated factors of chronic renal failure

Objectives

- 1) Assess the prevalence of chronic renal failure in Southern region in Saudi Arabia
- 2) Assess associated factors of chronic renal failure in Southern region in Saudi Arabia

Research Questions

- 1) What is the prevalence of chronic renal failure in the Southern region of Saudi Arabia?
- 2) What are the associated factors of chronic renal failure in the Southern region of Saudi Arabia?

Methodology

Overview

The study's participants and the tools used are presented in this chapter. Additionally, a detailed presentation of the research methodology, design, and data analysis is provided. The purpose of this study is to evaluate the prevalence and related variables of chronic renal failure.

Research design

An observational descriptive retrospective study was used to assess prevalence and associated factors of chronic renal failure.

Study duration and setting

An observational descriptive retrospective study was carried out from September to November 2023 in the Southern region.

Participants

The target patients were patients suffering from chronic renal failure in the Southern region. The study participants were selected from the records of cases entered the selected hospitals.

Using a checklist, a structured interview was performed to extract pertinent data from the patient files. Using the nonprobability sampling approach, One hundred and sixty three samples were taken from patient records, with a focus on files including patients with chronic renal failure. Measurements of the degree of hypertension, type of diabetes, severity of PKD, infection onset, and NSAID type were recorded. The incidence and frequent risk factors linked to chronic kidney disease (CKD) were described using percentages and frequency distributions.

Inclusion Criteria

Among the patients at risk for chronic kidney disease (CKD) were those with hypertension, diabetes mellitus (DM), polycystic kidney disease (PKD), certain infections, and non-steroidal anti-inflammatory medication (NSAID) use.

Statistical analysis

Version 26 of SPSS was used for statistical analysis. Numbers (percentages) were used to represent categorical data, while means $\pm$ standard deviation (SD) were used to express continuous data. When applicable, the independent sample student's t-test and the chi-square test were used to examine differences in the patient's characteristics and risk factors for chronic kidney disease. A p value of less than 0.05 is considered statistically significant.

Results

Table 1: Sociodemographic data of patients in the South region as reported.

Variable	Group	Frequency	Percentage
Gender	Males	57	34.8
	Females	106	65.2
Age group	10-20 years	1	0.6
	21-30 years	10	6.2
	31-40 years	16	9.9
	41-50 years	34	20.4
	51-60 years	38	23.5
	61-70 years	38	23.5
	> 70 years	26	16
Nationality	Saudi	161	98.8
	Non-Saudi	2	1.2
Marital status	Single	46	28.4
	Married	86	52.5
	Divorced	14	8.6
	Widowed	17	10.5

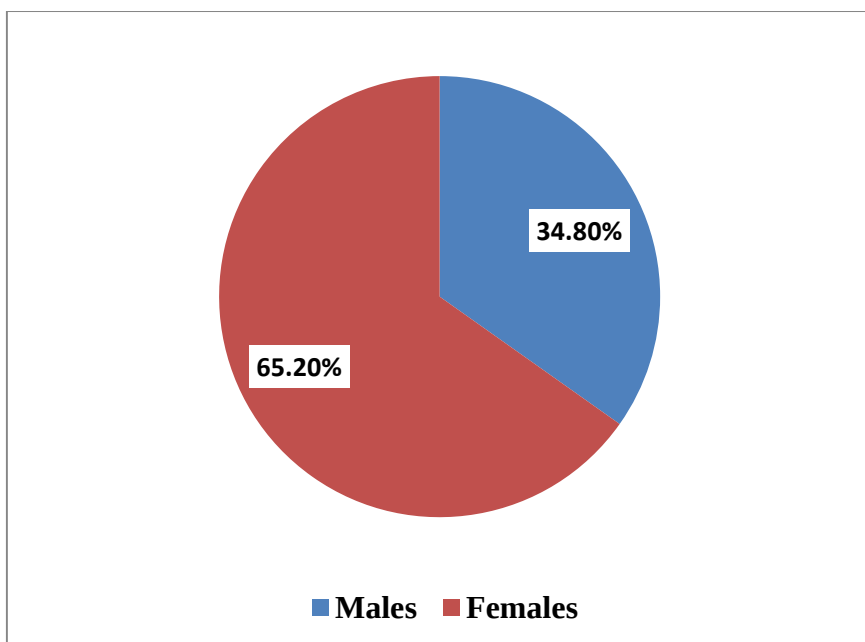


Fig (1): Gender distribution among the studied cases

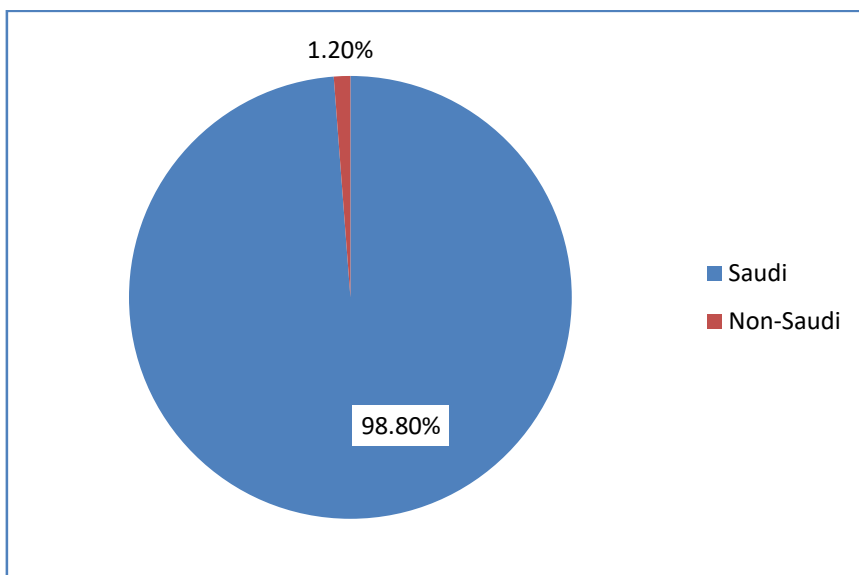


Fig (2): Nationality distribution among the studied cases

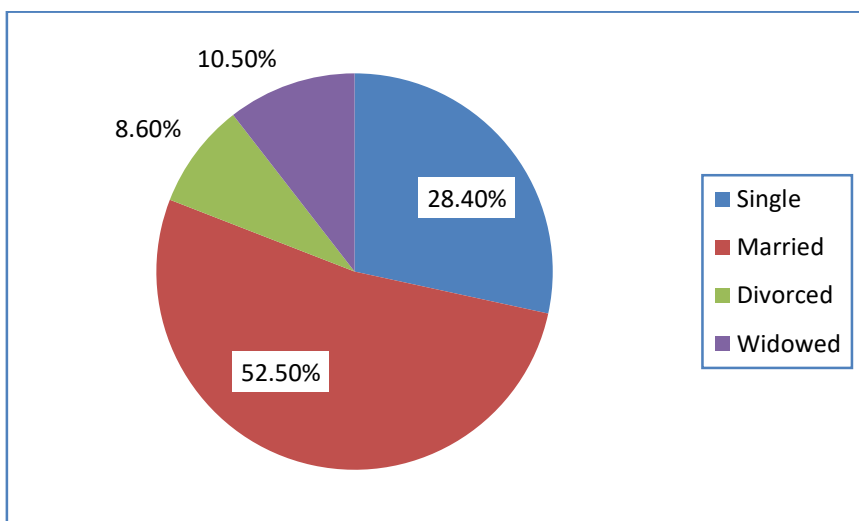


Fig (3): Marital status among the studied cases

Table 1 shows that 65.2% were female patients who suffered from chronic kidney failure. With regards to age, those aged from 10 -20 years represented 0.6, considered to be the lowest in the age distribution, having the CRF. Those with ages ranging between 51-60 years old and 61-70 years old represent the same percentage (23.5%). The majority were married (52.5%) and Saudis (98.8%) in general.

Table 2: History of CRF and other chronic illness.

Variable	Group	Frequency	Percentage
BMI	Underweight	15	9.3
	Normal	56	34.6
	Overweight	74	45.1
	Obese	18	11.1
Duration since diagnosis with CRF	1-3 years	1	0.6
	4-6 years	12	7.4
	7-10 years	36	21.6
	More than 10 years	114	70.4
Does the patient suffer from hypertension	Yes	163	100
Does the patient suffer from diabetes	Yes	59	35.8
	No	104	64.2
Does the patient suffer from any kind of allergy	Yes	2	1.2
	No	161	98.8
Does the patient suffer from ischemic heart disease	Yes	17	10.5
	No	146	89.5

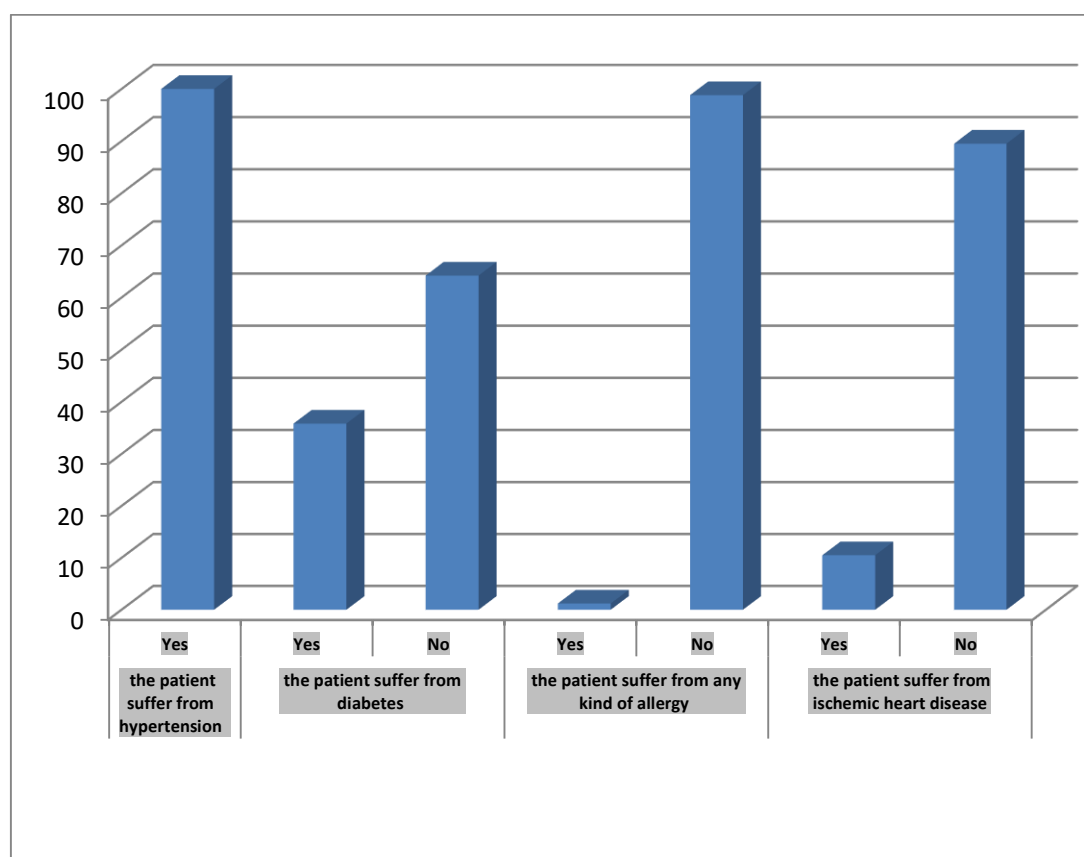


Fig (4): History of CRF and other chronic illness.

The above table 2 shows that most of the patients were overweight (45.1%) and most of them were diagnosed with CRF for more than 10 years 70.4%. All of the patients reported in this current study suffered from hypertension, and 35.8% of them suffered from diabetes. However, 98.8% patients did not suffer from allergies, and 89.5%.did not suffer from ischemic heart disease

Table 3: Family history of chronic illness among patients.

Variable	Group	Frequency	Percentage
Is there family history of hypertension in the patient family	Yes	37	22.8
	No	126	77.2
Is there family history of diabetes in the patient family	Yes	32	19.1
	No	131	80.9
Is there family history of allergy in the patient family	Yes	2	1.2
	No	161	98.8
Is there family history of ischemic heart disease in the patient family	Yes	34	21
	No	129	79

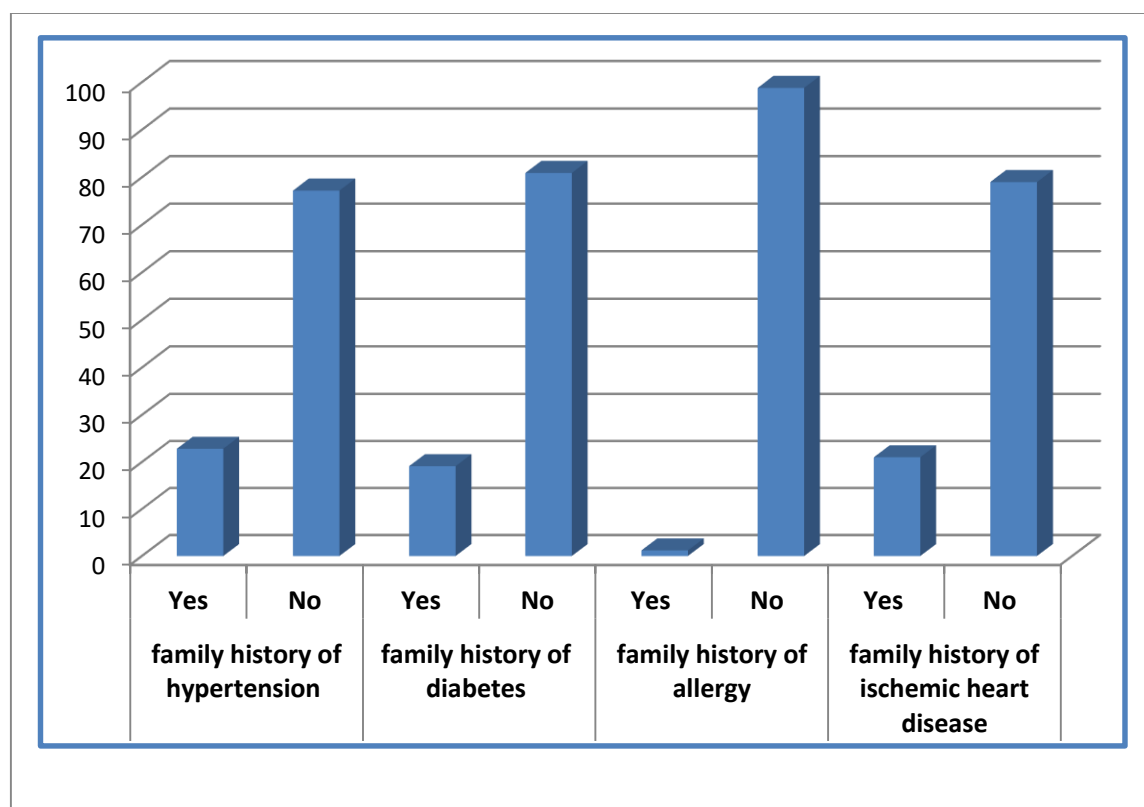
**Fig (6):** Family history of chronic illness among patients.

Table three shows that most of patients did not have a family history of hypertension (77.2%) and that most of them did not have a family history of diabetes (80.9%). Most of patients do not have a family history of allergies (98.8%) and that most of patients does not have a family history of ischemic heart disease (79%).

Discussion

Chronic kidney disease is the progressive and irreversible destruction of the kidneys. Those over 65 years of age have a higher chance of developing CKD. Over the past thirty years, there has been a sharp rise in the number of adults with CKD in the 50 and older age range. This study revealed that the majority of cases were between 50-70 years, as the age ranges of 51-60 years old and 61-70 years old represent the same percentage (23.5%). On the other hand, those who aged from 10 -20 years represented 0.6%, which was considered to be the lowest in the age distribution having the CRF (Alemu et al., 2020).

As a result, considerable future increases in the frequency of CKD among the elderly are anticipated. This increase in co-morbid conditions (such as diabetes, hypertension, and cardiovascular disease) is linked to a higher prevalence of chronic kidney disease (CKD) in adults over 65. This puts more strain on health care systems, lowers life expectancies, and negatively affects patient and family quality of life (Nazzal et al., 2020). Similarly, Alzamanan et al., (2018) documented the most affected group of people with renal failure to be the 41 to 50 years age group, which represented about 30% of all samples taken from King Khalid Hospital (Zhang et al., 2016).

The results also go hand with hand with a study by Ghonemy et al., in Egypt, who found that the mean age of patients was 52.03 ± 14.67 years. The highest percentage of patients (31.9%) was found to be between 50 and 60 years in both males and females (Ghonemy et al., 2016). The current findings are consistent with the research conducted by Yu et al. (2010), who found that the prevalence of chronic kidney disease (CKD) increased with age, especially in both genders beyond 50 years of age. Furthermore, these findings concur with a Japanese study (Nagata et al., 2010) that revealed men get ESRD more frequently than women. These findings are also consistent with a research by Zahran et al. (2011), which found that the average age of ESRD patients in the Menoufiya governorate, Egypt, was 52 years.

Therefore, screening for CKD risk factors becomes more important as people age and should be a top priority for all healthcare professionals. Screening can lead to quicker identification, more opportunities to control predisposing risk factors (such as controlling hypertension and glucose), and a delay in further declines in kidney function (Singh et al., 2013). The present study showed that 65.2% were female patients who suffered from chronic kidney failure. In contrast, a study in Kenya found male sex, having been diagnosed with haematuria, proteinuria, anaemia or hypertension at some time in the past (preceding CKD diagnosis) (Lew et al., 2018). Another study in Asia found association with male sex (Soyibo et al., 2007).

Gender, age, and family history are all very significant factors. Examples of significant risk factors for chronic kidney disease include older age, low birth weight, and a family history of kidney disease. In addition, renal disease can be caused due to diabetes mellitus, smoking, obesity, and hypertension (Lew et al., 2018). End-stage renal disease can readily and quickly develop in a patient with uncontrolled diabetes and/or hypertension. Risks include smoking, consuming large amounts of alcohol, using analgesic drugs, and being exposed to heavy metals. Additional risk factors include having a history of cardiovascular disease, hyperlipidemia, metabolic syndrome, HIV infection, hepatitis C virus, and cancer. For initial screening, serum creatinine levels and urinalysis results in patients at risk for chronic renal disease will often suffice (Zhang et al., 2016).

The present study reported the most risk factors for developing CRD were obesity, hypertension and diabetes, as all of patients reported in this current study suffered from hypertension, and 35.8% of them suffered from diabetes. Additionally, most of the patients were overweight 45.1%, and most of them were diagnosed with CRF for more than 10 years (70.4%). However, most of patients did not have a family history of hypertension (77.2%) and that most of them did not have a family history of diabetes (80.9%). Additionally, the risk factors mentioned in the present research were also found to be common in Najran City in a study by Alzamanan et al., which discovered that patients with polycystic kidney disease had a low risk of renal failure with a chance of 20%, while hypertensive patients occurred to be highest in 90% of patients with CRF (Alzamanan et al., 2018).

As per Kazancioğlu (2013), hypertension is a known risk factor for both chronic kidney disease (CKD) and end-stage renal disease (ESRD), affecting 27% of ESRD patients in the US and 28% of hemodialysis patients in Turkey. Subjects with systemic hypertension have varying risks of reduced renal function because systemic hypertension is transferred to intraglomerular capillary pressure, which leads to glomerulosclerosis and loss of kidney function (Ameer, 2022). Hypertensive individuals demonstrated the greatest incidence, with 45 patients (90%), which is comparable to the results obtained on 50 patients at King Khalid Hospital in Najran City, KSA. According to Alzamanan et al. (2018), diabetes mellitus (DM) is the primary cause of CKD and ESRD in both developed and developing nations.

The present findings align with a Netherlands research (Lin et al., 2021) that discovered diabetes mellitus to be the second cause of end-stage renal disease (ESRD) after hypertension. With an incidence of 14.7%, diabetes mellitus has been shown to be the second cause of end-stage renal disease (ESRD) in the United Kingdom (Singh, et al., 2013). According to a cross-sectional study done in the Caribbean, diabetes mellitus and hypertension were the main causes of end-stage renal disease (ESRD) (Soyibo et al., 2007). According to another Saudi Arabian study, diabetes mellitus accounts for 30.4% of all causes of end-stage renal disease (ESRD), with hypertension accounting for 25.2% of cases (Shaheen et al., 2005). Based on data from the Turkish Society of Nephrology registry, 37.3% of hemodialysis patients in Turkey are diabetics (Kazancioğlu, 2013).

According to the USRDS data, half of the ESRD patients in the United States had diabetic nephropathy (Mwenda et al., 2016). Reactive oxygen species, advanced glycosylation end products, and hyperfiltration damage were among the mechanisms underlying kidney disease in diabetes. At the molecular level, various cytokines, growth factors and hormones such as transforming growth factor-beta and angiotensin II promote pathologic alterations associated with diabetic nephropathy (Mwenda et al., 2016).

Conclusion

The associated risk factors of chronic renal failure among Saudi patients in the Southern region mainly impacted those aged from 50 to 70 years old. It may result from factors related to a healthy lifestyle, including a poor diet, insufficient water consumption, inactivity, or a family history of the condition. It is projected that the prevalence of CKD in older adults would rise significantly in the future. As the population ages, screening for CKD risk factors becomes increasingly important for healthcare practitioners. Screening will lead to earlier identification and more opportunities to manage risk factors that predispose people to prevent further decline in kidney function. Hypertension has been the most frequently found risk factor out of all of them. In classical essential hypertension, there is an increase in afferent arteriolar resistance and a lessened increase in efferent resistance, which results in a decrease in renal blood flow, an increase in filtration fraction (FF), and a tendency to preserve glomerular filtration.

Conflict of interest

The author declare no conflicts of interest.

References

1. Alemu, H., Hailu, W., & Adane, A. (2020). Prevalence of chronic kidney disease and associated factors among patients with diabetes in northwest Ethiopia: a hospital-based cross-sectional study. *Current Therapeutic Research*, 92, 100578.
2. Alsuwaida, A. O., Farag, Y. M., Al Sayyari, A. A., Mousa, D., Alhejaili, F., Al-Harbi, A., & Singh, A. K. (2010). Epidemiology of chronic kidney disease in the Kingdom of Saudi Arabia (SEEK-Saudi investigators)-a pilot study. *Saudi Journal of Kidney Diseases and Transplantation*, 21(6), 1066-1072.
3. Alzamanan, M. D., Rayshan, A., Salem, A., & Alyami, A. (2018). Risk factors of chronic renal failure in adult patients at King Khalid Hospital, Najran City, Saudi Arabia. *The Egyptian Journal of Hospital Medicine*, 70(1), 88-91.
4. Ameer, O. Z. (2022). Hypertension in chronic kidney disease: What lies behind the scene. *Frontiers in Pharmacology*, 13, 949260.
5. Buckalew Jr, V. M., Berg, R. L., Wang, S. R., Porush, J. G., Sally, R., Schulman, G., & Modification of Diet in Renal Disease Study Group. (1996). Prevalence of hypertension in 1,795 subjects with chronic renal disease: the modification of diet in renal disease study baseline cohort. *American Journal of Kidney Diseases*, 28(6), 811-821.
6. Cheng, H. T., Xu, X., Lim, P. S., & Hung, K. Y. (2021). Worldwide epidemiology of diabetes-related end-stage renal disease, 2000–2015. *Diabetes Care*, 44(1), 89-97.
7. Decreased, G. (2013). Definition and classification of CKD. *Kidney Int*, 3, 19-6.
8. El Nahas, A. M., & Bello, A. K. (2005). Chronic kidney disease: the global challenge. *The lancet*, 365(9456), 331-340.
9. Ghonemy, T. A., Farag, S. E., Soliman, S. A., El-Okely, A., & El-Hendy, Y. (2016). Epidemiology and risk factors of chronic kidney disease in the El-Sharkia Governorate, Egypt. *Saudi Journal of Kidney Diseases and Transplantation*, 27(1), 111-117.
10. Goro, K. K., Wolide, A. D., Dibaba, F. K., Fufa, F. G., Garedow, A. W., Tufa, B. E., & Bobasa, E. M. (2019). Research Article Patient Awareness, Prevalence, and Risk Factors of Chronic Kidney Disease among Diabetes Mellitus and Hypertensive Patients at Jimma University Medical Center, Ethiopia.
11. Hill NR, Fatoba ST, Oke JL et al. (2016): Global prevalence of chronic kidney disease - A systematic review and meta-analysis. *PLoS One*, 11(7): 158765-158772.
12. Hill, N. R., Fatoba, S. T., Oke, J. L., Hirst, J. A., O'Callaghan, C. A., Lasserson, D. S., & Hobbs, F. R. (2016). Global prevalence of chronic kidney disease—a systematic review and meta-analysis. *PloS one*, 11(7), e0158765.

13. Hunegnaw, A., Mekonnen, H. S., Techane, M. A., & Agegnehu, C. D. (2021). Prevalence and associated factors of chronic kidney disease among adult hypertensive patients at Northwest Amhara Referral Hospitals, Northwest Ethiopia, 2020. *International Journal of Hypertension*, 2021.
14. Kazancioğlu, R. (2013). Risk factors for chronic kidney disease: an update. *Kidney international supplements*, 3(4), 368-371.
15. Kopple, J. D. (2001). National kidney foundation K/DOQI clinical practice guidelines for nutrition in chronic renal failure. *American journal of kidney diseases*, 37(1), S66-S70.
16. Levey, A. S., Stevens, L. A., & Coresh, J. (2009). Conceptual model of CKD: applications and implications. *American journal of kidney diseases*, 53(3), S4-S16.
17. Lew, Q. L. J., Allen, J. C., Nguyen, F., Tan, N. C., & Jafar, T. H. (2018). Factors associated with chronic kidney disease and their clinical utility in primary care clinics in a multi-ethnic Southeast Asian population. *Nephron*, 138(3), 202-213.
18. Lin, J. J., Morey, F., Wu, H. Y., Yang, J. Y., Peng, Y. S., Mendez, D., & Chebat, M. (2021). Prevalence and risk factors for chronic kidney disease in Belize: A population-based survey. *The Lancet Regional Health–Americas*, 1.
19. Mousa, D., Alharbi, A., Helal, I., Al-Homrany, M., Alhujaili, F., Alhweish, A., ... & Al Sayyari, A. (2021). Prevalence and associated factors of chronic kidney disease among relatives of hemodialysis patients in Saudi Arabia. *Kidney international reports*, 6(3), 817-820.
20. Mwenda, V., Githuku, J., Gathecha, G., Wambugu, B. M., Roka, Z. G., & Ong'or, W. O. (2019). Prevalence and factors associated with chronic kidney disease among medical inpatients at the Kenyatta National Hospital, Kenya, 2018: a cross-sectional study. *The Pan African Medical Journal*, 33.
21. Nagata, M., Ninomiya, T., Doi, Y., Yonemoto, K., Kubo, M., Hata, J., ... & Kiyohara, Y. (2010). Trends in the prevalence of chronic kidney disease and its risk factors in a general Japanese population: the Hisayama Study. *Nephrology Dialysis Transplantation*, 25(8), 2557-2564.
22. Nazzal, Z., Hamdan, Z., Masri, D., Abu-Kaf, O., & Hamad, M. (2020). Prevalence and risk factors of chronic kidney disease among Palestinian type 2 diabetic patients: a cross-sectional study. *BMC nephrology*, 21, 1-8.
23. Shaheen, F. A., & Al-Khader, A. A. (2005). Epidemiology and causes of end stage renal disease (ESRD). *Saudi Journal of Kidney Diseases and Transplantation*, 16(3), 277-281.
24. Singh, A. K., Farag, Y. M., Mittal, B. V., Subramanian, K. K., Reddy, S. R. K., Acharya, V. N., ... & Rajapurkar, M. M. (2013). Epidemiology and risk factors of chronic kidney disease in India—results from the SEEK (Screening and Early Evaluation of Kidney Disease) study. *BMC nephrology*, 14, 1-10.
25. Soyibo, A. K., & Barton, E. N. (2007). Caribbean renal registry data. *West indian medical journal*, 56(3), 309.
26. US Renal Data System. (2013). *USRDS 2013 annual data report: atlas of chronic kidney disease and end-stage renal disease in the United States*. National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases, Vol. 2014.
27. Yu, M., Ryu, D. R., Kim, S. J., Choi, K. B., & Kang, D. H. (2010). Clinical implication of metabolic syndrome on chronic kidney disease depends on gender and menopausal status: results from the Korean National Health and Nutrition Examination Survey. *Nephrology Dialysis Transplantation*, 25(2), 469-477.
28. Zahran, A. (2011). Epidemiology of hemodialysis patients in Menofia governorate, delta region, Egypt. *Menoufia Med J*, 24(6), 211-20.
29. Zhang, L., Zhao, M. H., Zuo, L., Wang, Y., Yu, F., Zhang, H., ... & Zhou, Z. (2020). China kidney disease network (CK-NET) 2016 annual data report. *Kidney international supplements*, 10(2), e97-e185.