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Hydration Status of Junior Tennis Players and the Difference after a Lecture on Its Practice

RYO YOSHIKAWA[1], TETSUYA NAKATANI[2*], TAKAHIRO FURUKAWA[1], NORIYUKI KANZAKI[1], and RYOSUKE KURODA[1]

[1]*Department of Orthopaedic Surgery, Kobe University Graduate School of Medicine, Kobe, Japan*

[2]*Nakatani Orthopaedic Surgery Hospital, Kakogawa, Japan *Corresponding author*

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Dehydration reduces exercise performance and causes heat-related illness. However, the fact that dehydration is a serious sports injury is often forgotten, especially among junior tennis players, who engage in tennis matches alone without receiving advice from others. Our objective was to investigate the hydration status of junior tennis players and the difference after attending a lecture on the importance of hydration. In total, 157 junior tennis players attending a training camp participated in this study. The duration of the camp was two days, and a lecture was organized on the first night to educate the players about hydration using a body mass scale. Body mass (BM) was measured immediately before and after practice on the first and second day. The water loss rate (WLR) was calculated by dividing the loss in BM during practice by the BM before practice. In total, 34.4% of players had attended a lecture on hydration in the past. These players had a lower WLR than those who had not, but the difference was not significant. The WLR was significantly lower after attending our lecture than that before. This study suggests that a lecture on hydration could immediately improve the hydration status of the junior tennis players; however, this effect may not be lasting. They may need help from their coaches and parents to implement what they have learned in lecture.

INTRODUCTION

Dehydration during sports reduces exercise performance and causes heat-related illness that can lead to serious complications and even death. Although it is essential that clinicians know how to treat heat stroke and heat exhaustion, preventing these conditions is more important. The National Athletic Trainers Association (NATA) (1), the American College of Sports Medicine (ACSM) (2), and American Academy of Pediatrics (AAP) (3) have established hydration guidelines for exercising in the heat. These guidelines provide useful information for not only athletes but also coaches, teachers and parents. Knowledge of these guidelines and how athletes access this knowledge is important.

The study of hydration or fluid balance has been widely investigated in rugby players (4) and soccer players (5). In general, tennis is not commonly included in discussions of heat illness and hydration when compared with other sports, because the length of heat exposure during a session of tennis is often underestimated (6). However, tennis is an intermittent high-intensity sport, and players are exposed to hot and humid conditions over a long duration. Especially during summer, air temperature may exceed 40℃, and players often have no choice but to play under thermally challenging conditions, placing them at risk of compromised health (7).

Children and young adults have been reported to be at a greater risk of heat exhaustion during tennis training and competitions in the heat (8), because they do not always have easy access to water and because their perception of thirst is neglected (9). Additionally, dehydration is often forgotten during matches, especially among junior tennis players because tennis is an individual sport that players engage in alone without advice from others. Very few reports have investigated the hydration status of junior tennis players.

The purpose of this study was to investigate the hydration status of junior tennis players and the difference after attending a lecture on the importance of hydration.

MATERIALS AND METHODS

Participants

We participated in a training camp for junior tennis players and gave them a lecture to convey the importance of hydration. In total, 157 junior tennis players attending the training camp participated in this study. This study was approved by the ethics committee and institutional review board (IRB) of our affiliated institutions (IRB number #144). We complied with the Declaration of Helsinki on human research. All participants provided informed consent before participating in the study.

Phone: +81-79-426-3000 Fax: +81-79-426-1500 E-mail: ted-naka@wg8.so-net.ne.jp

Design of study

This was an observational study designed to investigate the hydration status of junior tennis players and the difference after attending a lecture on the importance of hydration. Dehydration was calculated based on the difference in before and after practice body mass (BM). All procedures were designed to cause minimal disruption to players. We also collected information on the players' previous participation in a lecture and the symptoms of heat-related illness during practice. In this study, we defined the symptoms of heat-related illness as muscle spasms, strong thirst, headache, dizziness, and absentmindedness as previously reported (10). We compared U12 and U15 among their respective groups.

Procedures

The duration of the camp was two days and a lecture was organized on the first night. Participants of the lecture included not only players but also their coaches and parents. In the lecture, we taught about symptoms and causes of heat-related illness and ways to prevent and treat it. We emphasized the importance of making a habit of measuring their own hydration status by using a body mass scale.

All players were enquired regarding any previous experience of attending a lecture on hydration before the camp. BM was measured immediately before and after practice on the first and second day by using a bathroom scale. When we measured players' BM, they took off shoes and kept their clothes on. The water loss rate (WLR) was calculated by dividing the loss in BM during practice by the BM before practice. The players were asked whether they experienced any symptoms of heat-related illness during practice.

We compared the WLR on the first day between players who had never attended a lecture on hydration (NL group) and players who had attended such a lecture before the training camp (AL group) to analyze if there was a difference between their hydration status based on their awareness. We compared the occurrence of heat-related illness on the first day between the NL group and AL group. We also compared the WLR between the first and the second day of the camp to evaluate the influence of the lecture. Finally, to confirm the relationship between WLR and occurrence of heat-related illness, we assessed the WLR between the presence and absence of heat-related illness symptoms.

Analysis of data

The measurement values were expressed as mean ± SD(%) or median% with minimum% and maximum%. Student's t-test was used to compare the WLR between the NL group and AL group. Fisher's exact test was used to compare the frequency of heat-related illness between the NL group and AL group. Wilcoxon signed-rank test was used to compare the WLR between the first and the second day of the camp. Mann-Whitney U test was conducted to compare the WLR and the occurrence of heat-related illness. All data were analyzed using IBM SPSS Statistics 24.0 for Windows/BM Corporation (Chicago, IL, USA). All analyses were performed with 95% confidence intervals, and $p<0.05$ was considered as significant.

RESULTS

Out of the 157 junior tennis players, there were 80 females and 77 males, and the mean age was 13.1±1.2 years at the time of the camp. Fifty-eight players were 10–12 years old (U12) and 99 were 13–15 years old (U15). In total, 54 players (34.4%) (U12: 5 players (8.6%), U15: 49 players (49.5%)) had attended the lecture in the past. In both U12 and U15 categories, the WLR was significantly lower after lecture attendance than before (total: $p<0.001$, U12: $p=0.005$, U15: $p=0.014$) (Table I).

Table I. The water loss rate (WLR) before lecture and after lecture. U12; 10–12 years old players, U15; 13–15 years old players.

		n	WLR(%)			p-value
			Median(%)	Min(%)	Max(%)	
Total	Before lecture	157	0.9	-1.3	3.0	<0.001
	After lecture	157	0.6	-1.7	6.0	
U12	Before lecture	58	1.0	-1.3	2.3	0.005
	After lecture	58	0.6	-1.1	6.0	
U15	Before lecture	99	0.9	-1.1	3.0	0.014
	After lecture	99	0.6	-1.7	3.7	

Players who had attended a previous lecture (AL group) had a lower WLR than those who had not (NL group), but the difference was not significant (0.94±0.75% vs 1.01±0.74%, p=0.583). Even in the case of U12 and U15, the differences between the two groups were not statistically significant (U12: p=0.265, U15: p=0.815) (Table II).

Table II. The water loss rate (WLR) on the first day in players who had never attended a lecture on hydration (NL group) and players who had attended one before the training camp (AL group). U12; 10–12 years old players, U15; 13–15 years old players.

		n	WLR (±SD) (%)	p-value
Total	NL	103	1.01(±0.740)	0.583
	AL	54	0.94(±0.754)	
U12	NL	53	1.09(±0.728)	0.265
	AL	5	0.68(±1.179)	
U15	NL	50	0.94(±0.752)	0.815
	AL	49	0.97(±0.710)	

There was a total of 24 heat-related cases (thirsty, 8 cases; dizziness, 7 cases; leg cramps, 5 cases; nose bleed, 3 cases; headache, 1 case) On the first day, 12 players (11.7%) in the NL group and 5(9.3%) in the AL group experienced symptoms of heat-related illness during practice, but the difference between the two groups was not statistically significant. (p=0.790). Even in the case of U12 and U15, the differences between the two groups were not statistically significant (U12: p=1.000, U15: p=0.741) (Table III).

Table III. The occurrence of heat-related illness on the first day in players who never attended a lecture on hydration (NL group) and players who had attended one before the training camp (AL group). U12; 10–12 years old players, U15; 13–15 years old players.

		n	Occurrence ratio (%)	p-value
Total	NL	103	11.7	0.790
	AL	54	9.3	
U12	NL	53	15.1	1.000
	AL	5	0.0	
U15	NL	50	8.0	0.741
	AL	49	10.2	

Players with heat-related illness symptoms had a significantly higher WLR than those without symptoms (p=0.027). Even in the case of U12 and U15, a similar tendency was seen. But in the case of U12, the difference was not statistically significant (p=0.350) (Table IV).

Table IV. The water loss rate (WLR) between the presence and absence of heat-related illness symptoms. U12; 10–12 years old players, U15; 13–15 years old players.

	Symptom	n	WLR(%)			p-value
			Median(%)	Min(%)	Max(%)	
Total	no	290	0.8	-1.7	6.0	0.027
	yes	24	1.2	-0.3	2.4	
U12	no	105	0.8	-1.3	6.0	0.350
	yes	11	1.2	-0.3	1.9	
U15	no	185	0.8	-1.7	3.7	0.041
	yes	13	1.1	0.4	2.4	

DISCUSSION

Our results suggest that a lecture on hydration could immediately improve the hydration status of junior tennis players. Tennis players, especially junior players do not always tend to their hydration status while playing tennis. However, tennis involves high workloads combined with an exposure to hot and humid environments. It has been reported that tennis players often begin playing a competition measurably dehydrated, which can increase on-court cardiovascular and thermal strain (11). It was also reported that junior tennis players often begin training or play not well hydrated (12) and their sweating rate during tennis practice was more than 1 L/h (13). Because this study demonstrated the effectiveness of the lecture on hydration, we suggest that the lack of players' hydration knowledge can be ameliorated with a lecture.

To quantify accurate total body water is very difficult. BM measurements by using a scale is not a precise indicator of absolute changes in total body water because BM change during exercise is a net balance of losses (fuel oxidation, respiratory water loss, urine output and seat loss) and gains (metabolic water gain, fluid intake, and food intake) (14). But, BM measurement allows players to identify mild to severe dehydration and plan fluid replenishment accordingly (15). Furthermore, it is very useful for junior players because measuring BM with a bathroom scale is very easy in daily practice.

There are some existing recommendations for prevention and management of heat-related illness (16). However, in this study, the number of top junior tennis players who had attended a lecture on hydration before the training camp was less than half of the participants. Especially in the case of U12, the proportion was less than 10%. This study shows that the awareness on hydration has not sufficiently spread. We should spread knowledge and awareness especially among pre-adolescent children.

In terms of WLR and the occurrence of symptoms of heat-related illness, there was no significant difference between players who had attended a previous lecture and those who had not. This result suggests that players who attended the previous lecture did not keep paying attention to the awareness about hydration despite having been taught it previously. Tennis players must control their own hydration status without advice from others due to the characteristics of tennis matches. For junior tennis players to acquire this ability, we believe that they must continue to effectively use the knowledge they acquired from lectures in their daily practice. Rowland T (17) suggested that coaches and parents should take responsibility to ensure that young athletes receive appropriate hydration because children may lack motivation for proper fluid intake behavior. It was reported that 46.9% of Singaporean youth athletes were dependent on teachers and coaches for exercise hydration knowledge (18). Thus, we suggest that coaches and parents should continue educating junior players in order to retain the acquired knowledge of hydration.

In this study, junior players with heat-related illness symptoms had a significantly higher WLR than those without symptoms. As a matter of fact, this indicates that dehydration has a high risk of heat-related illness. The effect of hydration status on exercise performance have been widely debated (19). Studies have reported that a 2% drop from baseline body weight due to dehydration decreased exercise performance (15, 20). Some other studies have reported that a 2% drop in body weight due to dehydration decreased tennis-specific skills (21, 22). Thus, hydration management is very important to optimize performance and reduce the risk of heat illness. Armstrong LE (23) reported that the most convenient method to manage hydration status was a combination of body weight measurements and urine color. Although there is some dispute as to the validity of urine color as a marker of hydration (24), it is recommended that athletes consume enough fluid such that their urine is maintained at a "pale yellow" or "straw" color (25).

The present study has several limitations. First, as the environmental conditions varied substantially between the days, the study results are not generalizable. In future, studies can be designed by accounting for this factor. Second, no biochemical tests were carried out to ascertain the results. Urine specific gravity and blood osmolality measures are useful to evaluate hydration status (26), but taking blood and urine sample in junior tennis players' training camp is not realistic. Finally, we did not investigate on how much the players need to drink, when to drink, and what to drink. This is a subject for future analysis. Despite these limitations, this study shows that lecture on hydration is very important not only for young tennis players but also their coaches and parents.

In conclusion, the lecture on hydration could immediately improve the hydration status of the junior tennis players, but this effect may not be lasting. They may need help from their coaches and parents to effectively implement what they learned in lecture.

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