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Association Between Potassium Intake and Potassium Serum Levels Among Hospitalized Patients with Heart Disease at Jombang General Hospital

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ABSTRACT

Heart disease is one of the leading non-communicable diseases worldwide, with a continuously increasing prevalence and a high mortality rate. Potassium plays an important role in maintaining normal cardiac function. Imbalances in potassium levels may lead to serious complications in patients with heart disease. Although dietary potassium intake is considered an important determinant of potassium homeostasis, evidence regarding the relationship between potassium intake and serum potassium levels among hospitalized patients with heart disease remains limited and inconsistent. This study aimed to determine the association between potassium intake and serum potassium levels among patients with heart disease at Jombang Regency General Hospital. This quantitative study employed a cross-sectional design. The study population consisted of all patients with heart disease hospitalized at Jombang Regency General Hospital between March-June 2026 which represented the available patient population at the study site during the study timeframe. A total sampling technique was used, resulting in 44 respondents. Primary data on potassium intake during the previous month were collected through interviews using a Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ). Secondary data on serum potassium levels were obtained from electronic medical records. Data were analyzed using descriptive statistics and the Spearman correlation test with a significance level of 0.05. Most respondents were in the late adulthood age group (46–65 years) (81.8%), male (61.4%), self-employed (36.4%), had a senior high school education (61.4%), had previously received nutrition education (61.4%), and had normal nutritional status (50.0%). The majority of respondents had normal potassium intake (68.2%) and normal serum potassium levels (65.9%). Spearman correlation analysis revealed a significant positive association between potassium intake and serum potassium levels ($p < 0.001$; $r = 0.894$). There was a significant association between potassium intake and serum potassium levels among patients with heart disease. However, the findings should be interpreted with caution, as serum potassium levels may also be influenced by clinical factors such as renal function, medication use, and fluid balance.

INTRODUCTION

Cardiovascular disease (CVD) is a group of disorders affecting the heart and blood vessels, including coronary heart disease, cerebrovascular disease, rheumatic heart disease, and other related conditions. Cardiovascular disease remains the leading cause of death worldwide. According to data from the World Health Organization (WHO), an estimated 17.9 million people (31% of all deaths) died from cardiovascular diseases in 2019[1].

Data from the Basic Health Research Survey in 2013 and 2018 showed an increasing trend in the prevalence of heart disease, rising from 0.5% in 2013 to 1.5% in 2018. In East Java Province, the prevalence of heart disease was reported at 1.5%, indicating that approximately 2–3 out of every 1,000 individuals suffered from heart disease[2]. Based on data from the Hospital Information System in 2022, heart disease was the third most common non-communicable disease in East Java, with a total of 52,316 cases. According to electronic medical record data from Jombang General Hospital in 2023, heart disease was among the ten most common conditions treated in the hospital's inpatient wards [3].

Potassium is a chemical compound that plays a crucial role in maintaining normal cardiac muscle function and the nervous system [4]. Potassium restriction is also associated with sodium retention and potassium depletion. Elevated potassium levels may increase the risk of cardiac arrhythmias, and at higher concentrations, may lead to cardiac arrest. Potassium is one of the most important electrolytes in the body because abnormalities in its concentration can be life-threatening [5]. The kidneys are primarily responsible for maintaining total body potassium balance by matching potassium intake with potassium excretion. However, because renal adjustments to changes in potassium intake require several hours, acute fluctuations in serum potassium concentrations are initially buffered through the redistribution of potassium between the intracellular and extracellular compartments, a process known as internal potassium balance [6]. Following dietary potassium intake, insulin released in response to a meal stimulates cellular potassium uptake through activation of the Na+/K+-ATPase pump, thereby limiting the rise in serum potassium concentration until excess potassium can be excreted by the kidneys. Catecholamines also contribute to potassium regulation, with β2-adrenergic stimulation promoting potassium entry into cells. Therefore, dietary potassium intake is physiologically linked to serum potassium concentrations through coordinated hormonal and renal regulatory mechanisms. In patients with heart disease, these regulatory processes may be altered by impaired renal perfusion, medication use, and fluid imbalance, potentially affecting serum potassium levels and increasing the risk of adverse cardiovascular outcomes[7]

Potassium plays an essential role in maintaining normal cardiac function, particularly in regulating cardiac muscle contraction and stabilizing heart rhythm; therefore, imbalances in potassium levels may have fatal consequences [8].Potassium intake is one of the factors influencing potassium balance in the body and may affect serum potassium levels in patients with heart disease[9]. However, the relationship between potassium intake and serum potassium levels in patients with heart disease remains insufficiently understood and requires further investigation. Therefore, this study was conducted to determine the association between potassium intake and serum potassium levels in patients with heart disease. We hypothesized that potassium intake is associated with serum potassium levels, such that patients with higher potassium intake would have higher serum potassium

concentrations. The findings are expected to provide a basis for developing appropriate nutritional interventions to support nutritional care management in patients with heart disease.

MATERIALS AND METHODS

This study employed a quantitative research approach with a cross-sectional study design. The study population consisted of all patients with heart disease who were hospitalized at Jombang General Hospital between March and June 2026. A total sampling technique was used whereby all eligible hospitalized heart disease patients during the study period were included in the study, resulting in a sample of 44 patients.

The data collected in this study consisted of both primary and secondary data. The primary data included potassium intake during the previous month, which was assessed through interviews using a Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ). The SQ-FFQ was selected because it is a commonly used dietary assessment tool for estimating habitual nutrient intake over an extended period. Prior to data collection, the questionnaire was reviewed by nutrition experts to ensure content validity and clarity. However, as the SQ-FFQ relies on participants' memory of food consumption over the preceding month, the possibility of recall bias cannot be entirely excluded and should be considered when interpreting the findings.

The secondary data consisted of serum potassium levels obtained from the electronic medical records of Jombang General Hospital. Serum potassium levels were measured by laboratory personnel at the Clinical Pathology Laboratory of the hospital using the Ion-Selective Electrode (ISE) method. The study subjects represented the target population who met the eligibility criteria for participation. Patients were included if they were diagnosed with heart disease without comorbid conditions that could significantly affect potassium metabolism or serum potassium levels, such as diabetes mellitus, hypertension, kidney disease, liver disease, cancer, stroke, infectious diseases, or other electrolyte disorders; were willing to participate in the study and provided informed consent; were conscious and able to communicate effectively; and were not experiencing severe dyspnea at the time of data collection. Patients were excluded if they followed special dietary patterns, including vegan, ketogenic, vegetarian, Mediterranean, paleo, or other restrictive diets that could substantially influence potassium intake; were receiving medications known to significantly affect potassium homeostasis or serum potassium levels, such as potassium supplements, potassium-sparing diuretics, loop diuretics, thiazide diuretics, angiotensin-converting enzyme (ACE) inhibitors, angiotensin II receptor blockers (ARBs), or other potassium-modifying medications; or had incomplete dietary intake or laboratory data required for the study analysis.

Univariate analysis was performed to describe the frequency distribution of the study

variables, including potassium intake and serum potassium levels among hospitalized patients with heart disease at Jombang General Hospital. Bivariate analysis was conducted to determine the relationship between potassium intake and serum potassium levels using the Spearman rank correlation test with a 95% confidence level (α = 0.05). The Spearman correlation test was selected because it is appropriate for assessing the relationship between two variables measured on at least an ordinal scale. This study received ethical approval from the Health Research Ethics Committee of Jombang General Hospital (Approval No. 61/KEPK/V/2026).

RESULTS

.**Table 1. Respondents Characteristic**

Characteristics, Measure	Category	Summary
Age, n (%)	21–35 years (Early Adulthood)	2(4,54)
	36–45 years (Middle Adulthood)	6(13,63)
	46–65 years (Late Adulthood)	36(81,81)
Gender, n (%)	Male	27(61,4)
	Female	17(38,6)
Occupation, n (%)	Housewives	12(27,27)
	Self-Employes	16(36,36)
	Private Employee	3(6,81)
	Farmer	4(9,09)
	Teacher	1(2,27)
	Unemployed	6(13,63)
	Retired	2(4,54)
Education Level, n (%)	Elementary School	4(9,09)
	Junior High School	8(18,18)
	Senior High School	27(61,36)
	Bachelor's Degree	5(11,36)
Status Gizi	Severely Underweight	1(2,27)
	Underweight	1(2,27)
	Normal	22(50,00)
	Overweight	9(20,45)
	Obese	11(25,00)
Nutrition Education History	No Previous Nutrition Education	17(38,63)
	Previous Nutrition Education	27(61,36)
Potassium Intake	Inadequate	9(20,45)
	Normal	30(68,18)
	Excessive	5(11,36)
Potassium Serum Level	Low	9(20,45)
	Normal	29(65,90)
	High	6(13,63)

Based on Table 1, the majority of respondents were aged 46–65 years, categorized as late adulthood, comprising 36 respondents (81.8%). Respondents aged 21–35 years (early adulthood) accounted for 2 individuals (4.5%), while those aged 36–45 years (middle adulthood) accounted for 6 individuals (13.6%).

Most respondents were male, with 27 respondents (61.4%), whereas female respondents accounted for 17 individuals (38.6%). Regarding occupation, the largest proportion of respondents were self-employed, totaling 16 individuals (36.4%), followed by housewives with 12 respondents (27.3%), farmers with 4 respondents (9.1%), private-sector employees with 3 respondents (6.8%), unemployed individuals with 6 respondents (13.6%), retirees with 2 respondents (4.5%), and teachers with 1 respondent (2.3%).

In terms of educational attainment, most respondents had completed senior high school, accounting for 27 respondents (61.4%). Respondents with elementary school education numbered 4 (9.1%), junior high school education 8 (18.2%), and bachelor's degree education 5 (11.4%).

The majority of respondents had previously received nutrition education, totalling 27 respondents (61.4%), while 17 respondents (38.6%) had not been exposed to nutrition education.

Regarding nutritional status, most respondents had a normal nutritional status, accounting for 22 respondents (50.0%). One respondent (2.3%) was classified as severely underweight, and one respondent (2.3%) as underweight. Mild overweight was observed in 9 respondents (20.5%), while severe overweight was identified in 11 respondents (25.0%).

Most respondents had normal potassium intake, totalling 30 respondents (68.2%). Potassium intake was categorized as inadequate in 9 respondents (20.5%) and excessive in 5 respondents (11.4%). Most respondents had normal serum potassium levels (65.9%, n = 29). Low serum potassium levels were observed in 9 respondents (20.5%), whereas high serum potassium levels were observed in 6 respondents (13.6%).

Table 2. Results of Spearman Test on Potassium Intake and Potassium Serum Level

Variable	n	P	Coefficient Correlation (r)
Potassium Intake	44	0,000*	0,894
Potassium Serum Level			

*Uji *Spearman* (nilai P<0,05)

Based on Table 2, the results of the Spearman correlation test showed a p-value of 0.000 (< 0.05), indicating that H_0 was rejected and H_1 was accepted. These findings demonstrate a significant association between potassium intake and serum potassium levels among patients with heart disease at Jombang General Hospital. The correlation coefficient was r = 0.894, indicating a strong relationship between the two variables. Furthermore, the positive correlation coefficient (r = 0.894)

suggests a positive directional relationship, meaning that higher potassium intake was associated with higher serum potassium levels.

DISCUSSION

The majority of respondents in this study were categorized as older adults (46–65 years), accounting for 36 respondents (81.8%). This finding is consistent with the study conducted by Melyani et al. at 2023, in which the largest proportion of respondents were aged over 40 years, comprising 58 individuals (58.6%) out of a total of 99 respondents[10]. Similarly, Fuadi et al. at 2023 reported that most respondents were aged 46–55 years, accounting for 36 individuals (40.4%)[11]. Increasing age is associated with a greater risk of developing coronary heart disease. This is attributed to physiological changes that occur with aging, including thickening of the cardiac muscle and alterations in blood vessels [12].The prevalence of coronary heart disease tends to increase among individuals aged ≥45 years [13]. As individuals age, the functional capacity of body tissues and organs gradually declines [14]. Furthermore, advancing age is associated with increased plaque accumulation along arterial walls, which can impair blood flow through the affected vessels. These age-related changes make individuals more susceptible to degenerative diseases such as hypertension, hypercholesterolemia, stroke, and diabetes mellitus, all of which are important risk factors for coronary heart disease [1315]

The majority of respondents in this study were male. This finding is consistent with the study conducted by Fuadi et al at 2023, in which most respondents were male, accounting for 64 individuals (71.9%) [16]. Men have approximately twice the morbidity risk of developing coronary heart disease (CHD) compared with women. Furthermore, CHD tends to occur about ten years earlier in men than in women. Women are relatively protected against CHD due to the presence of estrogen, which exerts a cardioprotective effect. However, following menopause, estrogen levels decline, resulting in a rapid increase in the risk of CHD among women [17].

The majority of respondents were self-employed, indicating that most relied on independent sources of income, such as trading, small businesses, family-owned enterprises, and other informal occupations. Informal employment has been associated with an increased risk of heart disease, as it is often characterized by unstable income, irregular working hours, high levels of economic stress, and limited access to healthcare services. These conditions may contribute to unfavorable health behaviors and reduced opportunities for disease prevention and management, thereby increasing the risk of cardiovascular disease [18]

The relatively low educational attainment of some respondents may influence their motivation and awareness regarding the prevention and management of heart disease. Individuals with lower levels of education often have limited access to health information and may possess lower levels of

health literacy, making it more difficult to understand their medical condition and effectively manage their health. Insufficient knowledge of health-related issues may increase the risk of developing cardiovascular disease. In contrast, individuals with higher educational attainment tend to have greater health awareness and are more likely to adopt healthy behaviors that reduce the risk of coronary heart disease. Education can positively influence health through healthier lifestyles, improved working conditions, and better access to healthcare services. Consequently, higher levels of education are generally associated with increased awareness of healthy living practices, including healthier dietary habits and lifestyle choices.

Most respondents had previously received nutrition education. This may be attributed to the fact that the study was conducted among patients who had already undergone treatment and received nutritional counseling as part of the nutrition care process provided during their hospital visits. As a result, many respondents had been exposed to nutrition education before participating in the study.

This study showed that the majority of patients with heart disease had a normal nutritional status. However, the proportion of respondents with excess nutritional status was also relatively high. This finding warrants attention, as excess nutritional status, particularly overweight and obesity, is a well-established risk factor for cardiovascular disease. Excessive body fat accumulation can increase cardiac workload and contribute to hypertension, dyslipidemia, and metabolic disturbances, all of which may further exacerbate cardiovascular conditions in patients with heart disease.

The majority of respondents in this study had normal potassium intake. This finding is inconsistent with the study conducted by Anggraini in 2017, which reported that most respondents had inadequate potassium intake, accounting for 48 individuals (66.67%)[19]. Inadequate potassium intake is often associated with low consumption of potassium-rich foods, such as fruits, vegetables, legumes, and tubers. This is supported by the Indonesian Health Survey in 2023, which found that 67.5% of Indonesians consume only 1–2 servings of fresh fruits and vegetables per day, far below the recommended intake of at least five servings per day[20]. However, the findings of the present study indicate that the majority of respondents had adequate potassium intake. Nutrition education may increase patients' awareness of the importance of consuming a balanced diet, including foods rich in potassium such as fruits, vegetables, and legumes.

The majority of respondents had normal serum potassium levels. This finding is consistent with the study conducted by Ardika in 2025, in which most respondents also had normal serum potassium levels, accounting for 19 patients (56%)[21]. Hypokalemia is a common adverse effect associated with the combined use of diuretics and digoxin in the treatment of heart failure, as this combination may increase potassium loss and consequently raise the risk of hypokalemia[22].

. The results demonstrated a significant positive association between potassium intake and serum potassium levels among patients with heart disease at Jombang Regency General Hospital.

This positive relationship indicates that higher potassium intake was associated with higher serum potassium levels. These findings are consistent with the meta-analysis conducted by Cappuccio et al. in 2016, which analyzed 20 randomized clinical trial groups involving a total of 1,216 participants and reported that increased potassium intake through oral potassium supplementation was associated with an increase in serum potassium levels of 0.14 mmol/L[23]. Similarly, a study by Yuan et al. in 2023, involving 48 participants, found an association between potassium intake and serum potassium levels, although the correlation was relatively weak[24].

Potassium is the principal intracellular cation in the human body, whereas extracellular potassium represents only a small proportion of total body potassium [25]. To prevent excessive increases in extracellular potassium following an acute potassium load, the body possesses efficient regulatory mechanisms that respond to changes in extracellular potassium concentrations by shifting potassium into cells and enhancing potassium excretion through the kidneys and gastrointestinal tract. These mechanisms maintain extracellular potassium within a safe physiological range of 3.5–5.5 mmol/L [26].

Dietary potassium derived from foods such as fruits, vegetables, legumes, and tubers is almost completely absorbed in the gastrointestinal tract. After ingestion, potassium is absorbed primarily in the small intestine and enters the circulation, resulting in a temporary increase in serum potassium levels[27]. Potassium homeostasis is achieved through appropriate distribution between the extracellular and intracellular fluid compartments and by balancing potassium excretion with potassium intake. Increased potassium intake may transiently elevate serum potassium levels; however, the body subsequently restores balance by promoting intracellular potassium uptake through the sodium-potassium adenosine triphosphatase (Na^+/K^+-ATPase) pump, a process influenced by insulin and catecholamines[28]. In addition, the kidneys increase urinary potassium excretion to maintain serum potassium concentrations within the normal range [29].

Monitoring serum potassium levels is particularly important in patients with heart disease because both hypokalemia and hyperkalemia are common complications associated with pharmacological therapy. Hypokalemia frequently occurs as an adverse effect of the combined use of diuretics and digoxin in the treatment of heart failure [30]. Conversely, patients with elevated serum potassium levels are more likely to be treated with angiotensin-converting enzyme inhibitors (ACE inhibitors) and mineralocorticoid receptor antagonists (MRAs) [31]. Loop diuretics, which constitute a cornerstone of heart failure management, may increase the risk of hypokalemia and ventricular arrhythmias. This effect may partially explain the dose-dependent association between diuretic use and increased mortality reported in observational studies. Furthermore, among patients receiving loop diuretics, adequate dietary potassium intake alone may not be sufficient to maintain normokalemia because substantial renal potassium losses continue to occur.

Given the complexity of serum potassium regulation in patients with heart disease, potassium intake management should be individualized and integrated with pharmacological therapy. Regular monitoring of serum potassium levels is essential to optimize electrolyte balance, prevent potassium-related complications, and support favorable clinical outcomes in this patient population.

The cross-sectional study design can only describe the association between variables and cannot establish a causal relationship. Another limitation of this study is the use of the Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ) to assess potassium intake. In addition, because the SQ-FFQ relies on participants' recall of dietary intake over the previous month, the possibility of recall bias cannot be completely excluded. Previous studies have shown that the assessment of potassium intake using 24-hour urinary potassium excretion is more accurate in reflecting actual potassium intake, as the majority of consumed potassium is excreted through urine. Therefore, urinary potassium is often considered the gold-standard biomarker and may provide a more representative measure of actual potassium intake than the SQ-FFQ method. Another limitation of this study is the relatively small sample size (n = 44), which may have reduced the statistical power of the analysis and limited the generalizability of the findings to broader populations of patients with heart disease. In addition, the study did not statistically control for all potential confounding factors that may influence serum potassium levels, such as fluid intake, disease severity, and other clinical characteristics.

CONCLUSION

The majority of respondents were aged 46–65 years, accounting for 36 respondents (81.8%); were male, accounting for 27 respondents (61.4%); were self-employed (36.4%); had completed senior high school education (61.36%); had been exposed to nutrition education, accounting for 27 respondents (61.4%); and had normal nutritional status, accounting for 22 respondents (50.0%). Most respondents had normal potassium intake, accounting for 30 respondents (68.2%), while the majority also had normal serum potassium levels, accounting for 29 respondents (65.9%). A significant association was found between potassium intake and serum potassium levels among patients with heart disease at Jombang General Hospital, with a strong correlation between the two variables.

The findings may serve as a basis for developing public health nutrition policies aimed at improving potassium intake among vulnerable groups through food fortification strategies, such as the addition of potassium to commonly consumed foods, including salt. Furthermore, this study may provide a foundation for future research, particularly randomized controlled trials (RCTs), to generate stronger evidence regarding the causal relationship between oral potassium intake and serum potassium levels.

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