Risk Factors for Chronic Renal Failure Among Patients at Alborgage Center, Northern Sudan (2022-2024).

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Abstract:

Background: Chronic kidney disease (CKD) is a progressive condition causing gradual loss of kidney function over time.

Objective: This study aimed to explore the risk factors for renal failure among patients at AL-Borgage Dialysis Center, Northern State, Sudan (2022-2024).

Materials and Methods: An analytical case study was conducted between 2022 and 2023, involving 60 patients with renal failure attending AL-Borgage Dialysis Center. Data were collected using a structured questionnaire and analyzed using Statistical Program for Social Sciences version 25. Descriptive statistics were used to summarize patient characteristics, and Chi-square tests were employed to examine associations between risk factors and clinical outcomes. Results were presented in tables and graphs.

Results: The study identified key risk factors: 73.3% of patients had hypertension, 40% were obese, 23.3% had diabetes, 20% were smokers, 13% consumed alcohol, and 3% reported cosmetic use. Complications included chronic hypertension (60%), anemia (33.3%), and heart disease (6.7%). These findings align with global literature indicating hypertension and diabetes as primary contributors to renal failure. Nearly half of the patients were income earners, highlighting the socioeconomic burden of Chronic Kidney Disease.

Conclusion and Recommendations: The study recommends strengthening health education initiatives focused on dietary practices, early screening for hypertension and diabetes, and improving access to clean water through community-level water treatment interventions. Implementation of these strategies by local health authorities, in collaboration with community leaders, could substantially mitigate the burden of Chronic Kidney Disease in the region.

Keywords: Chronic, Diabetes, Hypertension, Kidney Disease, Obesity, Risk Factors, Renal Failure, Sudan.

Introduction:

Chronic Kidney Disease (CKD) is a growing public health concern worldwide. It is a progressive condition that causes gradual kidney damage, affecting an individual's quality of life and ability to perform daily activities. CKD is typically diagnosed through screening, especially for those at higher risk such as individuals with hypertension, diabetes, or a family history of kidney disease. In advanced stages, CKD progresses to End-Stage Renal Disease (ESRD), requiring renal replacement therapies, including dialysis or kidney transplantation. Globally, over 1.4 million patients are currently undergoing such therapies, with early intervention being crucial to reduce the economic burden of the disease. Identifying high-risk individuals early on is key to preventing CKD, as genetic, environmental, and lifestyle factors all play a role in its development [1].

Risk Factors for Chronic Kidney Disease:

- **Age:** Advancing age is a well-established risk factor for chronic kidney disease (CKD). The prevalence of CKD increases significantly among individuals over 65 years, largely due to age-related decline in kidney function and the presence of comorbidities such as hypertension and diabetes [2, 16].
- **Family History**: A significant risk factor, with studies indicating that 23% of patients undergoing dialysis have close relatives with End-Stage Renal Disease (ESRD) [3].
- **Obesity**: Obesity is a major risk factor, as it contributes to conditions like diabetes and hypertension, both of which lead to kidney damage. It also causes hyperfiltration, which can damage kidney structures over time [1].
- **Socioeconomic Status**: Lower socioeconomic status (SES) is significantly associated with an increased risk of chronic kidney disease (CKD). A comprehensive meta-analysis encompassing 43 studies found that individuals with lower income levels had a 34% higher odds of CKD prevalence compared to those with higher incomes. Additionally, a large-scale cohort study in England involving over 1.4 million participants revealed that those in the most deprived quintile had a 76% higher risk of developing advanced CKD (Stages 4–5) compared to the least deprived, even after adjusting for age and sex .

- **Smoking**: Both current and former smokers, especially those with a long history of smoking, are at a higher risk for CKD [1].
- **Exposure to Toxins**: Alcohol consumption, recreational drug use, and prolonged exposure to heavy metals or analgesic medications can increase CKD risk. Studies show that excessive use of acetaminophen significantly raises the odds of ESRD [6].
- **Diabetes and Hypertension**: These are major risk factors, as they damage the blood vessels in the kidneys, impairing their function [1].

Nutrition and Chronic Kidney Disease:

Nutrition plays a vital role in CKD outcomes. In advanced stages, CKD is associated with protein-energy wasting, sarcopenia, and inflammation. Even in the early stages, diet impacts important aspects of CKD management, including blood pressure control, and the management of dyslipidemia, diabetes, anemia, and metabolic acidosis. Individuals from lower socioeconomic backgrounds are often more likely to consume diets that increase the risk of diabetes, obesity, and cardiovascular diseases—factors that contribute to CKD [7].

Problem Statement:

Chronic Kidney Disease is a major global health issue, affecting 5-10% of the population. Annually, 2.3-7.1 million deaths occur due to limited access to dialysis or transplantation. Diabetes and hypertension account for 70-75% of CKD cases worldwide, with higher prevalence in regions like the Middle East and North Africa due to factors such as diabetes and obesity. In Sudan, kidney disease deaths totaled 5,095 in 2020, representing 2.34% of all deaths [8]. Saudi Arabia, with one of the highest diabetes prevalence rates globally, has approximately 23,000 patients on dialysis, and diabetes is a leading cause of kidney failure in 40-50% of cases. Global CKD prevalence is estimated at 7.2%, with higher rates in China (10.8%) and Australia (20.4%) [9].

Research Objectives:

This study aims to identify the key risk factors contributing to the development of Chronic Kidney Disease (CKD) by evaluating genetic, environmental, and lifestyle factors. The study also seeks to assess the impact of socioeconomic status and environmental toxins on CKD prevalence, analyze the role of diet and nutrition in CKD progression, and provide recommendations for early diagnosis and intervention to reduce the overall burden of CKD.

Materials and Methods

Study Design: This study employed a case study design, focusing on renal failure patients at the Albrogage dialysis center.

Study Setting: The research was conducted in Al-Borgage locality, located in the northern state of Sudan, approximately 45 kilometers north of Dongola, the state capital. Al-Borgage is bordered by Karma al-Balad to the north, Argo to the south, Masrou al-Borgage to the east, and the Nile River and Artqasha Island to the west. The locality's population is predominantly Nubian, and agriculture, alongside trade, serves as the main source of livelihood. The Al-Borgage dialysis center, also known as the Late Saad al-Din Mohammed Ali Center, is the primary provider of dialysis care in the region. Established in 2013, the center has a capacity to treat 50 patients, equipped with 11 dialysis machines and 11 beds. The medical team at the center consists of 10 staff members: 1 doctor, 8 nurses, and 1 medical engineer.

Study Period: The study was conducted over a period from 2022 to 2024.

Study Population: The population of the study included all patients receiving hemodialysis treatment at the Al-Borgage dialysis center.

Sampling: A total coverage sampling method was applied, encompassing all patients at the Al-Borgage dialysis center. The study included all 60 registered patients at the center.

Inclusion and Exclusion Criteria: Patients who were undergoing hemodialysis at the Al-Borgage dialysis center were eligible for inclusion in the study. However, patients who refused to participate or were unavailable during the data collection period were excluded.

Study Variables: The study examined several variables, including age, gender, occupation, educational level, and the number of years of dialysis experience.

Data Collection: Data were gathered using a structured questionnaire, which included both open-ended and closed-ended questions.

Data Analysis: The data were analyzed using the Statistical Package for Social Sciences (SPSS) version 11.5. A Chi-square test was applied to assess relationships among variables, with a 95% confidence level.

Results Presentation: The findings were presented through tables and graphs to enhance the clarity of the results.

Dissemination of Results: The results of this study will be shared with the administration of the Al-Borgage dialysis center and relevant state authorities. Additionally, the findings will be submitted for publication in a scientific journal.

Study Limitations:

The main limitation is the small sample size (n=60), which may not represent all CKD patients in Northern Sudan. Also, data from a single center and self-reported questionnaires may introduce bias.

Results

Table 1: Demographic Factors of Study Population in Alborogage Center (2022)

Factor	Category	Frequency	Percent
Age	18-30 years	5	8.3%
	31-40 years	9	15%
	41-50 years	22	36.7%
	More than 50 years	24	40%
Gender	Male	44	73.3%
	Female	16	26.7%
Education Level	Illiterate	8	13.3%
	Primary	7	11.7%
	Medium	16	26.7%
	Basic education	11	18.3%

	Secondary	15	25%
	University	2	3.3%
	Above university	1	1.7%
Income Level	Less than 10000 pounds	31	51.7%
	10000-20000 pounds	8	13.3%
	21000-40000 pounds	6	10%
	More than 40000 pounds	15	25%
Occupation	Unemployed	28	46.6%
	Housewife	16	26.7%
	Business	4	6.7%
	Employees	12	20%
Marital Status	Single	6	10%
	Married	47	78.3%
	Divorced	4	6.7%
	Widow	3	5%

Table 2: Period of Disease Onset Among Study Population in Alborogage Center (2022)

Occurrence of the Disease	Frequency	Percent
A year ago	9	15%
Before 2 years	7	11.7%
3 years	14	23.3%
More than 3 years	30	50%
Total	60	100%

Table 3: Duration of Diabetes Among Study Population in Alborogage Center (2022)

Duration with Diabetes	Frequency	Percent
No Diabetes	46	76.7%
Less than 1 year	1	7.1%
1-5 years	2	14.2%

5-10 years	6	42.9%
More than 10 years	5	35.7%
Total	60	100%

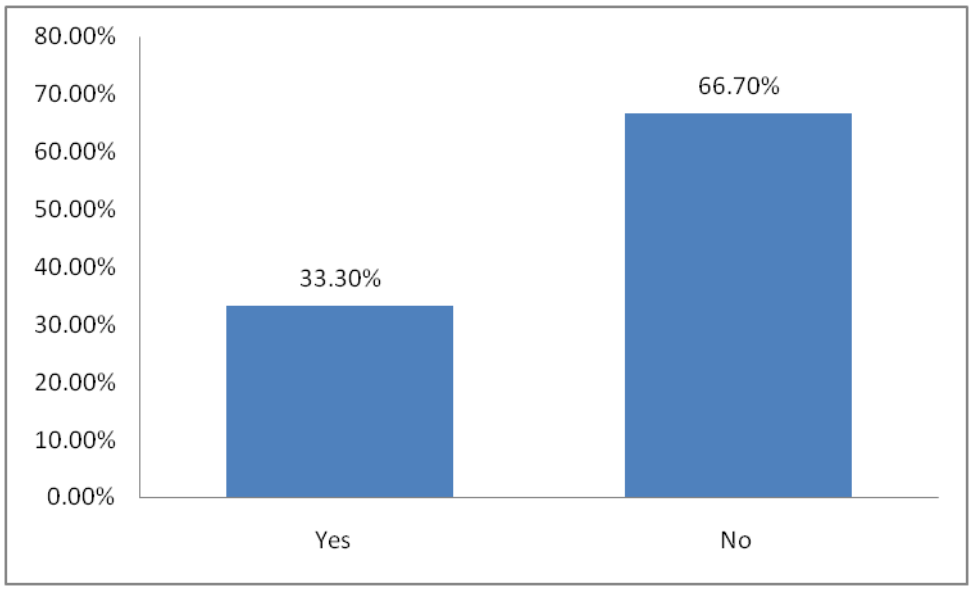


Figure 1: Presence of the disease in the family among study population in Alborgage center (2022)

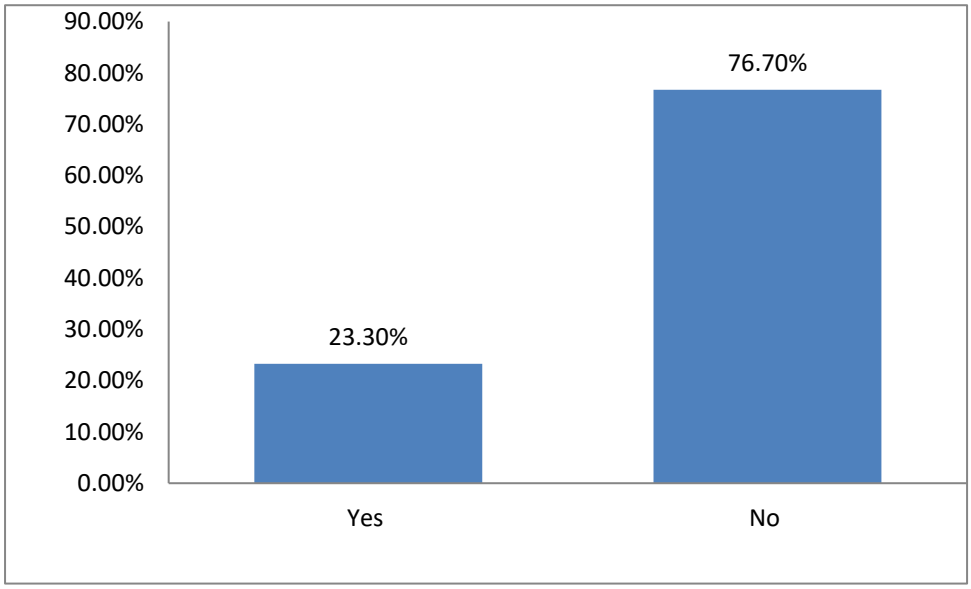


Figure 2: Presence of patients with diabetes among study population in Alborogage center (2022).

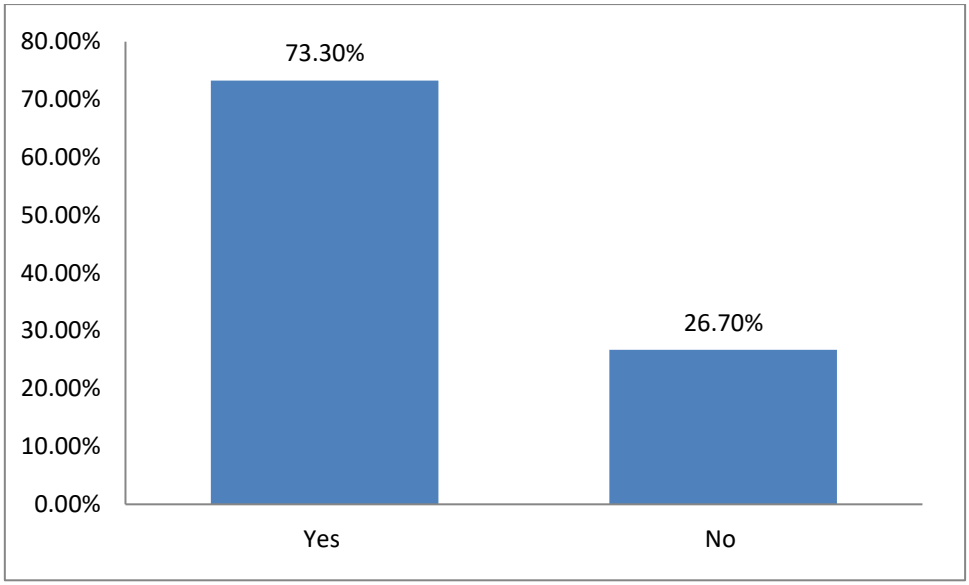


Figure 3: Presence of patients with hypertension among study population in Alborogage center (2022).

Discussion

This study was conducted among patients with renal failure at the Al-Brogage Dialysis Center in Northern Sudan to explore the demographic factors, risk factors, and complications associated with chronic kidney disease (CKD) in this population. The findings indicate a high prevalence of renal failure in males and older adults, with hypertension, diabetes, and obesity identified as the primary risk factors. The following discussion compares the results with relevant literature and provides an analysis of the findings.

Demographic Factors

The study revealed that 73.3% of the patients were male, while 26.7% were female. This gender distribution is consistent with a global trend where males are generally at a higher risk of developing renal failure (Iseki, 2005) [2]. Additionally, the highest prevalence of kidney failure was observed in patients over the age of 50 years (40%), with 36.7% of patients aged 41-50 years. The association between advancing age and an increased risk of kidney failure has been widely documented. A study conducted in Khartoum State, Sudan, in 2014 similarly showed a higher incidence of kidney disease in older adults, particularly in those over 50 years (Sudan Hemodialysis Study Group, 2014) [10]. This supports the notion that age is a significant risk factor for the development of CKD, possibly due to the cumulative effect of various comorbidities over time.

Risk Factors

Hypertension emerged as a prevalent risk factor, with 73.3% of the study participants affected. This is consistent with findings from various studies that have identified hypertension as a major contributor to CKD (Coresh et al., 2005) [5]. Hypertension leads to increased pressure on the kidneys, which over time causes damage to the blood vessels and filtration system. In the Sudanese study by Sudan Hemodialysis Study Group (2014) [10], hypertension was also found to be a leading cause of renal failure, although at a slightly lower prevalence (38.4%). The higher rate of hypertension in this study may reflect regional differences or the impact of environmental and lifestyle factors.

Diabetes mellitus was present in 23.3% of participants, which aligns with the well-established link between poorly controlled diabetes and kidney damage. A study by Song et al. (2009) [3] also found that diabetes is a significant risk factor for end-stage renal disease (ESRD), with elevated blood sugar levels leading to damage to the glomeruli, the filtering units of the kidneys. Poor management of diabetes in this population may be a contributing factor to the high incidence of renal failure.

Obesity was observed in 40% of the patients, highlighting the impact of lifestyle factors such as diet and physical inactivity on kidney health. This finding is consistent with research by Kovesdy et al. (2017) [11], who noted that obesity is a key risk factor for CKD due to its association with hypertension, diabetes, and other conditions that

exacerbate kidney damage. Obesity can also contribute to the development of metabolic syndrome, which further increases the risk of renal dysfunction (Kovesdy et al., 2017) [11]. The high rate of obesity in this study suggests that dietary interventions and increased awareness about healthy lifestyles are crucial for preventing CKD.

Smoking: Cigarette smoking is a significant modifiable risk factor for chronic kidney disease (CKD). A large-scale Japanese cohort study involving over 149,000 participants found that smoking was associated with a 24% increased risk of kidney function deterioration in men and a 27% increased risk in women, even after adjusting for other variables . Additionally, a Korean community-based cohort study reported that current smokers had a 26% higher risk of developing CKD compared to never-smokers, highlighting the detrimental impact of smoking on renal health **.** [12, 17], have demonstrated that smoking can lead to kidney damage through mechanisms such as glomerular hyperfiltration and proteinuria, which can eventually progress to kidney failure. In this study, the prevalence of smoking is relatively low compared to other risk factors, but it still represents a modifiable risk factor that should be addressed in educational campaigns aimed at preventing CKD.

Family History of Kidney Disease was reported by 33.3% of the study participants. A family history of CKD is an important risk factor for the disease, as genetic predispositions can increase the likelihood of developing kidney failure. Matsushita et al. (2010) [13] emphasized that individuals with a family history of kidney disease are at a higher risk of developing the condition and its associated comorbidities. This finding underscores the importance of screening individuals with a family history of kidney disease for early detection and intervention.

Socioeconomic Status

The study found that 51.7% of participants had a low income, which is a significant concern as low socioeconomic status has been linked to poor health outcomes. A study by Orlando et al. (2015) [14] found that individuals with lower incomes are more likely to engage in unhealthy dietary practices, which can exacerbate the risk of kidney disease. In this study, low-income individuals had limited access to healthy foods, which could contribute to poor disease management and complications such as anemia. Furthermore, limited access to healthcare services in low-income populations may

hinder early diagnosis and the proper management of renal failure, leading to worse outcomes (Orlando et al., 2015) [14].

Complications of Kidney Failure

The study also examined the complications associated with CKD. Chronic hypertension was the most common complication, affecting 60% of participants. Hypertension is both a cause and a complication of CKD, as it worsens kidney function over time by damaging blood vessels and increasing glomerular pressure. This result aligns with Abramson et al. (2003) [15], who identified hypertension as one of the most common complications of kidney failure.

Anemia was reported by 33.3% of participants, which is consistent with findings from other studies on CKD patients (Abramson et al., 2003) [15]. Anemia in CKD is often caused by reduced erythropoietin production, a hormone that stimulates red blood cell production. As kidney function declines, erythropoietin levels decrease, leading to anemia. This highlights the need for regular monitoring and management of hematologic parameters in patients with CKD.

Additionally, 6.7% of the participants had heart disease, which is a common complication of CKD. Cardiovascular diseases are prevalent in CKD patients due to the shared risk factors of hypertension, diabetes, and obesity, which further complicate kidney function (Coresh et al., 2005) [5].

Knowledge and Dietary Adherence

The study revealed that 68.3% of participants had good knowledge about the causes of kidney failure. However, despite this awareness, 51.7% of the patients did not adhere to recommended dietary practices. This discrepancy suggests that while knowledge about CKD risk factors is prevalent, adherence to preventive measures such as dietary modifications remains a challenge. This may be due to socioeconomic barriers, such as the inability to afford healthy foods or the lack of access to healthcare services, as noted in the findings of Orlando et al. (2015) [14].

Conclusion

In conclusion, the findings of this study highlight the critical role of age, hypertension, diabetes, obesity, and smoking as major risk factors for renal failure in Sudanese patients. The study also emphasizes the significant impact of socioeconomic status on kidney disease progression, with low-income individuals facing barriers to proper nutrition and healthcare. The high prevalence of hypertension and anemia as complications of CKD further underscores the need for better management strategies, including dietary education and regular monitoring of patients. Interventions targeting lifestyle modifications and increased awareness about kidney disease are essential for improving outcomes and preventing the progression of CKD in this population.

Declarations

Ethical Considerations: The study received approval from the University of Shendi. Informed consent was obtained from all patients who agreed to participate, and confidentiality was assured by assigning participant codes, with only the researcher having access to these codes. Written permission was obtained from the general manager of the Al-Borgage dialysis center to conduct the research.

Consent for publication:

Not applicable

Competing interests

The authors declared no conflict of interest.

Availability of data and materials;

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

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Authors' contributions

AY designed the study and collected data. HE and ASMA analyzed the data, designed tables and rewired rewrote manuscript text. All authors reviewed manuscript. All authors read and approved the final manuscript. All authors contributed significantly to this work, conceiving

the idea of the research, collection and analysis of data, writing and editing of the manuscript.

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Rrferences:

1 Kazancıoğlu, R. (2013). Factors for chronic kidney disease. *Nature*. https://doi.org/10.1038

2 Tonelli, M., & Riella, M. C. (2014). Chronic kidney disease and the aging population. Kidney International, 85(3), 487–491. https://doi.org/10.1038/ki.2013.440

3 Song, E. Y., McClellan, W. M., McClellan, A., et al. (2009). Effect of community characteristics on familial clustering of end-stage renal disease. *American Journal of Nephrology*, *30*, 499-504.

4 de Lusignan, S., Tomson, C., Harris, K., Van Vlymen, J., & Gallagher, H. (2012). UK prevalence of chronic kidney disease for the adult population is 6.76% based on two creatinine readings (Erratum). *Nephron Clinical Practice*, *120*, c107.

5 Jager, K. J., Kovesdy, C., Langham, R., Rosenberg, M., Jha, V., Zoccali, C., & Pecoits-Filho, R. (2019). Socioeconomic disadvantage and the risk of advanced chronic kidney disease: results from a cohort study with 1.4 million participants. Nephrology Dialysis Transplantation, 34(7), 1182–1189. https://doi.org/10.1093/ndt/gfz039

6 Singh, A. K., Farag, Y. M., Mittal, B. V., et al. (2013). Epidemiology and risk disease in India – results from the SEEK (Screening and Early Evaluation of Kidney Disease) study. *BMC Nephrology*, *14*, 114.

7 Gutiérrez, O. M. (2015). Contextual poverty, nutrition, and chronic kidney disease. *American Journal of Kidney Diseases*, *66*(1), 1-9. https://doi.org/10.1053/j.ajkd.2014.05.005

8 World Life Expectancy. (n.d.). Sudan kidney disease (WHO). Retrieved from https://www.worldlifeexpectancy.com

9 Vela, X. F., et al. (2012). Chronic kidney disease and associated risk factors in two Salvadoran farming communities.

10 Sudan Hemodialysis Study Group. (2014). Prevalence of renal failure in Khartoum State, Sudan. *Journal of Kidney Diseases, 45*(2), 87-91.

11 11Kovesdy, C. P., et al. (2017). Obesity and kidney disease: Pathophysiology and management. *Nephrology Dialysis Transplantation, 32*(3), 416-423.

12 Kawasaki, Y., et al. (2024). Cigarette smoking and progression of kidney dysfunction: a longitudinal cohort study. Clinical and Experimental Nephrology. https://pubmed.ncbi.nlm.nih.gov/38581622/

13 Matsushita, K., et al. (2010). Chronic kidney disease and its risk factors: A population-based study. *Kidney International, 78*(4), 357-365.

14 Orlando, M., et al. (2015). Dietary patterns and kidney disease: Socioeconomic status and nutrition in CKD. *Journal of Renal Nutrition, 25*(1), 49-56.

15 Abramson, J. L., et al. (2003). Complications of kidney failure: Cardiovascular and metabolic risk factors. *Journal of Clinical Nephrology, 8*(5), 1042-1050.

16 O'Hare, A. M., Choi, A. I., Bertenthal, D., Bacchetti, P., Garg, A. X., Kaufman, J. S., & Walter, L. C. (2020). Association of Age With Risk of Kidney Failure in Adults With Stage IV Chronic Kidney Disease. JAMA Internal Medicine, 180(4), 538–546. https://doi.org/10.1001/jamainternmed.2020.0003

17 Kim, H. J., et al. (2020). Association of smoking with incident CKD risk in the general population: A community-based cohort study. Kidney Research and Clinical Practice, 39(3), 276–284. https://pubmed.ncbi.nlm.nih.gov/32853266/