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HYDRATION STATUS DIFFERENCES BEFORE AND AFTER TRAINING IN YOUNG MALE AND FEMALE JUDO ATHLETES

Original research

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ABSTRACT
The aim of this study was to determine differences in hydration status before and after a judo training session. The sample of participants included boys (N = 60) and girls (N = 35) aged 11–14 years. The variables used as indicators of hydration status were body weight (BW), body mass index (BMI), fat mass (FM), and total body water (TBW). Based on mean values obtained after training, body weight decreased by 0.78 kg in girls and 0.54 kg in boys. Body mass index decreased by 0.39 in girls and 0.45 in boys, while fat mass decreased by 0.52 kg in girls and 0.18 kg in boys. Finally, the reduction in total body water amounted to 0.72 in boys and 0.28 in girls. Statistical significance was confirmed using a t-test for changes in body weight, body mass index, and total body water. Based on the findings of this study, it can be concluded that the introduction of scheduled rehydration breaks during training may reduce fluid loss and help preserve muscular strength in young judo athletes.

Keywords: martial arts, exercise, rehydration, fluid intake, health status

INTRODUCTION

Dehydration can affect athletic performance and increase the risk of physical injury. The negative effects of dehydration on performance are observed even at levels below 2% of body mass loss (Barr, 1999). Fluid deficits incurred during a single exercise session may potentially compromise the subsequent training session if adequate rehydration does not occur. More pronounced dehydration leads to a significant decline in athletic skills and motor function, attributable to neuromuscular, cognitive, and metabolic influences. Depending on hydration status, hydration may attenuate one, several, or all components that affect the level of skill execution and motor function (Edwards et al., 2007; Baker et al., 2007b). Consequently, post exercise fluid replacement can often be considered as hydration for the next training session (Shirreffs et al., 2004). However, athletes do not voluntarily consume sufficient amounts of water to prevent dehydration during physical activity (Casa et al., 2000; Maughan et al., 2010). Maughan and Shirreffs (2010) report that some athletes consume excessive amounts of fluid, while others may even develop hyponatremia due to overhydration. On the other hand, allowing unscheduled microbreaks during training for fluid replacement reduces training intensity, and when the objective of training is the acquisition of motor skills, it may disrupt the organization and continuity of practice (Gibson et al., 2012). This is particularly evident in paired training activities, where one partner rehydrates while the other remains inactive and waits. The perception of thirst is highly individual; therefore, the justification of ad libitum rehydration strategies should be examined. It is also well known that elite judo athletes use hypohydration to reduce body mass prior to competition, which negatively affects the athlete's physiological functioning and leads to impaired performance and adverse health outcomes

(Jung & Malliaropoulos, 2014). Fluid loss results in sensations of lethargy and decreased motivation to continue exercising, thereby contributing to the development of fatigue (Watson, 2008). Short term changes in hydration status can be assessed based on changes in body mass (Maughan & Shirreffs, 2010). The results of this study are expected to confirm dehydration in the absence of fluid intake during judo training and to highlight the justification for organized rehydration strategies in young male and female judo athletes aged 11–14 years.

METHODS

Sample of Participants

The sample of participants included 60 boys and 35 girls aged between 11 and 14 years. The participants were members of the following judo clubs in the Sarajevo Canton: Bosna, Vogošća, and Student. Only clinically healthy participants were included in the study, as during the training period and due to the specific requirements of the research design so they did not have the opportunity to consume fluids. In accordance with the Declaration of Helsinki, all participants and their parents provided informed consent to participate in the study, with the right to withdraw at any time.

Instruments, Procedure and Variables

Hydration status was assessed using a Tanita bioelectrical impedance scale (Tanita BC-418, Tokyo, Japan). This device operates on the principle of bioelectrical impedance analysis, whereby a low-level electrical current is transmitted through the body. The current passes more easily through hydrated muscle tissue, while greater resistance is encountered in adipose tissue. This resistance, referred to as impedance, is recorded and subsequently processed using validated Tanita algorithms to estimate body composition parameters. Depending on the model, body composition measurements are obtained within approximately 20 seconds (Kapo et al., 2018). All participants were fully informed about the research procedures prior to participation and underwent an identical measurement protocol. Wearing only underwear participants were standing barefoot on Tanita scale. The variables selected as indicators of fluid loss included: Body Weight (BW), Body Mass Index (BMI), Fat Mass (FM), and Total Body Water (TBW).

Training program

The training session lasted a total of 90 minutes. The structuring of training time followed the same framework used in physical and health education classes (Rašidagić et al., 2016), with the following distribution: warm-up phase 10% of total duration; preparatory phase 20%; main part A 40%; main part B 20%; and cool down phase 10%. The temperature in the training hall was 18°C at the beginning and 21°C at the end of the session. Lighting and ventilation conditions were controlled by the coach and remained within standard parameters throughout the experimental procedure. The spatial conditions and training structure fully corresponded to the standard organization of judo training in clubs across Bosnia and Herzegovina. During the training session, and due to the experimental protocol, the young male and female judo athletes did not consume any fluids.

Table 1. Training program

Training phase	*Training content*	*N0 of exercises*
Warm-up	Dynamic preparatory strengthening and stretching exercises for the locomotor system	10
Preparatory	Acrobatic exercises and judo breakfall techniques	10
Main A	Throwing techniques with transition into ground control hold (“kesa-gatame”)	6
Main B	Free sparing (randori)	4x4 min
Cool down	Static stretching and relaxation exercises	10

Statistical Analysis

The obtained data were expressed as measures of arithmetic mean and standard deviation. The normality of data distribution was assessed using the Kolmogorov–Smirnov test. Differences between the initial and final measurements were determined using a paired samples t-test. The level of statistical significance was set at the conventional 95% confidence level ($p<0.05$). All collected data were processed using SPSS version 22 (IBM Corp., New York).

RESULTS

Based on the descriptive results measured before and after judo training session (Table 2), lower mean values were observed for all variables. According to the mean values, body weight (BW) decreased by 0.78 kg in girls and by 0.54 kg in boys. Body mass index (BMI) decreased by 0.39 in girls and by 0.45 in boys, while fat mass (FM) was reduced by 0.52 kg in girls and by 0.18 kg in boys. Finally, the difference in total body water amounted to 0.72 kg in boys and 0.28 kg in girls. A decreasing trend in both minimum and maximum values was also observed for all analyzed variables, except for the maximum values of the fat mass (FM) variable. Girls exhibited a greater reduction in body weight (BW) and fat mass (FM), whereas the body mass index (BMI) values were nearly comparable between both genders. In contrast, the decrease in total body water (TBW) was almost three times greater in boys. All participants in this study experienced a reduction in body weight (BW). Statistical significance was confirmed using the t-test at the level of $p<0.05$ for variations in body weight (BW) and body mass i

Table 2. Basic descriptive statistics of initial and final measurement

Variables	Participants	Min	Max	M±SD
Baseline measurement				
Body weight (BW)	Boys	35.64	75.02	44.19±9.36
	Girls	21.42	90.9	44.90±16.12
Body mass index (BMI)	Boys	10.08	33.88	14.67±3.84
	Girls	12.51	27.4	19.71±4.17
Fat mass (FM)	Boys	2.43	23.10	7.38±5.04
	Girls	0.91	35.6	11.51±6.92
Total body water (TBW)	Boys	10.62	46.09	19.44±9.00
	Girls	13.23	40.2	24.29±7.24
Final measurement				
Variables	Participants	Min	Max	M±SD
Body weight (BW)	Boys	35.28	73.92	43.65 ±9.48
	Girls	21.10	89.9	44.12±15.93
Body mass index (BMI)	Boys	9.09	32.01	14.22±3.86
	Girls	12.00	27.1	19.32±4.14
Fat mass (FM)	Boys	0.81	23.87	7.20±5.16
	Girls	0.80	32.6	10.99±6.53
Total body water (TBW)	Boys	9.72	45.87	18.72±9.12
	Girls	13.11	41.6	24.01±7.34

Legend: Min. – minimum values; Max. – maximum values.
M ± SD – mean ± standard deviation

Table 3. Statistical significance of the differences between two measurement points in boys and girls

Variables	t	df	p
Boys			
Body weight (BW)	6.99	59	<0.001
Body mass index (BMI)	7.03	59	<0.001
Fat mass (FM)	2.11	60	<0.005
Total body water (TBW)	6.91	59	<0.001
Girls			
Variables	t	df	p
Body weight (BW)	11.53	34	<0.001
Body mass index (BMI)	9.76	34	<0.001
Fat mass (FM)	5.80	34	<0.001
Total body water (TBW)	2.93	34	<0.001

Table 4. Presentation of changes in parameters for boys and girls

Variables	Boys	Girls
Body weight (BW)	0.54	0.78
Body mass index (BMI)	0.45	0.39
Fat mass (FM)	0.18	0.52
Total body water (TBW)	0.72	0.28

DISCUSSION

The greatest differences observed in the obtained results were related to the parameter of total body water, where the reduction was almost three times greater in boys (0.72) compared to girls (0.28). In contrast, changes in fat mass were more pronounced in girls (0.52) than in boys (0.18). These findings suggest that boys may have trained at a higher intensity, which could be attributed to a higher level of technical proficiency, greater focus, and a stronger competitive drive. Cheuvront et al. (2003) attribute dehydration or hypohydration primarily to deficits in cardiovascular function. It has been reported that a reduction in body water negatively affects the neuromuscular system (Hoffman et al., 1995; Ftaiti et al., 2001) as well as muscle membrane excitability (Costill et al., 1976). When athletes become dehydrated during exercise, they may experience increased physiological strain. Even mild levels of dehydration have been shown to elevate core body temperature compared with a well-hydrated state (Casa et al., 2010). It has also been reported that young athletes often begin exercise in a hypohydrated state and typically fail to adequately compensate for fluid deficits when fluid intake is ad libitum (Meyers et al., 2016). In line with the present findings, Arnaoutis et al. (2015) reported a high prevalence of dehydration among elite young athletes across various sports during training days, emphasizing that athletes further deteriorated their hydration status during training despite fluid availability. Furthermore, previous studies (Osterberg et al., 2010; Palmer & Spriet, 2008; Rivera-Brown & De Félix-Dávila, 2012; Arnaoutis et al., 2015) have documented a high prevalence of dehydration among young athletes participating in indoor sports, even though they typically have greater opportunities to consume fluids due to easier access and more frequent breaks. Dehydration is associated with numerous adverse effects on well-being and health and is linked to elevated levels of arginine vasopressin (AVP). AVP travels through the bloodstream to the kidneys and plays a crucial role in preventing excessive water loss through urine. Although AVP is essential for maintaining fluid balance, chronically elevated levels may have detrimental consequences. Increased AVP concentrations have been associated with obesity, chronic kidney disease, impaired glucose regulation, and cardiovascular disease (Carroll et al., 2016; Arnaoutis et al., 2017). Moreover, dehydration has been suggested to contribute to cognitive impairments in younger populations, including deficits in memory and cognitive function (Bar-David et al., 2005; Fadda et al., 2012). Previous studies have examined the hydration status of judo athletes during competition days, training camps, or under humid environmental conditions (Rivera-Brown & De Félix-Dávila, 2012; Gürses et al., 2018; Stefanovsky et al., 2019; Ceylan et al., 2021), consistently indicating a high prevalence of dehydration among athletes at various competitive levels. Ceylan et al. (2021) assessed the hydration status of elite judo athletes during competition days using ultrasound and urine color analysis and reported high levels of dehydration despite ad libitum fluid intake. Rivera-Brown (2011) also identified negative effects of dehydration, and available evidence suggests that dehydration of 2–3% of initial body mass may result in decreased exercise quality due to reductions in muscle strength, followed by impairments in coordination and reaction time factors that are critical in judo performance. These findings are consistent with the results of our study. So, it is of considerable importance to assess the hydration status of judo athletes prior to training in order to discourage the common practice of fluid restriction for weight loss and to prevent the harmful effects of chronic fluid deficits on physical performance and health. This is particularly relevant for female athletes who, at this age, are entering puberty. Ensuring adequate hydration is essential for the full realization of planned training activities in judo, which require the execution of highly demanding technical-tactical elements and combat strategies.

CONCLUSION

In accordance with the results obtained in this study, it is of great importance that young male and female judo athletes develop the habit of consuming sufficient amounts of fluids throughout the day in order to arrive at training sessions in a well hydrated state, and that they are encouraged to drink fluids frequently during training. Furthermore, an individualized post-training rehydration plan should be proposed based on individual needs. Assessing athlete's hydration status prior to training is of considerable importance in order to discourage the common practice of fluid restriction for weight loss purposes and to prevent the harmful effects of persistent fluid deficits on physical performance and overall health. It would be of interest to investigate whether fluid replacement during training represents merely an athlete's habitual behavior or whether there is a genuine physiological need resulting from fluid loss through sweating and exertion during training.

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Conflict of Interest

The authors do not have any conflicts of interest to disclose. All co-authors have reviewed and concurred with the manuscript's content, and no financial interests need to be reported.