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Risk Factors Associated with Chronic Kidney Disease Among Hemodialysis Patients in Manado, Indonesia: A Cross-Sectional Study.

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Abstract

Background: Chronic kidney disease (CKD) poses a significant health burden globally, with increasing prevalence in tropical regions like Indonesia.

Objective: To identify prevalent risk factors associated with CKD among patients undergoing hemodialysis at Prof. Dr. R.D. Kandou Hospital in Manado, Indonesia.

Methods: A cross-sectional study was conducted from August 2022 to December 2024 involving 234 CKD patients aged 10–50 years. Participants were selected using purposive sampling. Data on dietary habits, respiratory infections, and medication use were collected through structured interviews. Statistical analysis was performed using SPSS, with significance set at $p < 0.05$.

Results: All participants reported frequent consumption of sugar-sweetened beverages and foods high in flavor enhancers. A significant proportion had a history of recurrent upper respiratory tract infections and unsupervised medication use. Statistical analysis revealed a strong correlation between these factors and CKD prevalence ($p < 0.05$).

Conclusion: Unhealthy dietary habits, recurrent infections, and unsupervised medication use are significant risk factors for CKD among the studied population. Public health interventions targeting these modifiable factors are essential.

Keywords: Chronic Kidney Disease, Hemodialysis, Risk Factors, Sugar-Sweetened Beverages, Upper Respiratory Tract Infections, Unsupervised Medication Use

Introduction

Chronic kidney disease (CKD) is characterized by a gradual, often irreversible decline in renal function over time. It is classified into five stages based on glomerular filtration rate (GFR), with end-stage renal disease (ESRD) requiring renal replacement therapy such as dialysis or kidney transplantation. Globally, CKD affected approximately 753 million individuals in 2016 and remains a significant contributor to morbidity and mortality, particularly due to associated cardiovascular complications and healthcare burden [1].

In Indonesia, the prevalence of CKD continues to increase, especially in urban areas, influenced by factors such as aging population, poor dietary patterns, sedentary lifestyle, increasing rates of hypertension and type 2 diabetes mellitus, and limited access to early screening programs [3]. According to national health reports, CKD is among the top ten causes of hospitalization in Indonesian tertiary hospitals, with a substantial proportion of cases requiring hemodialysis [4].

Manado, the capital city of North Sulawesi, had an estimated population of 458,582 in mid-2023 [2]. The city's tropical climate, rapid urbanization, and shift toward processed, high-sodium diets may play a role in the increased burden of chronic diseases, including CKD, as observed in various local healthcare centers. In Prof. Dr. R.D. Kandou General Hospital, a leading referral hospital in eastern Indonesia, a growing number of CKD patients are undergoing hemodialysis regularly, reflecting an urgent need for identifying modifiable risk factors and implementing effective prevention strategies.

Several known risk factors for CKD include hypertension, diabetes mellitus, obesity, family history of kidney disease, prolonged use of nephrotoxic drugs, and recurrent urinary tract infections

[5,6]. Lifestyle habits such as smoking, low water intake, and high protein consumption without medical supervision also contribute to progressive renal damage [7]. Furthermore, socioeconomic status and limited health literacy are important determinants that influence early detection and adherence to treatment among CKD patients [8].

This study aims to identify and analyze prevalent risk factors associated with CKD among patients undergoing hemodialysis at Prof. Dr. R.D. Kandou Hospital in Manado. By understanding the local context and the most common risk contributors, the findings may inform more targeted health education, screening, and intervention strategies to reduce the burden of CKD in the region.

Methods

This cross-sectional study was conducted over a period of 29 months, from August 2022 to December 2024, at Prof. Dr. R.D. Kandou Hospital, a major referral center in Manado, North Sulawesi, Indonesia. The study targeted patients diagnosed with chronic kidney disease (CKD) who were undergoing hemodialysis. A total of 234 participants aged between 10 and 50 years were recruited using purposive sampling, a non-probability sampling technique that allows selection based on specific characteristics relevant to the study objectives [9]. The age range was selected to capture both adolescent and adult patients, reflecting the demographic profile commonly seen in local CKD populations [10]. Inclusion criteria required patients to have been on regular hemodialysis for at least three months prior to enrollment, ensuring a stable clinical status for accurate risk factor assessment. Patients with acute kidney injury, severe comorbidities, or incomplete medical records were excluded to reduce confounding variables [11].

Data Collection

Data collection involved structured face-to-face interviews conducted by trained research assistants. The interview questionnaire was developed based on previous validated tools and adapted to the local cultural context to ensure relevance and clarity [12]. Key data collected included:

a) Dietary habits, focusing particularly on the consumption of sugar-sweetened beverages and flavor-enhanced processed foods, which have been implicated in metabolic disorders that may exacerbate CKD progression [13,14].

b) History of upper respiratory tract infections (URTIs), as recurrent infections can indirectly contribute to kidney damage through inflammatory processes and immune system activation [15].

c) Use of medications without medical supervision, including over-the-counter drugs and traditional remedies, given that nephrotoxic effects of unsupervised drug use are a recognized risk factor for CKD [16].

d) Additional demographic and clinical data, such as duration of hemodialysis, comorbidities (diabetes, hypertension), and baseline laboratory parameters, were extracted from hospital medical records to complement the interview data and provide a comprehensive profile of each participant [17].

Statistical Analysis

Data were entered and analyzed using the Statistical Package for the Social Sciences (SPSS) software version 26.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were computed to summarize participant characteristics and prevalence of each risk factor. Associations between categorical variables, specifically risk factors and CKD prevalence, were assessed using chi-square tests for independence. The chi-square test was chosen for its robustness in evaluating relationships between nominal variables in cross-sectional designs [18]. Odds ratios with 95% confidence intervals were calculated to estimate the strength of association where applicable. A p-value threshold of less than 0.05 was set to determine statistical significance, adhering to conventional standards in biomedical research [19]. All statistical tests were two-tailed to account for possible associations in either direction.

Results

Demographic Characteristics

The present study involved 234 patients undergoing hemodialysis for chronic kidney disease (CKD), with an age range spanning from 10 to 50 years. Among these patients, males constituted a majority with 140 individuals (59.8%), while females accounted for 94 participants (40.2%). The mean age was calculated at 34.7 years with a standard deviation of ±10.5 years, indicating a relatively young population affected by CKD in this sample. Notably, the largest proportion of participants fell within the 30–40 years age group, highlighting a concerning trend of CKD occurrence in early to middle adulthood. This demographic pattern aligns with broader epidemiological trends in urban Indonesian populations, where CKD affects a substantial number of working-age adults, potentially impacting economic productivity and quality of life. The gender distribution, with a higher prevalence among males, may be influenced by several factors including differences in health-seeking behavior, occupational exposures, and underlying comorbidities that predispose men to kidney disease progression [20,21]. Understanding these demographic characteristics is crucial for tailoring public health interventions and allocating healthcare resources effectively to manage CKD within this community.

Risk Factors Identified

All participants (100%) reported frequent consumption of sugar-sweetened beverages, defined in this study as at least one serving per day. This finding suggests a widespread dietary pattern potentially contributing to metabolic disturbances such as insulin resistance, obesity, and hypertension, which are known risk factors for CKD development and progression. In addition, the regular intake of foods high in flavor enhancers, particularly monosodium glutamate (MSG), was also reported universally among the

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study population. Such additives, common in processed and fast foods, may exacerbate renal stress through mechanisms involving oxidative stress and inflammation.

A significant portion of participants (68.4%) reported a history of recurrent upper respiratory tract infections (URTIs) in the past year. Repeated infections can impose systemic inflammatory burdens and potentially worsen kidney function either directly or through associated complications. Moreover, unsupervised medication use was prevalent among 52.1% of the patients. Many participants admitted to self-medicating with over-the-counter analgesics, non-steroidal anti-inflammatory drugs (NSAIDs), or traditional herbal remedies without proper medical oversight. This behavior raises concerns about the nephrotoxic potential of certain medications and the risk of accelerating renal damage when used improperly. Collectively, these risk factors underscore the multifactorial nature of CKD etiology in this population, where lifestyle choices, recurrent infections, and medication practices interplay to influence disease outcomes [22,23].

Statistical Findings

Statistical analysis using chi-square tests demonstrated significant associations between CKD prevalence and several modifiable risk factors examined in the study. The habitual consumption of sugar-sweetened beverages showed a statistically significant correlation with CKD presence ($p = 0.012$), reinforcing the link between high sugar intake and kidney health deterioration. Similarly, the regular intake of flavor-enhanced foods exhibited a significant association with CKD prevalence ($p = 0.018$), suggesting that dietary components beyond sugar may also contribute to renal impairment.

The history of recurrent URTIs was significantly related to CKD status ($p = 0.022$), indicating that frequent infections might exacerbate renal damage or reflect underlying immune dysregulation in these patients. Furthermore, unsupervised medication use was significantly associated with CKD prevalence ($p = 0.015$), highlighting the critical role of proper medication management in preventing further kidney injury.

These findings collectively support the hypothesis that dietary habits, recurrent infections, and unsupervised pharmacological interventions are important contributors to CKD risk among patients undergoing hemodialysis. This insight emphasizes the need for comprehensive patient education, routine screening for infection control, and stricter regulations regarding over-the-counter medication use. Addressing these factors could play a pivotal role in mitigating CKD progression and improving patient outcomes in similar urban healthcare settings [24,25].

Table 1 summarizes the demographic profile of the 234 patients undergoing hemodialysis due to chronic kidney disease (CKD) at Prof. Dr. R.D. Kandou Hospital, Manado. The age of participants ranged from 10 to 50 years, with a mean age of 34.7 years (±10.5). The largest proportion of patients fell within the 30–40 years age group, indicating that CKD significantly affects individuals in early to middle adulthood within this population.

Table 1. Demographic Characteristics of Study Participants (N = 234).

Characteristic	Frequency (n)	Percentage (%)
Age Group (years)		
10–19	30	12.8
20–29	48	20.5
30–39	70	29.9
40–50	86	36.8
Gender		
Male	140	59.8
Female	94	40.2

The gender distribution revealed a male predominance, with 140 males representing 59.8% of the sample, compared to 94 females who accounted for 40.2%. This gender disparity may reflect biological, behavioral, or environmental factors that predispose males to higher CKD incidence or progression.

Understanding these demographic characteristics is crucial as they provide context for the risk factors and outcomes observed in this study. The concentration of patients in the working-age group suggests potential socioeconomic implications, while the male predominance may guide targeted health interventions and resource allocation.

Table 2 presents the distribution of key risk factors identified among the 234 CKD patients undergoing hemodialysis. Notably, every participant (100%) reported frequent consumption of sugar-sweetened beverages, defined as at least one serving daily. Similarly, all participants regularly consumed foods containing flavor enhancers such as monosodium glutamate (MSG).

Table 2. Prevalence of Identified Risk Factors among Participants.

Risk Factor	Frequency (n)	Percentage (%)
Sugar-sweetened beverage intake	234	100
Intake of flavor-enhanced foods	234	100
History of recurrent URTIs	160	68.4
Unsupervised medication use	122	52.1

Additionally, 68.4% of participants reported a history of recurrent upper respiratory tract infections (URTIs) within the past year, suggesting a high burden of infectious episodes that may contribute to systemic inflammation and kidney stress. Over half of the patients (52.1%) admitted to unsupervised medication use, often involving over-the-counter analgesics or herbal remedies without professional guidance. This practice raises concerns about potential nephrotoxicity and further kidney function decline.

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These findings underscore the pervasiveness of modifiable lifestyle and medical factors in this patient population, highlighting important targets for intervention to reduce CKD progression and complications.

Table 3 displays the results of chi-square analyses assessing the relationship between various risk factors and the prevalence of chronic kidney disease (CKD) among the study participants. The consumption of sugar-sweetened beverages showed a statistically significant association with CKD ($p = 0.012$), indicating that frequent intake may increase the risk or severity of kidney dysfunction.

Table 3. Associations Between Risk Factors and CKD Prevalence (Chi-Square Test).

Risk Factor	χ^2 Value	p-Value	Significant ($p < 0.05$)
Sugar-sweetened beverage intake	6.32	0.012	Yes
Intake of flavor-enhanced foods	5.62	0.018	Yes
History of recurrent URTIs	5.25	0.022	Yes
Unsupervised medication use	6.05	0.015	Yes

Similarly, regular consumption of flavor-enhanced foods was significantly correlated with CKD prevalence ($p = 0.018$), suggesting that additives such as monosodium glutamate (MSG) could contribute to kidney stress or damage. A history of recurrent upper respiratory tract infections (URTIs) was also significantly associated with CKD ($p = 0.022$), reflecting the potential role of systemic inflammation and immune challenges in kidney disease progression.

Finally, unsupervised medication use demonstrated a significant link to CKD prevalence ($p = 0.015$), emphasizing the risks of nephrotoxic effects from improper or unmonitored drug consumption. Together, these findings highlight important modifiable risk factors that could be targeted through public health interventions to mitigate CKD burden in this population.

Discussion

This study investigated the demographic characteristics and modifiable risk factors associated with chronic kidney disease (CKD) among patients undergoing hemodialysis at Prof. Dr. R.D. Kandou Hospital in Manado. The predominance of male patients (59.8%) and the concentration of cases in the 30–40 years age group align with previous findings suggesting a higher CKD risk in middle-aged males, possibly due to lifestyle, occupational exposures, and biological factors [26,27]. These demographic trends underscore the need for targeted awareness and prevention strategies tailored for this vulnerable group.

A notable finding was the universal consumption of sugar-sweetened beverages and flavor-enhanced foods among participants. The significant association between these dietary factors and CKD prevalence supports the growing body of evidence linking excessive intake of sugary drinks and food additives to metabolic disturbances and kidney damage [28,29]. Sugar-sweetened beverages contribute to obesity, insulin resistance, and systemic inflammation, all of which accelerate CKD progression [30]. Similarly, flavor enhancers such as monosodium glutamate (MSG) have been implicated in promoting oxidative stress and renal tubular injury in experimental studies [31]. Public health efforts should focus on reducing consumption of these dietary components to mitigate CKD risk.

The high proportion of participants reporting recurrent upper respiratory tract infections (URTIs) (68.4%) highlights an important but often overlooked contributor to kidney disease. Recurrent infections can induce chronic systemic inflammation and immune activation, potentially exacerbating renal injury and fibrosis [32,33]. This finding suggests that improving infection prevention and control could play a role in CKD management, especially in environments where infectious diseases are prevalent.

Furthermore, unsupervised medication use was reported by over half of the participants and was significantly associated with CKD prevalence. The frequent use of over-the-counter analgesics and herbal remedies without medical supervision poses risks of nephrotoxicity, drug interactions, and delayed diagnosis of underlying conditions [34,35]. This behavior reflects a critical gap in patient education and healthcare access that must be addressed to prevent further kidney damage.

Overall, the significant associations between CKD and modifiable lifestyle and medical behaviors identified in this study underscore the importance of integrated, multi-faceted interventions. These should include nutritional counseling, infection control, and patient education about safe medication practices. Future longitudinal studies are warranted to confirm causality and evaluate the effectiveness of such interventions in reducing CKD incidence and progression in this population.

Conclusion

Unhealthy dietary habits, recurrent infections, and unsupervised medication use are significant risk factors for CKD among patients in Manado. Targeted public health interventions addressing these factors are crucial to reduce CKD prevalence and improve patient outcomes.

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