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Research Article

Salty Food Consumption and Its Association with Chronic Kidney Disease Among Older Adults in Indonesia: Findings from the 2023 National Health Survey

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Abstract: Chronic kidney disease (CKD) is an escalating public health issue, particularly among the elderly. High salt intake is a modifiable dietary risk factor suspected to accelerate CKD progression. However, large-scale evidence from Indonesia remains scarce. This study investigates the association between salty food consumption and CKD among older adults in Indonesia. Using data from the 2023 Indonesia Health Survey (Survei Kesehatan Indonesia/SKI 2023), we analyzed 97,339 individuals aged 60 and above. Descriptive statistics outlined participant characteristics, while chi-square tests and binary logistic regression assessed associations and adjusted effects. Statistical analyses were conducted using STATA 14.1, with significance set at $p < 0.05$. Among participants, 89.3% reported consuming salty foods, and CKD prevalence was 0.5%. Bivariate analysis showed significant associations between CKD and sex, education, and salty food intake ($p < 0.001$). Multivariate results indicated that elderly individuals who did not consume salty food had significantly reduced odds of CKD (OR = 0.70; 95% CI: 0.54–0.90; $p = 0.006$), suggesting a protective effect. These findings highlight a strong association between salty food consumption and CKD risk in Indonesia's aging population. Reducing dietary salt intake may serve as an effective, low-cost intervention for CKD prevention. Urgent public health strategies focusing on dietary behavior change and nutrition education for the elderly are needed to curb the rising burden of kidney disease.

Keywords: Chronic kidney disease; elderly; salty food; sodium intake; Indonesia; SKI 2023; public health

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1. Introduction

Chronic kidney disease (CKD) is an increasing global health challenge, particularly among older individuals. This condition is marked by a slow decline in kidney function over time, often leading to end-stage renal disease necessitating dialysis or kidney transplantation. The Global Burden of Disease Study indicated that the prevalence of CKD has been on the rise, affecting more than 850 million people worldwide. Older adults are particularly at risk due to age-related physiological changes and the buildup of other health conditions.[1-3].

Chronic kidney disease (CKD) is a significant public health concern in Indonesia. National health surveys indicate an increasing prevalence of CKD among those aged 60 and older, largely due to lifestyle-related risk factors like high blood pressure, diabetes, and poor dietary practices.[4-7]. Among these factors, overconsumption of salty foods, which are high in sodium, has been identified as a significant modifiable risk factor. Excessive sodium consumption is linked to elevated blood pressure, increased glomerular filtration, and dysfunction of the renal endothelium, all of which play a role in CKD progression. [8-10].

Although sodium reduction is globally acknowledged as a crucial approach for preventing CKD, there is a shortage of extensive population-based research exploring the connection between salty food intake and CKD among the elderly in Indonesia. The complexity of this issue is further increased by cultural dietary habits, availability of regional foods, and differences in health literacy, underscoring the necessity for localized research data.

In light of this context, the current study seeks to explore the link between the intake of salty foods and the incidence of chronic kidney disease among the elderly in Indonesia, utilizing data from the 2023 Indonesia Health Survey (SKI 2023). The results are anticipated to guide public health strategies for dietary interventions and prevention of CKD in aging populations.

2. Preliminaries or Related Work or Literature Review

Chronic Kidney Disease (CKD) poses a significant health challenge worldwide, and its occurrence is particularly elevated among older adults owing to the natural aging process and the buildup of additional health conditions. According to [11], Chronic kidney disease (CKD) affects more than 850 million individuals worldwide, with older adults bearing a significant portion of this burden. In Indonesia, a similar pattern is evident, with a rise in cases linked to lifestyle factors such as high blood pressure, diabetes, and unhealthy eating habits.[12, 13]

2.1. Sodium Intake and CKD Risk

It is well established that consumption of high levels of sodium is a significant risk factor for the development of CKD. From a mechanistic perspective, an excess of sodium can lead to increased blood and glomerular pressure, contribute to endothelial dysfunction, and hasten the loss of nephrons.[14, 15]. Multiple international meta-analyses [16, 17] and guidelines such as KDIGO [18] advocate the reduction of dietary sodium as a preventive measure for CKD. In Indonesia, research examining the direct link between salty food intake and chronic kidney disease (CKD) among the elderly is still limited. Hidayangsih et al. (2023) have documented the national prevalence of CKD and its risk factors, but their research did not specifically examine the impact of dietary sodium on the elderly population.[12].

2.2 Sociodemographic Influences on CKD

Research indicates that the risk of CKD is affected by education level. People with lower educational achievement often have limited access to health information, which can result in unhealthy eating habits and a lack of awareness about diseases. [19, 20]. In a similar vein, differences in sodium intake and CKD outcomes between genders have been observed.[21, 22] men generally consuming more sodium than women [23]. Nevertheless, the impact of marital status on CKD has not been consistently reported in literature.

2.3 Gap in Literature

While sodium consumption is recognized as a modifiable risk factor, earlier studies have either concentrated on the general population or not thoroughly examined the context of older adults in Indonesia. This study fills this gap by utilizing nationally representative data (SKI 2023) to investigate the link between the consumption of salty foods and CKD, specifically focusing on those aged ≥ 60 years. By integrating epidemiological data with socio-behavioral insights, this study offers new evidence to support dietary interventions for older Indonesians. This localized insight is essential for crafting culturally relevant public health strategies to reduce CKD risks

3. Propose Method

3.1. Study Design and Data Source

This study utilized a cross-sectional approach, drawing on secondary data from the 2023 Indonesia Health Survey (Survei Kesehatan Indonesia/SKI 2023). Conducted by the Indonesian Ministry of Health, the SKI is a survey that represents the nation and evaluates the health conditions and behaviors of people in Indonesia. The survey employed a multistage stratified cluster sampling technique and focused on individuals who are 60 years.

3.2. Study Population

After excluding participants with missing information on essential variables such as dietary habits and chronic kidney disease (CKD) status, the analysis included a total of 97,339 elderly individuals aged 60 years and above.

3.2. Variables

The study focused on chronic kidney disease as the dependent variable, determined by either self-reported diagnosis or medical verification in the survey. The primary independent variable was the intake of salty foods, classified as "Yes" for those who consumed salty foods and "No" for those who did not, according to the dietary habit questions in the SKI 2023. The covariates considered were gender (male/female), age group (60–69, 70–79, 80+ years), educational level (no education, elementary school, junior high school, senior high school, college), and marital status (Single, Married, Divorced).

3.2. Statistical Analysis

Descriptive statistics were used to display the frequency distribution of the respondents' characteristics. To explore the relationship between demographic factors and CKD status, bivariate analysis using the chi-square test was performed. Variables with a p-value less than 0.25 were included in the multivariate analysis. A binary logistic regression model was used to assess the link between the consumption of salty foods and chronic kidney failure, accounting for potential confounding factors. The findings were expressed as odds ratios (OR) with 95% confidence intervals (CI), and statistical significance was determined at $p < 0.05$. All analyses were performed using STATA version 14.1 (StataCorp LLC, College Station, TX, USA).

3.2. Ethical Consideration

The SKI 2023 dataset is accessible to the public and has been anonymized to protect the privacy of participants. Ethical approval for using these secondary data was granted by the Indonesian Ministry of Health. As the study relied on de-identified public data, no further ethical approval was necessary.

4. Results

In this study, 97,339 elderly individuals aged ≥ 60 years were examined. The sample had a slightly higher percentage of females (51.0%) than males (49.0%). Regarding age distribution, the largest group was those aged 60–69 years (68.3%), followed by those aged 70–79 years (24.9%), and those aged 80–112 years (6.8%). Most participants had completed elementary school (42.0%), whereas 26.7% had no formal education. A small percentage had finished senior high school (13.5%), junior high school (10.7%), or college (7.0%). In terms of marital status, a significant proportion of respondents were married (68.4%), with 30.4% divorced and 1.3% single. The majority of participants reported consuming salty foods (89.3%), whereas only 10.7% did not. Interestingly, only 0.5% of the respondents were identified as having chronic kidney disease (CKD), while 99.5% did not report having CKD

Table 1. Frequency Distribution of Characteristic (n = 97,339)

Variable	Frequency (n)	Percent (%)
Gender		
Male	47662	49.0
Famale	49677	51.0
Age Group		
60-69	66435	68.3
70-79	24282	24.9
80-112	6622	6.8
Educational Level		
None	25982	26.7
Elementary	40880	42.0
Junior High School	10431	10.7
Senior High School	13188	13.5
College	6858	7.0
Marital Status		
Single	1222	1.3
Married	66554	68.4
Divorced	29563	30.4
Consumption of salty food		
Yes	86925	89.3
No	10414	10.7
CKD		
Yes	452	.5
No	96887	99.5

Table 2 illustrates the relationship between demographic factors, intake of salty foods, and occurrence of chronic kidney failure (CKD) among older adults in Indonesia. A notable link was identified between sex and CKD status (p = 0.001), with male participants showing a higher likelihood of CKD (0.3%) than female participants (0.2%). The level of education also showed a significant correlation with CKD (p = 0.001), where the highest incidence of CKD was observed in individuals with only elementary education (0.2%) and the lowest was among those who had attended college (0.0%). Conversely, age (p = 0.871) and marital status (p = 0.058) did not demonstrate a statistically significant association with CKD in the elderly population. Notably, there was a strong and statistically significant association between the consumption of salty food and the prevalence of CKD (p = 0.001). Older adults who consumed salty foods were more prone to CKD (0.4%) than those who did not consume salty foods (0.1%).

Table 2. Association between Consumption of Salty Food and Chronic Kidney Disease in the Elderly in Indonesia (n = 97,339)

Variables	Chronic Kidney Disease (CKD)				p-Value
	Yes		No		
	n=452	(0.5%)	n=96.887	(99.5%)	
Gender					0.001*
Male	290	0.3%	47372	48.7%	
Famale	162	0.2%	49515	50.9%	
Age Group					0.871
60-69	304	0.3%	66131	67.9%	
70-79	115	0.1%	24167	24.8%	
80-112	33	0.0%	6589	6.8%	
Educational Level					0.001*
None	97	0.1%	25885	26.6%	
Elementary	159	0.2%	40721	41.8%	
Junior High School	53	0.1%	10378	10.7%	
Senior High School	96	0.1%	13092	13.4%	
College	47	0.0%	6811	7.0%	
Marital Status					0.058
Single	6	0.0%	1216	1.6%	

Married	332	0.3%	66222	68.0%	
Divorced	114	0.1%	29449	30.3%	
Consumption of salty food					0.001*
Yes	376	0.4%	86549	88.9%	
No	76	0.1%	10338	10.6%	

*p=<0.05

Logistic regression analysis was performed to evaluate the relationship between salty food intake and the probability of chronic kidney disease (CKD) in older adults. The findings indicated that seniors who refrained from eating salty foods had a notably reduced risk of developing CKD, with an odds ratio (OR) of 0.70 (95% CI: 0.54–0.90, p = 0.006). This implies that individuals who avoided salty foods had a 30% lower chance of encountering CKD than those who frequently consumed salty foods.

Table 3. Logistic regression

Variable	Odds Ratio (OR)	Confidence Interval (CI)	p-Value
Consumption of salty food			
Yes	1.00	-	-
No	0.70	0.54-0.90	0.006*

5. Discussion

This study highlights a significant association between the consumption of salty foods and the incidence of chronic kidney failure among older adults in Indonesia. These findings suggest that elderly individuals who steer clear salty foods have a markedly lower risk of developing chronic kidney disease (CKD), underscoring the crucial role of dietary habits in maintaining kidney health.

From a pathophysiological perspective, consuming too much sodium has been demonstrated to elevate glomerular pressure and hasten the deterioration of kidney function through mechanisms that involve high blood pressure and endothelial dysfunction.[24-27]. In older adults, the kidneys are especially susceptible due to the loss of nephrons with age, decreased blood flow to the kidneys, and diminished ability to regulate themselves. [28-31]. These bodily changes amplify the effects of dietary sodium on kidney structure and function.

This study's findings align with earlier research indicating that limiting sodium intake can decrease albuminuria and decelerate the advancement of CKD.[32, 33]. Additionally, the Kidney Disease: Improving Global Outcomes (KDIGO) guidelines suggest that reducing salt consumption is a non-drug strategy for people at risk of chronic kidney disease, especially those with high blood pressure or diabetes. [18]

There is a notable link between educational level and the prevalence of CKD. Individuals with less education might have restricted access to health information, which can lead to poorer dietary habits and a lack of disease awareness.[20, 34, 35]. This finding highlights the necessity of implementing health promotion strategies specifically designed for groups with limited health literacy.

The gender differences identified in this study might be attributed to both biological and behavioral influences. Some research suggests that men are more prone to consuming diets high in sodium, which increases their risk of kidney damage associated with hypertension. (Nitsch et al., 2011). Nonetheless, variations in hormones and gender-specific reactions to food consumption might also play a role in this difference.[22, 36, 37]. Unexpectedly, neither age nor marital status showed a significant association with CKD in this group. This could be attributed to the dominant role of changeable lifestyle factors, such as diet, which might obscure the anticipated impact of aging on kidney health.

This study has several limitations. First, the cross-sectional nature of the study restricts the ability to determine causal links between the consumption of salty foods and chronic kidney disease. Although associations were noted, it remains unclear whether high sodium intake occurred before the development of CKD. Longitudinal research is necessary to verify temporal connections. Second, the dietary data in the SKI 2023 dataset were self-reported, which could lead to recall or social desirability biases, particularly among older adults who may underreport unhealthy habits. Additionally, the variable for salty food consumption was

binary, lacking details on frequency, portion size, or sodium content, which limits the accuracy of the dietary exposure assessment. Third, despite controlling for several covariates in the multivariate analysis, residual confounding factors cannot be dismissed. Factors such as comorbidities (e.g., hypertension, diabetes), medication use (e.g., diuretics), and physical activity were not included because of data constraints; however, they could affect both diet and kidney health.

Despite these limitations, this study had significant implications for public health. The results offer strong evidence from a large, nationally representative dataset, emphasizing the need to address the high sodium intake among the elderly. Public health strategies should prioritize nutrition education, food-labeling policies, and community-based awareness initiatives targeting older adults and their caregivers. Furthermore, incorporating routine dietary screening into primary healthcare services for the elderly could help identify at-risk individuals and provide personalized dietary guidance. Considering the increasing burden of CKD in Indonesia, dietary interventions present a cost-effective and scalable approach to slowing disease progression, especially in resource-limited settings

6. Conclusions

This study highlights a notable link between the intake of salty foods and the occurrence of chronic kidney disease (CKD) among the elderly in Indonesia. Older adults who avoided salty foods were less likely to develop CKD, indicating that reducing dietary sodium might help protect kidney health. With increasing rates of CKD and an aging population in Indonesia, there is an urgent need for public health initiatives that encourage low-sodium diets. It is crucial to prioritize nutrition education programs, especially those aimed at older adults and their caregivers, to prevent CKD progression and alleviate the strain on the healthcare system. Future studies employing longitudinal methods and more comprehensive dietary evaluations are suggested to validate these results and to investigate the processes connecting sodium consumption to kidney function over time.

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Data Availability Statement: The dataset utilized in this research can be accessed by requesting it from the Ministry of Health of the Republic of Indonesia through this link: https://www.badankebijakan.kemkes.go.id/data-mikro-ski/

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Conflicts of Interest: The authors declare that they have no conflicts of interest

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