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Short Communication

Average Sodium Intake Among Student-Athletes at an NCAA Division II University

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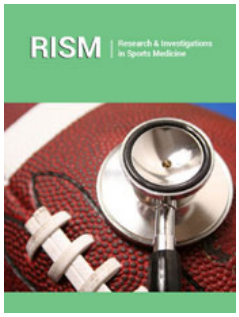

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Abstract

Previous research has shown that individuals experiencing dehydration present with decreased cognitive and physical function when attempting to take part in physical activity. Electrolyte balances, particularly those involving sodium and potassium, can also lead to several conditions that can prove detrimental to the overall health of athletes. As such, hydration strategies are a primary consideration for sports medicine professionals, coaching staffs and athletic administrators when planning athletic events. The sodium consumption of average United States citizens has been previously established in previous literature. However, there is a paucity of literature related to sodium consumption among competitive athletes. Without this information, it is difficult to make recommendations for sodium intake for athletes attempting to prevent dehydration and electrolyte imbalances. Therefore, the purpose of this study was to describe the sodium intake of collegiate athletes at an NCAA Division II institution. A secondary purpose of this study was to assess the difference in sodium intake between male and female collegiate athletes. Participants were recruited for this study via emailed invitations to complete an electronic survey. A total of 112 student-athletes (age=20±2 years, Male=31, Female=81) from an NCAA Division II institution were enrolled in this study. The survey included questions collecting information about demographics, and 42 multiple choice questions from a validated sodium intake questionnaire. The majority of participants in this study expressed positive impressions of the tested beverage Overall, participants reported daily sodium intake at a rate consistent 95.1% of the American Heart Association (AHA) recommendation for ideal daily sodium intake limit. Male participants reported an average daily sodium intake consistent with 116%, and females reported consuming an average of 86% of the AHA recommended limit. On average, females reported consuming significantly less sodium than males ($t(110)=5.146$, $p<.001$). On average, the student-athletes in this study reported sodium consumption that would be considered adequate, or close to adequate, within the framework established by the AHA. Sports medicine professionals, coaching staffs, and athletics administrators should consider the findings of this study when selected hydration options for their athletes.

Introduction

Dehydration and electrolyte imbalances have been studied for years in sports medicine research [1-3]. In most studies, the primary goal has been to examine the impact these conditions have on physical performance, cognitive performance, and mental health [4-7]. Previous research has shown that individuals experiencing dehydration present with decreased cognitive and physical function when attempting to take part in physical activity [4-6]. These deleterious effects of dehydration can present with as little as 2.5% of body weight lost and cognitive symptoms of dehydration have been found to be similar to those in patients suffering from mild traumatic brain injury [7]. As such, hydration strategies are a primary consideration for sports medicine professionals, coaching staffs, and athletic administrators when planning athletic events. Electrolyte balances, particularly those involving sodium and potassium, can also lead to several conditions that can prove detrimental to the overall health of athletes. Low sodium intake has been associated with increased risk of cardiovascular pathologies, regardless of blood pressure levels [8,9]. Low sodium intake can also lead to

insulin resistance, and increased serum levels of renin, aldosterone, epinephrine and norepinephrine [8,10]. Conversely, high sodium intake has been associated with increased risk of kidney disease and damage, osteoporosis and hypertension [11-15]. Patients reporting with chronic hypokalemia, or low serum potassium, are at increased risk for hypertension, cardiovascular disease, and kidney disease [16-19]. There is also evidence to suggest that hypokalemia can have negative effects on the gastrointestinal and nervous system [20]. Patients presenting with hyperkalemia, are also at an increased risk of muscle weakness, paralysis, cardiac arrhythmias and cardiac arrest [21,22].

A number of these studies have also assessed the effects of interventions such as education and taste of hydration beverages on improving hydration practices among athletes and other physically active individuals [4-7,23]. Education sessions have been shown to increase short term knowledge of the importance of proper hydration, though the authors of these studies noted that their findings did not take into account all factors of proper hydration [24,25]. While lack of knowledge was found to be a barrier to proper hydration, lack of sources of food and hydration, lack of finances for securing food and hydration, lack of time to prepare appropriate meals, and a dislike of available food and beverages were also noted to be barriers [26-28]. All these factors should be considered when sports medicine clinicians, coaching staffs, and athletics administrators are considering hydration strategies for their programs. While understanding and addressing barriers to proper hydration strategies is critical, it is also important to ensure that hydration options provided meet the nutritional needs of athletes. While the current recommended daily allowance for sodium is 2300mg, it is important to note that this number is intended to serve as a maximum, rather than a minimum [29]. In fact, the American Heart Association (AHA) has suggested that the ideal limit for sodium in most adults is 1,500mg per day [30].

It has been suggested that some athletes may require more sodium than the average individual. However, this adjustment would be most pertinent for individuals engaging in high level endurance activities. Even then, these individuals like need to increase their sodium consumption by approximately 600mg per day [29]. This information stands in contrast to the fact than on average United States citizens consume an average of twice the recommended dietary allowance of sodium [31,32]. When considering this, the recommendation would likely be for most individuals to reduce sodium consumption. The sodium consumption of average United States citizens has been previously established in previous literature. However, there appears to be a paucity of literature related to sodium consumption among competitive athletes. Without this information, it is difficult to make recommendations for sodium intake for athletes attempting to prevent dehydration and electrolyte imbalances. Therefore, the purpose of this study was to describe the sodium intake of collegiate athletes at an NCAA Division II institution. A secondary purpose of this study was to assess the difference in sodium intake between male and female collegiate athletes.

Methods

Participants

Participants were recruited for this study via emailed invitations to complete an electronic survey. A total of 382 student-athletes competing at an NCAA Division II institute were emailed during the recruitment process. A total of 112 student-athletes (age=20±2 years, Male=31, Female=81) completed the survey, representing a 29.3% completion rate. Additional demographic information for participants is detailed in Table 1.

Table 1: Participant demographic information.

Demographic Factor	Response	Total, Percentage
Sport	Baseball	24, 21.4%
	Basketball	3, 2.7%
	Cheerleading	3, 2.7%
	Golf	1, 0.9%
	Soccer	10, 8.9%
	Softball	33, 29.5%
	Tennis	7, 6.3%
	Track & Field	10, 8.9%
	Volleyball	21, 18.8%
Race	White	100, 89.3%
	Black or African American	7, 6.3%
	Native American/First Nations	3, 2.7%
	Asian	1, 0.9%
	Pacific Islander	1, 0.9%
Hispanic	Yes	23, 20.5%
	No	89, 79.5%

Sodium intake questionnaire

To quantify the average amount of sodium consumed by the survey student-athletes, a previously validated sodium intake questionnaire was used. The instrument consisted of 42 questions prompting participants to quantify their consumption of different types of food and beverages. Each question prompted participants to quantify their consumptions of these foods and beverages on a six-point Likert scale ranging from "Never" to "3+ times a day". Participants' responses are then summated and multiplied by 50 to determine approximate daily sodium consumption in milligrams. Using this equation, a score of 30 would intake a participant was consuming sodium at the ideal limit. The authors who created this instrument validated its accuracy by comparing scores on the survey to urinary sodium values [33].

Data collection

To determine average daily sodium intake, participants were instructed to fill out an electronic survey. The survey included one multiple choice obtaining consent per institutional review board standards, one fill in the blank, and four multiple choice questions intended to gather demographic information. Following

the demographic section, subjects were to answer the 42 multiple choice questions included in the previous described sodium intake questionnaire.

Statistical analysis

Relevant data from the survey was analyzed using a commercially available statistics software package (SPSS Version 28, IBM, Armonk, NY). Frequencies, means, and standard deviations were calculated where appropriate. An independent samples t-test was performed to assess differences in sodium intake between male and female participants. Due to number of responses, differences based on sport, race and ethnicity were not calculated. Significance was set at $p<0.05$ a priori.

Results

Overall, participants scored an average of 28.5±9.6 on the sodium intake question. This equated to an average of daily sodium intake of 1,425±480mg. 1,425mg amounts to 95.1% of the AHA recommendation for ideal daily sodium intake limit. Male participants reported an average daily sodium intake of 1,740±400mg, while female participants reported an average daily sodium intake of 1,290±420mg. As such, male participants reported consuming an average of 116% of the AHA recommended limit, and females reported consuming an average of 86% of the AHA recommended limit. On average, females reported consuming significantly less sodium than males ($t(110)=5.146$, $p<.001$).

Discussion

The purpose of this study was to describe the sodium intake of collegiate athletes at an NCAA Division II institution. A secondary purpose of this study was to assess the difference in sodium intake between male and female collegiate athletes. Overall, the participants in this study reported an average daily sodium intake of 1,425±480mg. Male athletes reported an average daily sodium intake of 1,740±400mg, while female athletes reported an average daily sodium intake of 1,290±420mg. This meant that on average, male collegiate athletes reported consuming 116% of the daily amount of sodium recommended by the AHA on average, with female collegiate athletes consuming 86% of the daily amount of sodium recommended by the AHA on average. It is important to note that 1,500mg of sodium is the maximum end of the range of sodium intake recommended by the AHA for most individuals. Some individuals attempt to increase sodium intake before, during, and after physical activity in an attempt to prevent a condition known as Exercise-Associated Hyponatremia (EAH). EAH develops when serum, plasma, or blood sodium concentration level falls below the normative range [34]. Signs and symptoms of EAH include nausea, headache, lethargy, confusion, short-term amnesia, muscle weakness and cramps [34]. Severe EAH can lead to decreased consciousness or coma and ultimately death [34]. However, the presentation of EAH has been largely attributed to excess water consumption as opposed to low dietary sodium [34]. In fact, previous research has found that even in athletes who have an above average sodium content in their sweat, sodium loss likely only has an additive effect to overhydration [35]. The current evidence to suggest sodium as a primary mechanism for developing EAH is limited, at best [36]. Additionally, two studies of endurance athletes found that sodium supplementation had little to no effect on preserving serum sodium levels [37,38]. Based off this information, the female athletes in this study would likely not be at increased risk of developing hyponatremia.

While certain medical conditions and high-level endurance activities warrant an increase in dietary sodium, many athletes do not require an increase to the recommended dietary sodium limit [19]. In the absence of methods to determine individual sodium loss rates, sports medicine professionals, coaching staff and athletics administrators should use this information when determining the best options for hydrating student-athletes. Another consideration when selecting hydration options for athletes should be the relatively low amount of potassium consumed in the American diet. Even from a global perspective, only 14% of the world's population consumes the recommended amount of daily potassium in their diet [39]. As such, beverages with higher potassium content should be considered when selecting hydration options for athletes. A possible limitation of this study was the relatively small sample size. This study was conducted at a single institution, which posed challenges for recruiting a larger sample size. Compared to other survey-based studies on collegiate athletes, the sample size for this study was comparable [40,41]. Future research should seek to recruit a larger sample size from multiple institutions to allow for more generalizable conclusions. To the authors' knowledge, this is one of the most recent studies to describe the sodium intake of student-athletes at an NCAA institution. This study demonstrated that on average, male collegiate athletes that completed the involved survey exceeded the sodium intake recommendations set forth by the AHA. Furthermore, female collegiate athletes involved in this study were currently consuming 86% of the about of sodium recommended by the AHA. This places the female athletes involved in this study within 240mg of the AHA recommended limit for sodium.

Conclusion

In conclusion, sports medicine professionals, coaching staffs and athletics administrators should consider dietary consumption of sodium and potassium when attempting to select appropriate beverages for hydrating student-athletes. attempting to improve the hydration behaviors of their patients should consider using a similar hydration strategy. On average, the student-athletes in this study reported sodium consumption that would be considered adequate, or close to adequate, within the framework established by the AHA. With the exception of high-level endurance athletes, the majority of the athletic population likely would not require a large amount of sodium supplementation to decrease the risk of developing an electrolyte balance. Future research should attempt to recruit a larger sample size from multiple institutions to allow for the creation of a more generalizable statement on the need for protein supplementation before, during, and after athletic activity. Until such research is conducted, sports medicine professionals, coaching staffs, and athletics administrators should consider the

findings of this study when selected hydration options for their athletes.

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