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Do Saudi football players maintain urine sodium level during A week of training days?

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Abstract: to investigate the weekly level of urine sodium among young Saudi football players by using three spot urine samples during two separate days of exercise. Method: a cross-sectional design was used to implement the study during the official Saudi football league 2015/2016. Twenty-seven football players from the capital of Riyadh, Saudi Arabia, were recruited in the study. Anthropometric measurements (weight, height, age, body fat percentage, and three single urine samples were collected from morning, pre-exercise, and post training each day. Urine samples were collected on two days, with a four-day interval between them. Urine sodium were analyzed in each spot. Calculation of urine sodium samples were added from three spots and divided by three and consider as a 24-hour sample. Descriptive data were reported for characteristics, and a Wilcoxon Signed Ranks Test analysis was used to compare between day 1 and day 2 of urine sodium levels for morning, pre-exercise and post-exercise. Results: all urine sodium levels of the spot samples were in the normal reference range. The urinary sodium measurment values showed an optimal level. There were significant differennces between day 1 and day 2 in the 24-hour urinary sodium level of 112.0 and 84.5 mEq/L, respectively. The results revealed significant differences between day 1 and day 2 in the morning and pre-exercise urinary sodium levels, $P < 0.05$. The analysis of urinary sodium level on day 1 showed that it was higher than on day 2. Conclusion: spot urinary sodium samples showed variation in the urinary sodium levels of football players from day 1 to day 2. Moreover, further studies are needed to investigate urinary sodium for more than five days to assess the status of electolates in the urine samples of atheletes for sodium.

هل يحافظ لاعبو كرة القدم السعوديون على مستوى الصوديوم خلال أسبوع من أيام التدريب؟

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الكلمات المفتاحية: صوديوم البول ، عينة بول ، ترطيب ، إلكتروليتات.

ملخص البحث: الهدف: فحص المستوى الأسبوعي لصوديوم البول بين لاعبي كرة القدم السعوديين الشباب باستخدام ثلاث عينات بول موضعية خلال يومين منفصلين من التمرين .

المنهجية: تم استخدام تصميم مقطعي لتنفيذ الدراسة خلال الدوري السعودي الرسمي لكرة القدم ٢٠١٥/ ٢٠١٦. تم تجنيد ٢٧ لاعب كرة قدم من العاصمة الرياض بالمملكة العربية السعودية في الدراسة. تم جمع القياسات الأنثروبومترية (الوزن ، الطول ، العمر ، نسبة الدهون في الجسم ، وثلاث عينات بول مفردة من الصباح وقبل التمرين وبعد التمرين كل يوم ، وتم جمع عينات البول على يومين بفاصل أربعة أيام بينهما. تم تحليل صوديوم البول في كل عينه، وأضيفت حسابات عينات صوديوم البول من ثلاث عينات صغيره وقسمت على ثلاث واعتبرت عينة مدتها ٢٤ ساعة. تم الإبلاغ عن البيانات الوصفية للخصائص ، واستخدم تحليل اختبار تصنيفات ويلكوكسون للمقارنة بين اليوم الأول واليوم الثاني من مستويات الصوديوم في البول في الصباح وقبل التمرين وبعد التمرين .

النتائج: كانت جميع مستويات الصوديوم في البول في العينات الموضعية في النطاق المرجعي الطبيعي ، وأظهرت قيم قياس الصوديوم في البول المستوى الأمثل. تختلف بين اليوم الأول واليوم الثاني في مستوى الصوديوم في البول على مدار ٢٤ ساعة عند ١١٢,٠ و ٨٤,٥ ملي مكافئ / لتر على التوالي ، وكشفت النتائج عن وجود فروق ذات دلالة إحصائية بين اليوم الأول واليوم الثاني في الصباح وقبل الوجود. تمرين مستويات الصوديوم في البول ، $P < 0.05$. أظهر تحليل مستوى الصوديوم في البول في اليوم الأول أنه كان أعلى مما كان عليه في اليوم الثاني .

الخلاصة: أظهرت عينات صوديوم البول الموضعية تباينًا في مستويات الصوديوم في البول لدى لاعبي كرة القدم من اليوم الأول إلى اليوم الثاني. علاوة على ذلك ، هناك حاجة لمزيد من الدراسات للتحقيق الصوديوم البولي لأكثر من خمسة أيام لتقييم حالة الإلكتروليتات في عينات البول من الأثيليت للصوديوم.

Introduction

Maintenance of electrolytes stability is an important factor of athletes' normal physiological and biochemical functions during intense exercise and competition. Sweating and heat production is caused by the process of muscular contractions and hemostasis of the body's core temperature during exercise in an environment of heat or relatively high humidity (Sawka et al., 2015). Moreover, performance can be decreased or affected by a high volume of sweating during exercise, which, when combined with unhealthy or inadequate dietary intake, can unbalance electrolytes in the human body. Sodium plays a role in maintaining body water hemostasis, sweating, and muscle contraction as an essential electrolyte that regulates fluid balance in the body (Baker, 2017; Periard et al., 2021). Therefore, intense exercise may cause excessive sweating, leading to high sodium loss (Baker, 2017). On the other hand, high sodium intake may cause high blood pressure and is one of the factors of an increased risk of cardiovascular disease (He & MacGregor, 2010; Nagashima et al., 2021). Approximately 90% of sodium found in dietary intake and fluid intake (Institute of Medicine (US) Committee on Strategies to Reduce Sodium Intake, 2010). Athletes have little information regarding the importance of sodium dietary intake and the relationship to exercise and competition performance (McCubbin et al., 2019). Guidelines concerning electrolytes exist in sport nutrition, but there are few recommendations on the benefits of sodium for athletes (Thomas et al., 2016).

Measurement of urinary sodium excretion every 24 hours is considered to be a reliable method of assessing sodium level (Organización Mundial de la Salud, 2016). However, collecting spot urine samples are a practical means of detecting urinary sodium (Kawasaki et al., 1993; O'Donnell et al., 2011; Tanaka et al., 2002). Furthermore, the spot urine collection method is simple and inexpensive for both athletes and non-athletes, especially during the busy season. However, further studies are necessary to indicate whether 24-hour or spot urine sample are more suitable for athletes (Alshuwaier, 2021).

The assessment of spot urine sodium samples of football players has been inadequate (Alshuwaier, 2021). Obliging the assessment of urinary sodium level for athletes, especially during endurance exercise, may support and prove a very practical method to evaluate sodium level and amount in the player's body. In addition, the analysis of urinary sodium could provide good results when measured over a period of days (Lerchl et al., 2015). Spot and 24-hour urinary sodium level has not been previously investigated for periods of more than one day in Saudi football players. Therefore, it is significant to implement a study to assess and detect urinary sodium in spot and 24-hour samples in Saudi football players, who often exercise and compete in hot and humid weather during the season. The aim of the current study was to investigate urinary sodium level using three spot samples and 24-hour samples on two different days among young Saudi football players.

Method:

A cross-sectional design was performed in the current study. The study was implemented during the month of September 2015 in clubs from Riyadh, Saudi Arabia. The permanent ethical approval committee of King Saud University, Riyadh, approved the study (No. 4/67/352673). The main purpose of the study, protocol, and procedures were described to all the football players prior to the preliminary measurements. All players signed the written consent form in which they agreed to participate and were informed of the main purpose of the study and risks of participating during the measurements.

Participants:

Twenty-seven young Saudi football players participated in the study. Football players typically trained three hours daily during the week and played one official game during the Saudi season League 2015/2016 (mean±: age 20.2 ± 0.89 years, weight 66.2 ± 5.15 kg, height 175 ± 4 cm, body fat % 6.6 ± 2.08).

Anthropometric measurements:

Anthropometric assessments were conducted on separate days from players attending the clubs before the collection of urine samples. Measurements of body weight were obtained using a digital scale to the nearest 0.1 kg (Seca 813, Germany), and height was obtained by a stadiometer to the nearest 0.01 cm (Seca 213, Germany). The body fat percentage was calculated by experts with the skinfold thickness measurement method, using a Holtain skinfold caliper (Holtain Ltd., Crymych, UK) at four sites: suprailiac, abdominal, thigh, and triceps. The total sum of the four measurements was calculated to report the percentage of body fat of each player using the following equation (Jackson & Pollock, 1985): body fat percentage = (0.29288 x sum of skinfolds) – (0.0005 x square of the sum of skinfolds) + (0.15845 x age) – 5.76377 (Jackson & Pollock, 1985).

Urine sample collection:

Urine samples were collected from football players on two separate days of exercise. There was a four-day interval between the days. The first day was Sunday and the second day was Friday to avoid the high-intensity match day on Saturday. Football players provided three spot urine samples each day: morning, pre-exercise, and post-exercise. The morning sample was collected two hours after waking up. The second sample was pre-exercise and was collected when players attended the clubs at least one hour before the session of exercise started. The last urine sample was collected three hours after exercise at home. All urine samples were collected by each football player from midstream, and players were provided with a 30 ml sterile tube for each sample. The urine tubes were labeled based on a confidential code for each participant. The urine samples were kept and stored in a specific cold container, then transferred to a sport biochemistry laboratory at the College of Sport Science and Physical Activity at King Saud University for analysis.

Urine sodium level:

The urine sodium levels of all samples were analyzed by intergraded multisensor technology (IMT) (Siemens Dimension Xpand Plus, Germany). Siemens reagent (Siemens QuikLYTE® Integrated Multisensor) was used to detect the urinary sodium levels. The measurement of urinary sodium was based on a direct analysis using 500 µl of urine. In addition, calibration of the instrument was conducted every morning through quality control samples from the company.

Statistical analysis:

Descriptive data were reported as means and standard deviations for the characteristics of the football players. The urine sodium level was presented as a median and interquartile range (IQR). The Wilcoxon Signed Ranks Test was used to compare the differences in urine sodium levels between day 1 and day 2 for morning, pre-exercise, and post- exercise and between the average of three spot urine sodium tests on day 1 and day 2. A significance level of $P < 0.05$ was considered statistically significant. The analysis of all data was performed using IBM's SPSS version 26 (version 26 SPSS, Inc. Chicago, Illinois).

Results:

There were 27 football players involved in the study, and the ages of players ranged from 19 to 22 years. A summary of players' characteristics is presented in Table 1.

Table 1. Characteristics of football players (n = 27)

Variable	Mean ± SD	Min/Max
Age (years)	20.2 ± 0.89	(19 – 22)
Weight (kg)	66.2 ± 5.15	(55.1 – 73.7)
Height (cm)	175 ± 4	(1.63 – 1.82)
Body Fat (%)	6.6 ± 2.08	(3.9 – 13.7)

The results of the analysis showed significant differences in urinary sodium level in the morning and pre-exercise from day 1 and day 2 (Table 2). The results also revealed significant differences between day 1 and day 2 in post-exercise (124 – 84 mEq/L).

Variable	Day 1		Day 2		*P* value
	Median	*IQR*	Median	*IQR*	
Urine Sodium Morning (mEq/L)	110.0	(57 – 183)	72.0	(44.0 – 123.0)	$P < 0.05$
Urine Sodium Pre-exercise (mEq/L)	117.0	(70.0 – 202.0)	93.0	(62.0 – 149.0)	$P < 0.05$
Urine Sodium Post-exercise (mEq/L)	124.0	(54.0 – 163.0)	84.0	(52.0 -146.0)	$P <0.05$
24-hour Urine Sodium (mEq/L)	112.0	(63.3 – 184.5)	84.5	(53.0 – 140.5)	$P < 0.05$

Discussion:

It is known that electrolyte balance is affected by different factors such as fluid intake, sweating, and general dietary intake during the day (Armstrong & Casa, 2009). Consequently, sodium content in daily dietary intake is fundamental to maintaining a typical electrolyte level in the human body (Armstrong et al., 1985). In addition, assessment of urinary sodium level using spot urine or 24-hour samples has been studied in the general population (Cogswell et al., 2018; Rhee et al., 2014). However, to our knowledge, there has been no study of the assessment or investigation of urinary sodium in athletes. Therefore, this study aimed to investigate urinary sodium level by using three spot samples and 24-hour samples in young Saudi football players on two different days.

Electrolytes in sodium play a role in regulating the total body water and control of muscle contractions (Bergeron, 2003; Ganio et al., 2007; Stofan et al., 2005). High-intensity exercise (Cooper et al., 2006) and rigorous endurance training (Schwellnus et al., 2011) have been found to influence the amount of sweat loss, particularly in hot or high-humidity environments. Thus, a high volume of sweating is one of the main factors and reasons for muscle cramps due to dehydration (Maughan & Shirreffs, 2019; Miller et al., 2020). The condition of dehydration is associated with sodium depletion in the human body that may lead to exhaustion during training (Miller et al., 2020). Well-planned strategies to balance the sodium level

through optimal sodium intake achieved from diet and fluid during the day by athletes in hot weather helps the body regulate total water.

The normal reference range of urinary sodium is from 40 to 220 mEq/L (Alshuwaier, 2021). A recent study of young Japanese football players showed a urinary sodium of level of 143.2 mEq/day (Nagashima et al., 2021). In addition, Alshuwaier (2021) found that the urinary sodium level of Saudi soccer players was 104.8 mEq/L using an estimation 24-hour sample, which was lower than that of Japanese football players (Alshuwaier, 2021; Nagashima et al., 2021). The data of the current study revealed a urinary sodium level in a 24-hour sample during day 2 (84.5 mEq/L) to be lower than in recent studies. This result could mean that the Saudi football players were not obtaining the optimal sodium from daily dietary or fluid intake. Meanwhile, the spot urine sodium from morning, pre-exercise, and post-exercise on day 1 showed a good level of urinary sodium. In addition, both day 1 and day 2 measurements were in the normal urinary sodium level range. Nevertheless, these values were lower compared to recent studies evaluating urinary sodium level.

Some earlier studies have confirmed that in general, younger people do not have optimal dietary intake (Betancourt-Nuñez et al., 2018; Schulze et al., 2001). Therefore, dietary intake plays a role in maintaining sodium, which can also affect and regulate the balance of total body water. Moreover, assessments of urinary sodium from spot samples or estimation 24-hour samples should count for over days for athletes. In the current study, the investigation of the urinary sodium level in both the spot samples and 24-hour samples on each day from different times showed that Saudi football players had an optimal intake of sodium based on the analysis of urine sample. In addition, assessing sodium level in urine samples could help in interpreting the status of electrolytes in the population of football players in Saudi Arabia.

Conclusion:

Measurement of urinary sodium has been widely used to detect the balance of sodium intake. Moreover, any mothed of evaluating sodium can help football players and their medical teams to monitor the electrolyte balance in the body and support a sport nutrition strategy for players during exercise sessions or competition events. It is important for Saudi football players to maintain the optimal dietary and fluid intake due to sweating and exercise and playing games in the hot weather.

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