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RELATIONSHIP BETWEEN INTAKE OF FLUID, POTASSIUM, SODIUM WITH HYDRATION STATUS

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Abstract
Background: Body fluids contain water and electrolytes in which both are needed by the body. The most needed electrolytes in the body are sodium (Na^+) and potassium (K^+). Potassium in the body works with sodium in regulating the body's electrolyte charge. An imbalance of fluids in the body can cause dehydration. This research aims to knowing the relationship between intake of fluid, potassium, and sodium with hydration status. **Method**: This research was an observational study with a cross-sectional approach with 56 samples. The sampling technique used random sampling. Fluid intake was taken with 2x24 hour Food Recall, intake of potassium and sodium was taken with SQ-FFQ. Data were analyzed using the Rank Spearman test. **Results**: The highest fluid intake of respondents was less category at 98,21%. Potassium intake of all respondents included in the category of less. The highest sodium intake of respondents was less category at 94,6%. The highest hydration status of respondents was less hydrated by 73,2%. Based on bivariate analysis showed that there was a relationship between fluid intake and hydration status (p = 0,000), but there was no relationship between potassium intake and hydration status (p = 0,135) and there was no relationship between sodium intake and hydration status (p = 0,414). **Conclusion**: There was a significant relationship between fluid intake and hydration status. There was no relationship between potassium intake and sodium intake with hydration status.

Introduction

Hydration is fundamental for maintaining health and supporting essential physiological functions such as temperature regulation, nutrient transport, and metabolic activity. Inadequate hydration can lead to significant health consequences, including impaired cognitive performance, increased hospitalization, and higher mortality, especially

among vulnerable populations such as the elderly (1). These outcomes highlight the urgent need to understand and promote adequate hydration practices.

Maintaining hydration involves a balance between fluid losses through urine, sweat, and respiration, and fluid gains from beverages, food, and metabolic water. Electrolytes—particularly sodium (Na^+) and potassium (K^+)—are vital in this process. Sodium plays a pivotal role in maintaining osmotic pressure and extracellular fluid volume, primarily due to its status as the major cation in extracellular fluid (ECF) (2). Potassium plays a crucial role in maintaining cellular hydration and electrical activity, collaborating with sodium in creating gradients essential for various cellular functions (3). Imbalances in these electrolytes can disturb fluid homeostasis, leading to conditions such as dehydration, hyponatremia, or hypernatremia (4,5). These imbalances may stem from both physiological factors (e.g., excessive sweating during physical activity) and inadequate dietary intake, underscoring the importance of studying fluid and electrolyte consumption patterns.

In tropical countries like Indonesia, high temperatures and humidity increase fluid loss through perspiration. If this loss is not matched with sufficient intake of water and electrolytes, dehydration may occur more rapidly. However, public awareness regarding hydration, especially the role of electrolytes in maintaining hydration—not just fluid balance—is still low. Most individuals primarily focus on water intake without recognizing the essential contribution of sodium and potassium in sustaining hydration. This limited awareness represents a significant gap, as highlighted in recent studies. Research by Anggraeni and Fayasari (2020) showed a strong relationship between insufficient fluid intake and the occurrence of dehydration with a p value of 0.000. However, research by Maslicha and Anang (2017) did not find a significant relationship between potassium or sodium intake and hydration status in adolescents. These conflicting findings indicate that the relationship between electrolyte intake and hydration status remains unclear and deserves further investigation.

This issue is particularly relevant for students of Physical Education, Health, and Recreation (PJKR), who are at higher risk of dehydration due to frequent engagement in physically demanding activities, particularly field-based training. Physical exertion increases metabolic activity and sweat rate, resulting in higher fluid and electrolyte losses. Despite these elevated needs, hydration practices in this group are seldom studied in depth. Therefore, this study aims to address this research gap by examining the relationship between fluid, potassium, and sodium intake with hydration status among PJKR students. By identifying intake patterns and their associations with hydration outcomes, this research will contribute valuable insights into dietary and behavioral strategies for maintaining hydration in physically active individuals. These findings can inform targeted health promotion interventions aimed at reducing dehydration risk in similar populations.

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Materials and Methods

This study used an observational analytic method with a cross-sectional design to assess the relationship between fluid, sodium, and potassium intake with hydration status at a single point in time. This design was chosen for its efficiency in evaluating associations in populations with stable characteristics, such as university students. While it cannot determine causality, potential confounders were minimized through strict inclusion and exclusion criteria. The study was conducted at the Department of Physical Education, Health, and Recreation, Jenderal Soedirman University, Purwokerto, from October to December 2023. The sample size of 56 students was calculated using the Lemeshow formula, with a 95% confidence level (Z = 1.96), estimated prevalence (p = 0.5), and a margin of error (d) of 0.1. PJKR students were selected due to their high physical activity levels, which increase the risk of fluid and electrolyte imbalance. Inclusion criteria were: aged 18–20 years, willing to participate, not on a special diet, and not using diuretic medications. The age range represents early adulthood, where fluid regulation is relatively stable. Exclusion of certain diets and medications was intended to avoid factors that could independently affect hydration.

Fluid intake was measured using 2 × 24-hour food recall, taken on both a weekday and a weekend to reflect typical patterns. Potassium and sodium intake were assessed using a SQ-FFQ covering the past month, suitable for capturing habitual intake. Both tools were adapted from validated instruments used in previous studies Sari et al (2017) and Briawan et al (2011). Hydration status was assessed using the urine color chart, with color levels 1–3 classified as hydrated, and 4 or more as under-hydrated, based on Armstrong's scale. Data were analyzed using SPSS version 25. Descriptive statistics were used for respondent characteristics, and the Spearman's Rank correlation test was applied to assess relationships between intake variables and hydration status.

Results

Table 1. Characteristics of Respondent

Karakteristik	n	Percentage (%)
Gender		
Male	47	83.9
Female	9	16.1
Age		
18 years	20	35.7
19 years	26	46.4
20 years	10	17.9
Total	**56**	**100**

Based on table 1, of the total 56 respondents involved, the majority were male, 47 people (83.9%) and female, 9 people (16.1%). This composition reflects the general

demographic of students in the Department of Physical Education, Health, and Recreation (PJKR), which is predominantly male. This gender distribution is relevant, as physiological differences between males and females—such as body mass and sweat rate—may affect fluid requirements and hydration status. In terms of age distribution, 35.7% were 18 years old, 46.4% were 19 years old, and 17.9% were 20 years old.

Tabel 2. Relationship between fluid intake and hydration status

	Hydration status				*p value*
	Under-hydrated		hydrated		
	n	%	n	%	
Fluid Intake					
Not Enough	41	73.2	14	25	0.000
Enough	0	0	1	1.8	
Potassium Intake					
Less	41	73.2	15	26.8	0.135
Sodium Intake					
Less	38	67.9	14	25	
Enough	0	0	1	1.8	0.414
More	3	5.4	0	0	

Table 2 presents the relationship between fluid, potassium, and sodium intake with respondents' hydration status. Most respondents (98.21%) had inadequate fluid intake, and 73.2% of them were classified as under-hydrated. Statistical analysis revealed a significant relationship between fluid intake and hydration status (p = 0.000), indicating that lower fluid intake was strongly associated with an increased risk of dehydration. Regarding potassium intake, all respondents had inadequate levels, and 73.2% of them were also under-hydrated. However, the statistical test showed no significant relationship between potassium intake and hydration status (p = 0.135). Similarly, 94.6% of respondents had low sodium intake, and 67.9% of them were under-hydrated, yet the relationship between sodium intake and hydration status was also not statistically significant (p = 0.414).

Although a large proportion of respondents with low potassium and sodium intake were under-hydrated, the lack of statistical significance may be due to several factors. One possibility is the lack of data variability—most respondents had uniformly low potassium and sodium intake, which may have limited the ability to detect a meaningful association. Additionally, the relatively small sample size may have reduced the statistical power to detect a relationship that might exist. These considerations highlight important limitations for interpreting the findings, which will be further addressed in the discussion section.

DISCUSSION

This study confirms a significant relationship between fluid intake and hydration status among PJKR students. Respondents with inadequate fluid intake tended to be under-

hydrated. This finding aligns with the results of Sari et al. (2017) and Armstrong et al. (2007), who found that inadequate fluid consumption leads to dehydration and more concentrated urine. This physiological mechanism can be explained through the role of the antidiuretic hormone (ADH), which regulates water reabsorption in the kidneys. When fluid intake is insufficient, plasma osmolality increases, stimulating the secretion of ADH. This hormone increases the permeability of the kidney's collecting ducts by acting on aquaporin water channels, specifically aquaporin 2 and aquaporin 3, facilitating water reabsorption and resulting in the production of concentrated urine (11). Persistent fluid deficiency poses a significant challenge to maintaining plasma osmolality. While initial ADH release helps conserve water, prolonged dehydration can lead to a failure in maintaining hydration levels, eventually causing dehydration symptoms (11). The type of beverage consumed may also influence hydration. Diuretic drinks such as tea and coffee, commonly consumed by university students, contain caffeine, which increases renal blood flow and inhibits sodium reabsorption—stimulating greater urine output (12). Although this study did not collect specific data on diuretic beverage intake, this should be considered as a potential unmeasured factor influencing hydration status in this population. Future studies should include a more detailed dietary assessment of beverage types.

Despite their high level of physical activity, most respondents had inadequate fluid intake, resulting in 73.2% being under-hydrated. According to and Briawan et al (2011), physical activity increases fluid needs, and insufficient intake during such activity can increase the risk of dehydration. Several factors contribute to students not meeting their hydration needs, including a lack of knowledge about fluid requirements during activities, poor hydration habits, limited access to water during exercise, or misconceptions about thirst. These hypotheses are supported by Anggraeni and Fayasari (2020), who found that both knowledge and behavior influence hydration status among university students. Compared to studies in athletic populations, such as those by Chang et al. (2016), similar trends in underhydration despite increased need have also been reported.

Interestingly, this study found no statistically significant relationship between potassium or sodium intake and hydration status, despite a large proportion of respondents with inadequate electrolyte intake also being under-hydrated. Several factors may explain this result. First, there was very low variability in potassium and sodium intake among respondents nearly all were classified as “less,” which could mask any potential association due to a lack of contrast in the data. Second, the SQ-FFQ method, while useful for estimating long-term intake, may lack sensitivity for detecting detailed micronutrient intake variations. Third, the sample size may have been insufficient to detect subtle correlations between electrolyte intake and hydration, especially if the effect size is small. These findings are consistent with a study by Maslicha and Anang (2017), who also found no significant relationship between potassium and sodium intake with hydration status among

adolescents. However, it is worth noting that those studies, like this one, share limitations in measurement and sampling. An alternative explanation could be that underhydration in this group is driven more by insufficient fluid volume than by electrolyte imbalance, particularly given the relatively uniform deficiency in both potassium and sodium intake across the sample.

Several limitations of this study should be acknowledged. First, the cross-sectional design prevents causal inference, and only associations can be identified. Second, electrolyte intake was self-reported and may be subject to recall bias or underreporting, especially with the SQ-FFQ tool. Third, the lack of data on types of beverages consumed, such as diuretic drinks, is a potential confounder that was not controlled. Fourth, the homogeneity of intake patterns in this population may have limited the ability to detect associations. Finally, the sample size may have been underpowered to detect statistically significant associations for potassium and sodium intake.

Conclusion

This study found a strong and significant relationship between fluid intake and hydration status, indicating that adequate fluid intake is a key determinant of maintaining proper hydration. This emphasizes the importance of promoting regular and sufficient fluid consumption, particularly among individuals engaged in high levels of physical activity such as PJKR students, who are more vulnerable to dehydration. In contrast, no statistically significant relationship was found between potassium and sodium intake with hydration status. While this may reflect a true lack of association in this population, it may also be influenced by factors such as low intake variability, limitations of the dietary assessment method, or unmeasured confounding variables. These findings suggest that future interventions aiming to improve hydration status in active student populations should prioritize increasing fluid intake awareness and behavior. Further research is recommended to explore the role of electrolyte intake using more detailed assessment tools and larger, more diverse samples.

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