Turkish Journal of Sport and Exercise /Türk Spor ve Egzersiz Dergisi
http://dergipark.gov.tr/tsed
Year: 2021 - Volume: 23 - Issue 2 - Pages: 165-170
DOI: 10.15314/tsed.954854

Turkish Journal of Sport and Exercise
Türk Spor ve Egzersiz Dergisi
ISSN: 2147-5652
https://dergipark.org.tr/tr/pub/tsed

Hydration Status and Fluid Intake of Adolescent Athletes From Different Sports During Training

Bayram CEYLAN[1A]

[1] *Kastamonu University Faculty of Sport Sciences, Merkez/Kuzeykent, Kastamonu*
Address Correspondence to B. Ceylan : e-mail: bceylan@kastamonu.edu.tr

(Received): 20.06.202/ (Accepted): 30.08.2021

A: Orcid ID: 0000-0002-6753-1848

Abstract

Despite many studies presenting that a high number of adult athletes start exercise in sub-optimal hydration state, limited data concerning hydration levels in athletic youth exists. This study aimed to identify the hydration status of adolescent athletes of different sports during a typical training. Sixty-nine adolescent men athletes from different sports (swimming, judo, basketball, football) voluntarily participated in the study (age: 13.7±1.7 years, experience: 4.8±2.0 years). Measurements were carried out before and immediately after training. Data collection took place at the same time of the day. All athletes trained for about 90 minutes and they consumed fluids ad libitum during their training. Pre-training urine measurement revealed that 58.2% of the athletes started training in dehydrated state (Urine Specific Gravity [USG]≥1.020). Besides, 63.3% of the athletes completed the training in also dehydrated state with USG values ≥ 1.020 and urine colour between 4-6. Mean body weight loss during the training was -0.26±0.40 kg. This study concluded that the prevalence of dehydration in adolescent athletes is high according to USG and urine colour values. Great number of the athletes arrived at training in dehydrated state and dehydrated even more during training despite access to fluids. Some educational programs and measures for optimal hydration in adolescent athletes should be taken into consideration.

Keywords: fluid intake; young athletes; dehydration

INTRODUCTION

Maintaining fluid balance is very important for performance and temperature regulation in both young and adult athletes. It has already been clearly demonstrated that even low levels of dehydration cause physiological stress, mediated by a disproportionate increase in heart rate, accompanied by a decrease in cardiac output, which reduces the body's ability to remove heat (13,14). Moreover, ≥2% dehydration of total body weight significantly reduces exercise, skill and mental performances in both laboratory and field studies. (1,4,6,8). Moreover, recent studies have shown that lower dehydration levels (~1%) trigger undesirable changes in athletic performance (5,11).

Studies examining the hydration status of young people exercising under hot environmental conditions have revealed that most of the athletes are dehydrated from the beginning of the training and this condition is maintained throughout the measurement days and they show insufficient hydration habits. This situation may occur with insufficient fluid intake and long-term fluid deficiency despite the presence of sufficient fluid in the training areas (2,17,18).

Current studies show that young athletes come to training dehydrated, do not consume enough fluids during training, thus voluntary dehydration is common in both indoor and outdoor sports (10,12,18). Although there are many studies examining the hydration status and related variables in adult athletes from different sports, there are limited studies comparing the hydration status of adolescent athletes from different sports. Also, there are no current studies monitoring fluid balance of adolescent athletes. Therefore, the aim of this study was to reveal the hydration status and fluid intake of adolescent athletes engaged in different sports during a training session. Our study had two main

hypotheses; 1) Adolescent athletes who do sports indoors would consume more fluid than those who do outdoor sports, and 2) Adolescent athletes would dehydrate both before and after training.

MATERIAL AND METHODS

Approach to the Problem

The detrimental effects of dehydration on athletic performance have been demonstrated by numerous studies. Moreover, most of the studies in the literature focus on elite adult athletes. In addition, this study aimed to reveal the changes in hydration status in adolescent athletes from different sports in a typical training session. In conclusion, this descriptive study was designed to determine the hydration status and fluid intake of adolescent athletes.

Participants

Sixty-nine adolescent athletes (swimming: 12, judo: 22, basketball: 15 and football: 30) voluntarily participated in the study. The characteristics of the participants are presented in Table 1. Athletes and their coaches agreed to participate in the study, and signed informed consent forms were obtained from both athletes and their legal guardians. The criteria for participation in the study included; absence of a current health problem and having at least 2 years of sports experience. All measurements were performed in accordance with the Declaration of Helsinki. Ethical approval was obtained from Kastamonu University Clinical Research Ethics Committee (Date: 28/01/2021, No: 2020-KAEK-143-32).

Data Collection

Data collection took place in the middle of the week. The day before the measurement, the athletes were instructed not to use performance-enhancing food or beverages (i.e, cafein). Two sterile urine containers were given to the athletes for urine collection before and after training. The body weight of the athletes was measured before and after the training. The water consumed by the athletes during the training was monitored, but the athletes were not encouraged to consume fluid and they continued their habitual fluid consuming. The hydration status of the athletes was determined by urine specific gravity (USG) and urine color (UC). USG was measured with a digital refractometer (ATAGO PAL-10S, Japan), while UC was classified by the same researcher each time. The hydration status of the athletes was classified as hydrated (≤1.020) or dehydrated (>1.021) according to Sawka et al. (20) UC was classified according to Casa et al. (7). All measurements were performed by the same researcher each time.

Statistical Analysis

Data were expressed as mean and standard deviation. In addition, 95% confidence intervals of the data were given. The normality of the data was tested with Shapiro-Wilk test and descriptive methods such as the skewness and kurtosis coefficients (15). The two-way repeated measures ANOVA (4 x 2) (sport x time) test was used to determine the differences in USG, UC, body weight and fluid consumption between the groups. Eta squared (η^2_p) was calculated to determine the effect size (ES), and 0.0099, 0.0588, and 0.1379 were considered as small, medium, and large effect sizes, respectively (9). The relationship between fluid intake, body weight change, and USG changes was tested with the Pearson correlation test. Statistical significance was set at $p<0.05$.

RESULTS

Information about the age, height, BMI and sports experiences of the participants is given in Table 1.

Table 1. Characteristics of the athletes

Variables	Swimming (N=12)	Judo (N=22)	Basketball (N=15)	Football (N=30)
Age (year)	13.4±2.1	12.0±0.7	13.0±0.0	15.4±0.6
Height (m)	1.59±0.14 (1.49-1.68)	1.52±0.10 (1.50-1.55)	1.69±0.10 (1.64-1.75)	1.72±0.06 (1.70-1.75)
Body mass (kg)	50.2±15.1 (40.5-59.8)	45.3±1.7 (41.5-49.0)	63.4±3.7 (55.4-71.3)	61.8±1.4 (58.8-64.8)
BMI (kg/cm2)	19.4±2.5 (17.7-21.0)	19.2±2 .6 (18.1-20.4)	21.8±3.3 (19.9-23.6)	20.6±2.1 (19.8-21.4)
Experience (year)	6.4±2.1 (5.0-7.8)	3.2±1.0 (2.8-3.7)	5.1±2.1 (3.9-6.3)	5.3±1.7 (4.6-5.9)

According to repeated measures ANOVA results, there was a significant interaction effect of time and sport ($F_{3\text{-}75}$=3.42; p=0.02; ES=0.121) on body mass of the athletes. Moreover, the effect of time and sport factors was separately found significant on changes in body mass ($F_{1\text{-}75}$=38.78; p=0.00; ES=0.341; $F_{3\text{-}75}$=13.45; p=0.00; ES=0.350, respectively). When pairwise comparison was carried out, a significant difference in body mass change was found between swimmers and judo athletes (p<0.05). Body mass changes of the athletes are presented in Figure 1.

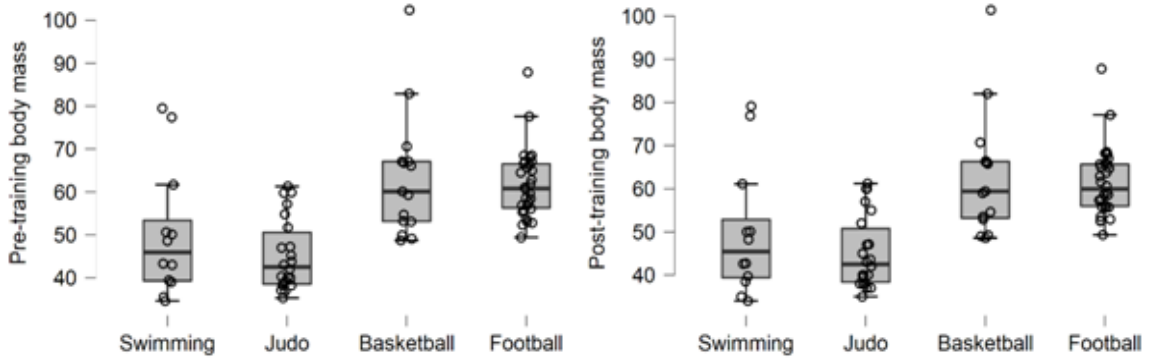

Figure 1. Body mass changes of the athletes pre and post training

The interaction effect of time and sport was significant for USG ($F_{3\text{-}75}$=5.94; p=0.001; ES=0.192). While a significant effect of sport was found in USG ($F_{3\text{-}75}$=5.94; p=0.001; ES=0.192), there was no main effect of time on USG ($F_{3\text{-}75}$=0.31; p=0.60; ES=0.004). Swimmers presented significantly lower USG values compared to the rest at both pre and post training (p<0.05). USG values of the athletes can be found in Table 2.

Table 2. USG values of the athletes pre and post training

	Pre-training	Post-training	p
Swimming (N=12)	1.018±0.008 (1.013-1.023)	1.013±0.005 (1.009-1.016)	0.058
Judo (N=22)	1.022±0.004 (1.020-1.025)	1.023±0.004 (1.021-1.025)	0.291
Basketball (N=15)	1.020±0.006 (1.016-1.023)	1.023±0.006 (1.020-1.027)	0.017
Football (N=30)	1.021±0.006 (1.020-1.024)	1.022±0.006 (1.019-1.024)	0.630

There was a significant interaction effect of time and sport on UC ($F_{3\text{-}75}$=3.51; p=0.019; ES=0.123). However, there was no main effect of time and sport separately on UC ($F_{1\text{-}75}$=3.77; p=0.056; EB=0.048; $F_{3\text{-}75}$=1.47; p=0.228; ES=0.056, respectively). The UC values of the athletes can be found in Table 3.

Table 3: The UC values of the athletes before and after the training

	Pre-training	Post-training
Swimming (N=12)	5.17±2.51 (3.5-6.7)	3.58±2.02 (2.3-4.8)
Judo (N=22)	6.00±2.02 (5.1-6.9)	5.27±2.02 (4.3-6.1)
Basketball (N=15)	4.33±2.19 (3.1-5.5)	5.20±2.00 (4.0-6.3)
Football (N=30)	5.07±2.13 (4.2-5.8)	4.63±2.04 (3.8-5.4)

When athletes' USG values were classified, 58.2% of the athletes were dehydrated while 41.8% of them were hydrated before training. Following the training session, the ratio of the dehydrated athletes increased to 63.3% and the ratio of the hydrated athletes was 36.7%. The classification of the hydration status of athletes from each sport can be found in Figure 2 and 3.

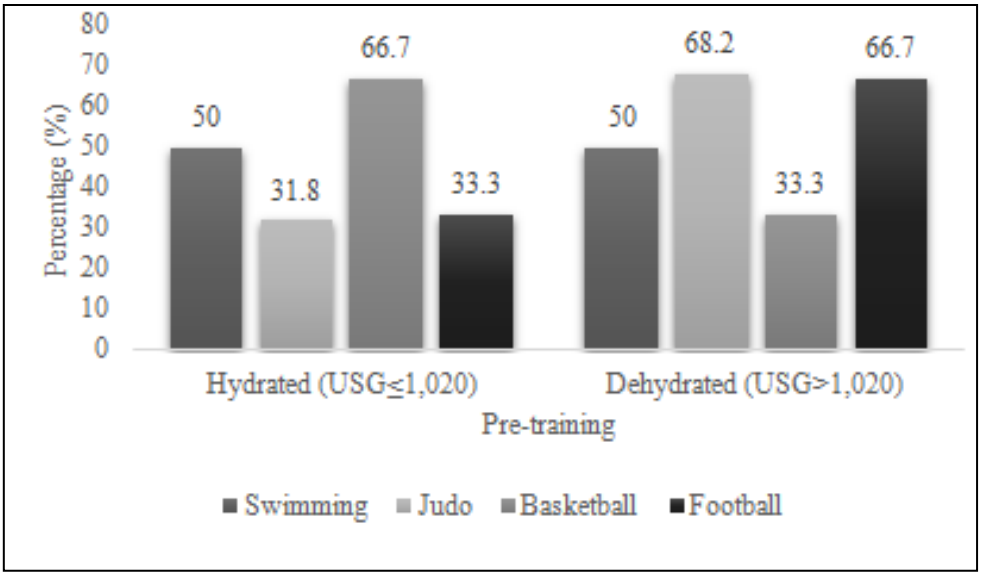

Figure 2. USG classification of the athletes before training

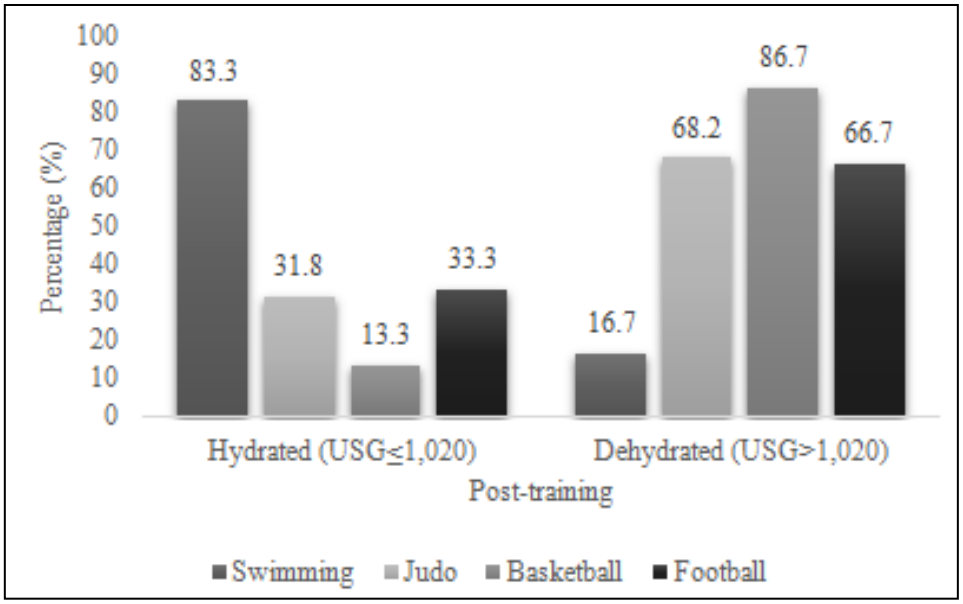

Figure 3. USG classification of the athletes after training

As shown in Figure 2, the majority of the athletes except swimming and basketball arrive at the training in a dehydrated state. According to the classification after training (Figure 3), most of the athletes completed the training session in a dehydrated state except for swimmers despite accessibility of fluid.

There was a significant association between fluid intake and body mass changes in the athletes (r=0.448; p=0.000), there was no significant association between fluid intake and USG changes (r=0.179; p=0.114)

DISCUSSION

This study aimed to determine the hydration status and fluid intake of adolescent athletes from different sports during a training session. The most important finding of the study was that the majority of the athletes started training in a dehydrated state and completed the training in a dehydrated state again despite availability of fluids.

Since the measurements took place in the middle of the week, while the athletes were participating in their regular training, the pre-training USG values showed that the athletes acquired insufficient rehydration habits outside of training and came to the training without being rehydrated. Similarly, in a study where hydration status and fluid intake of young elite athletes were investigated, Arnoutis et al. (2) stated that the athletes arrived at the training with a high level of dehydration and they worsened the hydration status although they had access to fluid during the training. Likewise, Ashadi et al. (3) investigated hydration status of young runners before and after training and highlighted increased dehydration in most of the athletes after training. Muth et al. (16) monitored hydration status and fluid loss perceptions of the athletes and they were reported to maintain their hydrated state and improved their perception of sweat loss during the study. Professional football players who had a match play in a hot and humid environment started the match in euhydrated state (19), which confirms that there may be differences in hydration knowledge among difference age groups.

The findings of the study reveal that there was a significant increase in the hydration status of judokas, basketball players and football players. This finding is important because two of the aforementioned sports are practiced indoors and athletes have more opportunities to consume fluids as they have easier access to fluids and more frequent breaks during training. However, in parallel with our study, young athletes who train indoors are stated to be exposed to fluid loss during exercise (2,18,20). These findings highlighted that voluntary dehydration is high in young athletes.

In the literature, it is commonly recommended for athletes to consume fluids when they feel thirsty during hot environment (18,20). The findings of our study do not support this view. In the study, we expected that athletes would experience hyperosmotic hypovolemia due to dehydration, resulting in dehydration during training, which would lead to greater fluid intake. However, contrary to our expectations, the athletes remained dehydrated at the end of the training despite the presence of fluid in the training area. Therefore, personalized rehydration strategies should be developed without leaving fluid consumption to the preferences of the athletes.

This study had some limitations. Urinary indices such as USG present high variety and especially a single-time-point hydration status assessment could be insufficient (21). Moreover, morning USG assessments are more appropriate to determine hydration status (22). Future studies could include morning USG measurements following a-night fasting to determine athletes' morning hydration status as well as before and after the training.

CONCLUSION

In conclusion, young athletes showed high level of dehydration on a training day. Therefore, it is of great importance to make adolescent athletes gain the habit of consuming enough fluids during the day so that they can come to training in a hydrated state. Adolescent athletes should be encouraged to drink frequently during training. In addition, fluid intake plans should be recommended according to the individual needs of the athletes. Evaluating the hydration status of athletes before exercise is of great importance to avoid the negative effects of insufficient fluid intake and prolonged fluid deficiency on performance and health.

REFERENCES

1. Ali A, Gardiner R, Foskett A, & Gant N. Fluid balance, thermoregulation and sprint and passing skill performance in female soccer players. Scandinavian Journal of Medicine & Science in Sports. 2011; 21(3): 437-45.
2. Arnaoutis G, Kavouras SA, Kotsis YP, Tsekouras E, Makrillos M, & Bardis, CN. Ad libitum fluid intake does not prevent dehydration in suboptimally hydrated young soccer players during a training session of a summer camp. International Journal of Sport Nutrition and Exercise Metabolism. 2013; 23(3): 245-51.
3. Ashadi, K., Mirza, D. N., & Siantoro, G. (2018). Hydration status in adolescent runners: pre and post training. In IOP Conference Series: Materials Science and Engineering (Vol. 296, No. 1, p. 012014). IOP Publishing.
4. Baker LB, Dougherty KA, Chow M, & Kenney WL. Progressive dehydration causes a progressive decline in basketball skill performance. Medicine and Science in Sports and Exercise. 2007; 39(7): 1114-23.
5. Bardis CN, Kavouras SA, Arnaoutis G, Panagiotakos DB, & Sidossis LS. Mild dehydration and cycling performance

during 5-kilometer hill climbing. Journal of Athletic Training. 2013; 48(6): 741-47.
6. Barley, O. R., Iredale, F., Chapman, D. W., Hopper, A., & Abbiss, C. R. (2018). Repeat effort performance is reduced 24 hours after acute dehydration in mixed martial arts athletes. The Journal of Strength & Conditioning Research, 32(9), 2555-2561.
7. Casa DJ, Armstrong LE, Hillman SK, Montain SJ, Reiff RV, Rich BS, et al. National Athletic Trainers' Association position statement: fluid replacement for athletes. Journal of Athletic Training. 2000; 35(2): 212.
8. Casa DJ, Stearns RL, Lopez RM, Ganio MS, McDermott BP, et al. Influence of hydration on physiological function and performance during trail running in the heat. Journal of Athletic Training. 2010; 45(2): 147-56.
9. Cohen J. [The effect size index: d. Statistical Power Analysis For the Behavioral Sciences]. 1988; 2nd Edition, Erbaum Press.
10. Da Silva RP, Mündel T, Natali AJ, Bara Filho MG, Alfenas RC, Lima J R., et al. Pre-game hydration status, sweat loss, and fluid intake in elite Brazilian young male soccer players during competition. Journal of Sports Sciences. 2012; 30(1): 37-42.
11. Driscoll, R. L., McCarthy, D. G., Palmer, M. S., & Spriet, L. L. (2020). Mild dehydration impaired intermittent sprint performance and thermoregulation in females. Applied Physiology, Nutrition, and Metabolism, 45(9), 1045-1048.
12. Gibson JC, Stuart-Hill LA, Pethick W, & Gaul CA. Hydration status and fluid and sodium balance in elite Canadian junior women's soccer players in a cool environment. Applied Physiology, Nutrition, and Metabolism. 2012; 37(5): 931-37.
13. Gonzalez-Alonso J, Mora-Rodriguez R, Below PR, & Coyle EF. Dehydration reduces cardiac output and increases systemic and cutaneous vascular resistance during exercise. Journal of Applied Physiology. 1995; 79(5): 1487-96.
14. Gonzalez-Alonso J, Mora-Rodriguez R, Below PR, & Coyle EF. Dehydration markedly impairs cardiovascular function in hyperthermic endurance athletes during exercise. Journal of Applied Physiology. 1997; 82(4): 1229-36.
15. Mishra P, Pandey CM, Singh U, Gupta A, Sahu C, & Keshri A. Descriptive statistics and normality tests for statistical data. Annals of Cardiac Anaesthesia. 2019; 22(1): 67–72.
16. Muth T, Pritchett R, Pritchett K, Depaepe J, & Blank R. Hydration status and perception of fluid loss in male and female university rugby union players. International Journal of Exercise Science, 2019, 12.3: 859.
17. Noakes TD. Is drinking to thirst optimum? Annals of Nutrition and Metabolism. 2010; 57(Suppl. 2): 9-17.
18. Osterberg KL, Horswill CA, & Baker LB. Pregame urine specific gravity and fluid intake by National Basketball Association players during competition. Journal of Athletic Training. 2009; 44(1): 53-57.
19. Kurdak SS, Shirreffs SM, Maughan RJ, et al. Hydration and sweating responses to hot-weather football competition. Scand J Med Sci Sports. 2010;20 Suppl 3:133-139.
20. Rivera-Brown AM, & De Félix-Dávila RA. Hydration status in adolescent judo athletes before and after training in the heat. International Journal of Sports Physiology and Performance. 2013; 7(1): 39-46.
21. Zubac D, Cular D, Marusic U. Reliability of Urinary Dehydration Markers in Elite Youth Boxers. Int J Sports Physiol Perform. 2018;13(3):374-381.
22. McDermott BP, Anderson SA, Armstrong LE, et al. National Athletic Trainers' Association Position Statement: Fluid Replacement for the Physically Active. J Athl Train. 2017;52(9):877-895.