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SMOKING BEHAVIOR CAN INCREASE CREATININE LEVELS IN CHRONIC KIDNEY DISEASE PATIENTS UNDERGOING HEMODIALYSIS

Perilaku Merokok dapat Meningkatkan Kadar Kreatinin pada Pasien Gagal Ginjal Kronik yang Menjalani Hemodialisa

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ABSTRAK

Penyakit ginjal kronik (PGK) merupakan penyakit tidak menular dengan angka morbiditas dan mortalitas yang tinggi, sering kali memerlukan terapi hemodialisis. Kadar kreatinin serum berfungsi sebagai indikator utama dalam menilai kerusakan fungsi ginjal. Merokok diketahui dapat mempercepat kerusakan ginjal melalui berbagai mekanisme. Penelitian ini bertujuan untuk mengetahui hubungan antara perilaku merokok dan kadar kreatinin pada pasien PGK yang menjalani hemodialisis. Metode penelitian menggunakan pendekatan kuantitatif dengan desain cross-sectional, melibatkan 57 responden yang dipilih melalui purposive sampling, data kadar kreatinin diambil dari rekam medis pada kondisi predialisis. Instrumen yang digunakan mencakup kuesioner GN-SBQ dan data laboratorium kadar kreatinin. Hasil menunjukkan seluruh responden merupakan perokok aktif, dengan mayoritas (57,9%) tergolong perokok berat, serta rata-rata kadar kreatinin sebesar 10,90 mg/dL. Uji Spearman menunjukkan hubungan positif yang signifikan antara perilaku merokok dan kadar kreatinin (p = 0,034; r = 0,256). Disimpulkan bahwa terdapat hubungan signifikan dengan kekuatan sedang antara perilaku merokok dan kadar kreatinin. Edukasi berkelanjutan dan konseling berhenti merokok, termasuk pendekatan spiritual, direkomendasikan untuk mencegah kerusakan ginjal kedepannya.

***Kata kunci**: gagal ginjal kronik, hemodialisa, kadar kreatinin, perilaku merokok*

ABSTRACT

Chronic kidney disease (CKD) is a non-communicable disease with high morbidity and mortality rates, often requiring hemodialysis therapy. Serum creatinine levels are key indicators for assessing kidney function impairment. Smoking is known to accelerate kidney damage through various mechanisms. This study aimed to examine the relationship between smoking behavior and serum creatinine levels in CKD patients undergoing hemodialysis. A quantitative approach with a cross-sectional design was employed, involving 57 participants selected through purposive sampling. Instruments included the GN-SBQ questionnaire to assess smoking behavior and laboratory data to measure creatinine levels. Results showed that all respondents were active smokers, with the majority (57.9%) categorized as heavy smokers. The average serum creatinine level was 10.90 mg/dL. Spearman correlation test indicated a significant positive relationship between smoking behavior and creatinine levels (p= 0.034; r= 0.256). In conclusion, there was a statistically significant moderate correlation between smoking behavior and serum creatinine levels. Ongoing education and smoking cessation counseling, including a spiritual care approach, are recommended to prevent further kidney damage.

Keywords: chronic kidney disease, creatinine levels, hemodialysis, smoking behavior

INTRODUCTION

Non-communicable diseases (NCDs), including degenerative diseases such as chronic kidney disease (CKD), remain a major global health challenge due to their high morbidity and mortality rates. NCDs generally develop slowly and persist over a long period of time, and are not contagious between individuals[1]. Chronic kidney failure itself is a type of NCD that contributes the largest amount to health costs and is the main cause of death[2].

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Chronic kidney failure is known as a condition where kidney function gradually declines and cannot return to normal. One of the main parameters used to assess kidney function is the glomerular filtration rate (GFR), which reflects the kidneys' ability to filter blood.[3]. Furthermore, blood creatinine levels are often used as an indicator of kidney function due to their stability and association with renal filtration activity. Creatinine is a byproduct of creatine metabolism in muscles and is excreted through glomerular filtration without reabsorption[4].

Kidney dysfunction can be identified by elevated blood creatinine levels. A doubling of creatinine generally indicates a decline in kidney function of approximately 50%, while a threefold increase indicates a decline in kidney function of approximately 75%.[5]. Decreased kidney function causes an accumulation of creatinine in the body, so that its levels, and affects the kidney's ability to concentrate urine optimally[6].

According to the Kidney Disease Improving Global Outcomes (KDIGO) guidelines, chronic kidney failure is divided into six stages based on GFR values, namely from stage 1 to stage 5. CKD is characterized by a progressive decline in kidney function, which in advanced stages requires replacement therapy such as dialysis or kidney transplantation.[7]In general, hemodialysis is performed on patients with stage 5 CKD who are unable to undergo a kidney transplant[8].

Various factors can contribute to kidney failure, both related to lifestyle and medical history. Habits such as smoking, alcohol consumption, excessive use of traditional medicines and energy supplements, and low water intake are known to trigger the development of CKD.[9]. In addition, other diseases such as hypertension, diabetes, urinary tract infections, kidney stones, lupus, chronic glomerulonephritis, and polycystic kidney disease are also risk factors[10].

Data from WHO states that there are around 500 million CKD sufferers in the world, and 1.5 million of them undergo hemodialysis.[11]In Indonesia, the 2023 Indonesian Health Survey showed that the prevalence of chronic kidney disease (CKD) was 0.18%, or approximately 638,178 cases, and hemodialysis therapy remained the primary treatment option. The number of patients undergoing hemodialysis increased from 19.33% in 2018 to 21.3% in 2023. West Java was the province with the highest number of CKD cases, with 114,619 cases diagnosed by doctors. A preliminary study conducted at Welas Asih Regional Hospital in 2024 showed that from January to September 2023, 426 patients routinely underwent hemodialysis at the hospital.

The same survey also reported that smoking prevalence in Indonesia remains high, with 22.46% being daily smokers and 4.56% being occasional smokers. West Java recorded the highest percentage of smokers in Indonesia, at 27.0%, which contributes to the high rate of chronic kidney disease (CKD) in the region. Smoking is known to cause kidney damage through two mechanisms: hemodynamic and non-hemodynamic. Nicotine in cigarettes can increase blood pressure and heart rate through activation of the sympathetic nervous system, while angiotensin II exacerbates kidney damage through hypertension, proteinuria, and fibrosis. Furthermore, smoking also triggers oxidative stress, endothelial dysfunction, and metabolic disorders, as well as causing toxic effects on renal tubules, insulin resistance, and hypoxia due to carbon monoxide[12].

Research conducted by Sangmi Lee et al. (2020)[13]showed that an average duration of smoking of 23.6 years can significantly reduce GFR, with the rate of GFR decline in smokers reaching -1,569 mL/minute/1.73 m^2 per year, compared to -1,282 ml/minute/1.73 m^2 in non-smokers. Another study by Syamsi et al. (2021)[14] showed a significant association between smoking and increased creatinine levels and decreased GFR. This finding is supported by a study by Eid et al. (2022)[15], who found that both active and passive smokers had higher serum creatinine and urine albumin levels than non-smokers.

Given the high prevalence of chronic kidney disease (CKD) and smoking habits, particularly in West Java, this study aims to examine the relationship between smoking and creatinine levels in chronic kidney disease (CKD) patients undergoing hemodialysis at

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Welas Asih Regional Hospital. Creatinine levels were measured before dialysis, reflecting the accumulation of metabolic toxins during the interdialytic period (the interval between sessions).

METHODS

This research was an analytical observational study with a cross-sectional approach. The study was conducted in the Hemodialysis Room of Welas Asih Regional Hospital to analyze the relationship between smoking behavior and creatinine levels in chronic kidney failure patients. The study subjects were 57 hemodialysis patients who were selected purposively, referring to the inclusion criteria, namely smoking duration of more than 1 (one) year, smoking intensity of at least 1 pack per day, undergoing hemodialysis for more than 6 months regularly once or twice a week, while the exclusion criteria were patients whose condition was unstable.

The measurement tools used included the Glover-Nilsson Smoking Behavior Questionnaire (GN-SBQ) questionnaire, consisting of 11 items to assess the duration, frequency, and intensity of smoking, as well as the latest creatinine value data obtained from patient medical records after undergoing Hemodialysis. The analytical method chosen in this study was Spearman's rank correlation test to identify the correlation between the two variables. The research's ethical feasibility was approved on April 21, 2025, with the number: 46/KEPK/EC/IV/2025

RESULT

Table 1. Overview of Respondent Characteristics

Variables	Characteristics	n	Percentage
Gender	Male	57	100%
	Female	0	0%
	Total	57	100%
Age Group (years)	17 – 25	4	7%
	26 – 45	23	40.4%
	46 – 65	27	47.4%
	>65	3	5.3%
	Total	57	100%
Level of education	Elementary School	14	24.6%
	Junior High School	18	31.6%
	Senior High School	19	33.3%
	College	6	10.5%
	Total	57	100%
Smoking Status	Yes	57	100%
	No	0	0%
	Total	57	100%
Smoking Intensity (Brinkman Index)	0-199 (Light Smoker)	29	50.9%
	200-599 (Moderate Smokers)	22	38.6%
	>600 (Heavy Smokers)	6	10.5%
	Total	57	100%
Duration of Hemodialysis	<12 months	12	21.1%
	1-3 years	29	50.9%
	>3-5 years	8	14%
	>5 years	8	14%
	Total	57	100%

Table 1 shows that all respondents were male (100%) and all were active smokers. Nearly half of the respondents were aged 46–65 years (47.4%) and 26–45 years (40.4%). The highest educational attainment was high school (33.3%), followed by junior high school (31.6%) and elementary school (24.6%), with only 10.5% being college graduates. Based on the Brinkman Index, most respondents were light (50.9%) and moderate (38.6%) smokers, while only 10.5% were heavy smokers. The most common duration of

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hemodialysis was 1–3 years (50.9%), while the rest were <12 months (21.1%), >3–5 years (14%), and >5 years (14%).

Table 2. Results of Smoking Behavior

Category	n	Percentage (%)
Light	3	5.3
Currently	18	31.6
Strong	33	57.9
Very strong	3	5.3
Total	57	100

Table 2 shows that the majority of respondents, 33 respondents (57.9%), fell into the strong smoking category. This finding indicates that the majority of respondents still maintain a high-intensity smoking habit, which has the potential to exacerbate kidney damage.

Table 3. Creatinine Level Results

Variables	Mean ($\bar{x}$)	Standard Deviation
Creatinine	10.90	4,284

Table 3 shows that the mean creatinine level reached 10.90 mg/dL, indicating that respondents' creatinine levels were generally well above the normal limit, indicating severe kidney dysfunction. The standard deviation of 4.284 indicates a fairly wide variation or spread in creatinine values among respondents.

The Spearman's Rank Correlation test was chosen because the data were not normally distributed according to the results of the Kolmogorov-Smirnov normality test with a p-value <0.05. Ordinal scale data that has extreme outliers, because Spearman's rho works based on ranks, not absolute values.

Table 4. Relationship between Smoking Behavior and Creatinine Levels

Variables	n	r^2	*p-value*
Smoking Behavior	57	0.256	0.034
Creatinine	57	1	

Table 4 shows a moderate positive correlation between smoking behavior and creatinine levels in patients with chronic kidney disease. The correlation coefficient value of r = 0.256 and p-value of 0.034 ($\alpha \leq 0.05$) indicate that the relationship is statistically significant. In other words, the higher the smoking behavior score based on the GN-SBQ questionnaire, the higher the creatinine level tends to be.

DISCUSSION

The Relationship Between Smoking Behavior and Creatinine Levels in Chronic Kidney Failure Patients in the Hemodialysis Ward of Welas Asih Regional Hospital

This study found a significant relationship between smoking behavior and creatinine levels in chronic kidney disease patients undergoing hemodialysis at Welas Asih Regional Hospital. The analysis showed a p-value of 0.034 ($\alpha \leq 0.05$) and a correlation coefficient of r = 0.256, indicating a moderately strong positive association between the two variables. In other words, the higher the intensity and frequency of smoking behavior in patients, the higher the blood creatinine levels tend to be.

All participants in this study were active smokers, and the majority (57.9%) fell into the heavy smoking category. Others (31.6%) fell into the moderate smoking category, and the remainder fell into the light and very heavy smoking categories (5.3% each). This reflects the persistence of smoking habits despite the patients' serious kidney problems.

Several factors contribute to smoking behavior, including low education levels, social support, and psychological pressures such as stress. Findings from Yahya et al. (2022)[16], explained that low levels of education lead to a lack of understanding of health risks, so individuals tend to maintain smoking behavior. Meanwhile, research by Widyorini et al. (2023)[17] shows that among adult men, smoking is often seen as part of social interaction and a symbol of masculinity.

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From a medical perspective, smoking is known to accelerate the decline of kidney function through several mechanisms. Chemicals such as nicotine and cadmium in cigarettes can cause narrowing of the renal blood vessels, chronic inflammation, and oxidative stress, which directly damage kidney structure. Nicotine can activate the renin-angiotensin system, increasing angiotensin II levels and triggering vasoconstriction in the renal blood vessels and increasing glomerular pressure. This process results in a decrease in the glomerular filtration rate, which is indicated by increased creatinine levels[18]. Research from Wang & Su (2024) added that rapid nicotine metabolism is associated with more severe kidney damage[19].

Nicotine is known to increase systemic blood pressure (BP), heart rate, and stimulate the release of catecholamines through activation of the sympathetic nervous system[12]. Nicotine-induced increases in blood pressure can be transmitted to the renal glomeruli, causing intraglomerular hypertension. This condition, often accompanied by glomerular hyperfiltration (excessive initial filtration), gradually damages the glomerular capillary structure [14],[20]. Damage to the glomeruli due to this high pressure progressively reduces the kidneys' ability to filter waste, ultimately leading to a decrease in the Glomerular Filtration Rate (GFR) and an increase in serum creatinine levels.

Other studies have shown that nicotine can increase fibrosis (scar tissue formation) and inflammation in the proximal tubules of the kidneys [14]. Induces apoptosis (programmed cell death) in renal podocytes. Podocytes are essential for the integrity of the glomerular filtration barrier [14]. Induces cell proliferation and increased production of extracellular proteins, such as fibronectin, which contribute to the development of glomerulosclerosis[12]. This cellular damage and fibrosis lead to the destruction of kidney structures, reduce the number of functioning nephrons, and accelerate the decline in GFR, which is clinically characterized by a consistent increase in creatinine levels. Furthermore, cadmium, a toxic heavy metal found in cigarette smoke, is known to accumulate in kidney tissue and cause chronic kidney injury. Yan & Allen (2021) reported that up to 50% of cadmium exposure in humans can persist in the kidneys for decades[18].

The kidney, particularly the renal cortex, is the primary target organ for cadmium. Cadmium has a very long biological half-life (15–33 years), meaning it accumulates progressively and persistently over time, causing chronic damage. Cadmium is transported to the kidney bound to the protein metallothionein. This Cd-MT complex is reabsorbed by the proximal renal tubule. Within the tubular cells, this complex is broken down, releasing free Cd ions. Free cadmium ions are highly reactive and cause increased oxidative stress and mitochondrial dysfunction, leading to necrosis (cell death) in the proximal tubule. This damage initially causes tubular dysfunction, characterized by proteinuria (the presence of low-molecular-weight proteins in the urine) and glycosuria, rather than increased creatinine[21],[22].

In addition to structural damage, smoking also disrupts fluid regulation in the body. Nicotine-induced sympathetic nervous system activation leads to decreased renal blood flow, which then triggers excessive thirst. Research by Tampubolon et al. (2024) shows that patients with chronic kidney failure often experience intense thirst, which can worsen fluid overload if not properly controlled[23].

This study has the advantage of addressing a clinically relevant topic, namely the relationship between smoking behavior and creatinine levels in patients with kidney failure, using a correlational research design with real-world clinical data. The instruments used, such as the GN-SBQ questionnaire and creatinine laboratory results, are also valid and reliable, thus supporting the accuracy of the results. However, this study has limitations, including a homogeneous sample of respondents (all male), the failure to control for confounding factors such as comorbidities and other lifestyle factors, and the inability to analyze the duration of hemodialysis therapy in depth. The implications of this study are the importance of smoking cessation education and interventions for patients with kidney failure

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to prevent further kidney damage and serve as a basis for developing more effective health care policies.

CONCLUSION

All participants were smokers, the majority with heavy smoking habits, and had high creatinine levels, indicating severe kidney impairment. Smoking significantly contributes to increased creatinine levels and decreased kidney function. It is recommended that educational programs and interventions to promote smoking cessation are crucial for patients with chronic kidney disease, particularly in efforts to lower creatinine levels, slow disease progression, and improve quality of life. Future studies should consider confounding factors and include a more diverse sample for more comprehensive results.

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