

# The effect of acute dehydration on agility, quickness and balance performance in elite wrestlers

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## Abstract

**Background and Study Aim** The aim of this study was to investigate the effect of acute dehydration on agility, quickness and balance performance in elite wrestlers.

**Material and Methods** In research participated male elite wrestlers (n=12). All wrestlers were students of Selçuk University Faculty of Sport Sciences (Turkey). The wrestlers have participated the study voluntarily. The mean age was  $21.58 \pm 1.44$  years, the mean height of  $176.67 \pm 5.87$  cm, mean body weight of  $74.25 \pm 17.79$  kg, and the mean age of sports  $8.92 \pm 1.44$  years. The masses of wrestlers were weighted before the training. The body mass index, body fat percentage, muscle mass and total body fluid were taken with Tanita Bc 730. Agility, quickness (5 m) and balance performance tests were performed. By limiting the fluid intake of the athletes, after losing weight by training, the same tests that were applied before the training applied to the athletes after the training. The study was conducted in accordance with the pre-test and post-test model. T test was used for agility performance measurement of the athletes and 5 m test was used for quickness performance. Dominant foot was determined for balance test. Measurement was made via Biodex Balance System. Balance measurements were performed eyes open (EO) and eyes closed (EC), overall stability index (OSI).

**Results** In this study, body weight, body mass index, total body fluid, agility, quickness and balance with eyes open mean values were found to be statistically significant ( $p < 0.05$ ). Muscle mass, body fat percentage, balance with eyes closed found not to be statistically significant ( $p > 0.05$ ).

**Conclusions:** It is believed that acute dehydration negatively affects agility, quickness and balance performances in wrestlers.

**Keywords:** quickness, agility, dehydration, balance, wrestling.

## Introduction

The main target of athletes and trainers is to demonstrate the highest performance they can achieve. All sports and athletes use scientific principles to achieve their goals. The motor characteristics of an athlete such as strength, flexibility, speed, skill, endurance, balance, and agility, can be increased by training and studies for that sports branch [1].

Wrestling is a close combat sport that requires a high level of strength by using all body parts without using any tools that aim to excel each other by revealing the technical, tactical, skill, psychological power, and intelligence of two individuals on a certain ground [2]. Wrestling, as in all weight division sports, loss weight by reducing food intake, reducing fluid intake, entering the sauna or intensive training methods for sweating before the competition [3]. One of the main reasons why wrestlers lose weight before the competition is that they have the psychology of thinking that the chance of medals is higher in a lower class and that the competition will contribute positively to them. However, considering the literature, studies on weight loss generally indicate that dehydration causes physical and physiological decline in athletes [4-7]. As there is a change in the hydration status of the athletes who lost weight before the competition,

depending on the food and fluid restriction; It has been reported that symptoms such as sleep disturbance, memory, depression, learning, anxiety, body temperature irregularity and muscle function disorders can be observed [8].

This dehydration is tried to be remedied with fluid intake and food during the recovery period. Inadequate replacement of body fluid loss not only negatively affects performance, but also leads to serious health problems and even can be fatal in athletes [9]. The Center for Disease, Control and Prevention of America stated that wrestlers' loss of body weight of 15% as a result of hunger and dehydration practices were the cause of death [10].

When our body starts to lose the amount of water in the organism, dehydration occurs. Dehydration comes in two forms, acute and chronic, and both are important for athletes. During exercise, water loss occurs depending on the intensity, duration, and ambient temperature of the training, and if it is not remedied, acute dehydration occurs [11].

Fastness is the event that muscles can activate joints despite the resistance of a part of the body against external resistance as soon as possible [12, 13]. Agility is defined as the ability to change direction, slow down and accelerate in a fast and balanced way [14]. The term that does not drop the body's mass to the ground and shows its dynamics is called balance [15]. It is thought

that dehydration in the body may affect the performance in weight division sports and studies in this matter are insufficient. Unlike other acute dehydration studies, this study is important for athletes and trainers to examine the effect of fluid loss on performance before and after intense training.

*In this study, it is aimed to investigate the effect of acute dehydration on agility, quickness and balance performance in elite wrestlers.*

## Material and Methods

### Participants

A total of 12 elite wrestlers participated, who are participants in national and international competitions studying at the Faculty of Sport Sciences of Selçuk University, with an average age of  $21.58 \pm 1.44$  years, an average height of  $176.67 \pm 5.87$  cm, and a sports age of  $8.92 \pm 1.44$  years. Before the study, the athletes who participated in the study voluntarily were informed in detail about the risks that may be encountered in the study and about the study, and the voluntary consent form was read and signed by athletes. In the formation of the research group, it was determined that the subjects did not have any injury period or had not experienced any injury that would affect their performance recently.

### Research Design

After taking the height measurement of the wrestlers participating in the research, the weight is weighed before the 1st measurement; Body mass index, body fat percentage, muscle mass and total body fluid were taken with Tanita BC 730 and performance tests (agility, quickness, and balance) were applied. Then, by limiting the fluid intake of the athletes, after losing weight by training, the same tests that were applied before the training applied to the athletes after the training. These tests were applied in the performance measurement laboratory of the sports science faculty. This study was conducted in accordance with the non-invasive clinical research ethics committee decision of Selçuk University, Faculty of Sport Sciences, numbered 41 and dated 11.04.2019.

### Height Measurement

The height of the subjects was determined by using a 0.01 mm precision height gauge with bare feet and only shorts on top.

### Body Weight, Body Fat and Muscle Ratio and Total Fluid Distribution Measurement

Measurements were made with Tanita Bc 730 body composition device twice in total, the first measurement and the second measurement. Care has been taken to ensure that the device is on a flat and rigid ground. During the measurement, the athletes preferred to be with bare feet and clothes that would not affect the weight. In order to ensure that the two legs are open at equal distance on the device and the weight is given equally on each foot, the body is directed to an upright point with eyes directed forward. After the command is given to person on the device in anatomical posture, the person did not move in any way and was warned to observe commands. Body weight in kilograms (kg), body fat percentage (%),

body muscle percentage (%) and total fluid distribution as a percentage (%) were automatically recorded by the device. The amount of fluid lost during training is calculated by the following formula [16]:

Dehydration percentage =  $[(\text{pre-training body weight} - \text{post-training body weight}) \times 100] / \text{pre-training body weight}$ .

### Body Mass Index (BMI)

The following formula was used to determine the body mass index [17, 18].

Body Mass Index (BMI) =  $\text{Body Weight (kg)} / \text{Height (m)}^2$

### Training Program (tabl. 1).

### Test Protocol

### T Agility Test

The 3 cones were placed in the same line, 4.57 meters apart. The test includes a 9.14 meters fast forward run, 4.57 meters side slide to the left, 9.14 meters side slide to the right, 4.57 meters side slide left, 9.14 meters backward run. The athlete took a standing position on the A cone at the starting point. Before starting to run at the starting point, the athletes were instructed to take a forward leaning stance of at least 3 seconds. No swaying or similar movements were allowed. After holding this position for at least 3 seconds, the athlete ran and touched the cone B at a distance of 9.14 meters in the middle from the starting point at maximum speed, and then went quickly to the left cone C with a sliding step and touched the cone at a distance of 4.57 meters with his hand. Then, the athlete went quickly with a right shift step, touched the D cone at a distance of 9.14 meters, quickly ran to the B cone in the middle with the slide step, and then backed quickly to the starting point, and completed the test. The agility performance of the athletes was measured with a photocell placed at the starting point, with a single gated start and end sensor. 3 trial rights were given for each athlete. The athletes were allowed 3 minutes of rest between each run. By writing the measurement results in seconds, the best time obtained in three trials was recorded [1, 19, 20].

### Quickness Test

The visual and auditory quickness performances of the athletes were evaluated at a distance of 5 meters. For the visual quickness performance, the trainer lowers the flag in his hand 10 meters away from the athlete and starts the value at the 5 m distance was recorded in seconds with the stopwatch. For the auditory quickness performance, the athlete was asked to start with the whistle of the trainer in the standing position and the degree was recorded in seconds. In the starting position, the athlete is not allowed to step by coming behind the position. 3 trial rights were given for each athlete and the best measurement was recorded. Between each run, the athletes were given 3 minutes of rest [19, 21, 22].

### Balance Test

Biodex Balance System (Biodex Balance System, BBS, Biodex Medical Systems Inc, Shirley, NY) was used for balance measurements of the subjects. System has a movable balance platform with 360° joint range of motion, the surface of which can tilt up to 20°.

**Table 1.** Unit training application for acute dehydration

<b>Warm-up phase (15 min)</b>	
	10 minutes general warm-up
	5 minutes special warm-up (for wrestling techniques)
<b>Main Stage (80 minutes)</b>	
1st Set	1 min standing balance break training (50 % resistance)
	30 sec rest
	1 min standing balance break training (60 % resistance)
	30 sec rest
	1 min standing balance break training (70 % resistance)
	1 min rest
2nd Set	Techniques applied from foot to floor for 2 minutes (50 % resistance)
	1 min rest
	Techniques applied from foot to floor for 2 minutes (60 % resistance)
	1 min rest
	Techniques applied from foot to floor for 2 minutes (70 % resistance)
	2 min rest
3rd Set	Techniques applied from foot to floor for 3 minutes (60 % resistance)
	1.5 min rest
	Techniques applied from foot to floor for 3 minutes (70 % resistance)
	3 min rest
4th Set	Techniques applied from foot to floor for 6 minutes (70 % resistance)
	8-10 minutes of active rest
5th Set	1 min ground wrestling balance disturbing (50 % resistance)
	30 sec rest
	1 min ground wrestling balance disturbing (60 % resistance)
	30 sec rest
	1 min ground wrestling balance disturbing (70 % resistance)
	30 sec rest
	1 min ground wrestling balance disturbing (80 % resistance)
	1 min rest
6th Set	2 minutes of ground wrestling technical practice (50 % resistance)
	1 min rest
	2 minutes of ground wrestling technical practice (60 % resistance)
	1 min rest
	2 minutes of ground wrestling technical practice (70 % resistance)
	1 min rest
	2 minutes of ground wrestling technical practice (80 % resistance)
	5 min rest
7th Set	3 minutes of ground wrestling combined techniques (70 % resistance)
	1.5 min rest
	3 minutes of ground wrestling combined techniques (80 % resistance)
<b>Finishing phase (15 min)</b>	
	Cool down gymnastics and stretching

Adjustable stability levels from one to 12 are available. Level 1 is the least stable, level 12 has the most stable level. The platform is linked with computer software for an objective assessment of balance. With this software, an overall postural oscillation score (OSI) is obtained.

Postural oscillation score expresses the general balance ability of the person, and a high balance score indicates a low balance performance [23, 24]. Postural oscillation tests were performed under two conditions, with eyes open and eyes closed. The resistance level of the device is

set to Level 8 for the eyes open condition and to Level 10 for the eyes closed condition.

The question “Which foot would you prefer to use to kick a ball?” was directed to subjects before postural oscillation test to find out the dominant leg. The subjects were asked to stand on the platform with the dominant leg in one leg, with the knees at 45° of slight flexion, the other leg at 90° of flexion from the knee, and the arms crossed on the chest. Before the test, the center of gravity of each subject during one-foot stance on the platform was monitored on the screen of the device and recorded on the device. This value has been accepted as a reference for other measurements. The subject was started while he was seeing the center of gravity projection from the screen and the screen was turned off. During the test, after the screen was turned off, the subject was asked to look at a fixed point approximately 1 m ahead at eye level. The subjects were asked to maintain their test stance during the 30-second test period. During the measurements made in the closed condition, the subjects were allowed to close their eyes during the test. Before the tests, the subjects were given enough opportunity to experiment in both eyes open and eyes closed conditions. Postural oscillation measurements were taken twice before and after acute dehydration application. A 5-minute rest was given between tests [25].

#### *Statistical Analysis*

SPSS 22.0 IBM statistical program was used for the

evaluation of the data obtained. Descriptive statistics of the data were made, variance and homogeneity were tested and statistical changes were determined by Wilcoxon test. In this study, the error level was accepted as 0.05.

#### **Results**

Table 2 shows that the average age of the athletes participating in the study was  $21.58 \pm 1.44$  years, an average height of  $176.67 \pm 5.87$  cm, and a sports age of  $8.92 \pm 1.44$  years.

Considering the Table 3, a statistically significant decrease was found in the change in body weight, BMI, and body fluid pre-post test mean values of the athletes participating in the study ( $p < 0.05$ ). It was determined that the change in muscle mass and BMI pre-test and post-test mean values were not statistically significant ( $p > 0.05$ ).

Considering the Table 4, it was determined that the change in the agility and visual quickness test with flag pre and post test values of the athletes participating in the study was statistically significant ( $p < 0.05$ ). There was no significant difference in the auditory quickness performance pre and post test values ( $p > 0.05$ ).

Considering the Table 5, a statistically significant difference was found when the eyes open before and after training were compared ( $p < 0.05$ ). However, it was determined that there was no statistically significant change in the eyes closed pre-test and post-test values ( $p > 0.05$ ).

**Table 2.** Descriptive data of all participants

Variables	N	Mean $\pm$ SD
Age (years)	12	21.58 $\pm$ 1.44
Height (cm)	12	176.67 $\pm$ 5.87
Sport age (years)	12	8.92 $\pm$ 1.44

**Table 3.** Comparison of the physical and physiological characteristics of the athletes participating in the research

Variables	Test	Mean $\pm$ SD	z	p
Body weight (kg)	Pre-test	74.25 $\pm$ 17.80	-3.068	0.002*
	Post-test	72.34 $\pm$ 17.84		
BMI (kg/m <sup>2</sup> )	Pre-test	23.65 $\pm$ 4.64	-3.063	0.002*
	Post-test	23.03 $\pm$ 4.67		
Body fat (%)	Pre-test	12.05 $\pm$ 4.13	-1.750	0.080
	Post-test	12.02 $\pm$ 4.11		
Muscle mass (%)	Pre-test	60.97 $\pm$ 10.52	-0.551	0.582
	Post-test	60.88 $\pm$ 10.70		
Total body water (%)	Pre-test	63.22 $\pm$ 4.80	-3.063	0.002*
	Post-test	62.50 $\pm$ 4.97		

\* $p < 0.05$

**Table 4.** Comparison of the agility and quickness pre-post test values of the athletes participating in the study

Variables	Test	Mean±SD	z	p
Agility (s)	Pre-test	10.15±.85	-2.667	0.008*
	Post-test	10.49±1.03		
Quickness visual (s)	Pre-test	1.144±0.09	-2.404	0.016*
	Post-test	1.21±0.08		
Quickness auditory (s)	Pre-test	1.20±0.17	-1.335	0.182
	Post-test	1.25±0.12		

\*p<0.05

**Table 5.** Comparison of the agility and balance pre-post test values of the athletes participating in the study

Balance	Test	Mean±SD	z	p
Eyes open	Pre-test	2.05±0.63	-3.061	0.002*
	Post-test	3.13±1.25		
Eyes closed	Pre-test	2.41±0.86	-1.379	0.168
	Post-test	2.86±0.75		

\*p<0.05

## Discussion

In this study, which was conducted to examine the effect of acute dehydration on agility, quickness and balance in elite wrestlers, the agility, quickness and balance measurements of the athletes were compared before and after training. In the study, in the elite wrestlers, the body weight, BMI and body fluid pre-post test mean values of acute dehydration were found to be statistically significant ( $p<0.05$ ), and there was no significant difference between the pre-test and post-test mean values of muscle mass and body fat percentage. ( $p>0.05$ ).

Aydos [26] reported in his study on wrestlers that there was a significant difference in the mean body weight values of weight loss in a short time. Aydos et al. [27] reported in the study of young elite wrestlers that age, height and body weight values of the athletes were in the young middleweight and body mass index was within the normal range. In a study conducted by Dölek [28] on the effects of changes in body fluid caused by swimming on performance on female and male athletes, body weight, body fat percentage and total body fluid before and after training were significantly important, while mean BMI values were significant for female athletes, they were not significant for male athletes. As a result of the study conducted by Ağırbaş et al. [29] in which they investigated the effects of high-intensity acute wrestling exercise and sauna on serum lipids, they reported that body weight changes were statistically significant. Alpay et al. [30] found that there was no statistically significant difference in body weight and body mass index mean

values between the two groups of elite wrestlers who lose weight and who do not, but there was a significant difference between lean mass and total body water when body composition was compared. Moghaddami [31], in his study of acute dehydration in the exercise and sauna groups of elite wrestlers, reported that while the pre-post-test mean values of body weight and body fat percentage were found to be significant in the exercise group, there was no significant difference in the sauna group. In a study by Yapıcı et al. [32] examining the effects of dehydration resulting from threshold endurance training on performance in swimmers, reported that there was a significant difference between the pre- and post-test mean values of body weight, body mass index, total body fluid and body fat percentage in the group without fluid supplementation. Bayer [33], in his study examining the physical and physiological values caused by acute weight loss in young wrestlers, reported that there was a significant difference between the pretest and post-test mean values of the experimental group, while there was no difference in the control group. In the study on Greco-Roman style wrestlers of Ayar [34], trial group tried to lose weight by assistance of a dietitian in the period of pre-competition weight loss, while the control group tried to lose weight with their own methods. As a result of the research, the decrease in weight measurements according to the pre and post tests was found to be statistically significant in the experimental group, while the weight changes in the control group were not found to be significant. While BMI pretest and post-test mean values were significant



in both groups, Body fat ratio values were statistically significant in the experimental group, the changes in the percentage of body fat in the control group were not found to be significant. Şahin [35] used the skinfold device measurement method to determine the body fat ratio of wrestlers before and after acute weight loss in his study on university wrestlers. With this method, the skin fold thicknesses of eight standard areas of the body were measured before and after weight loss. According to the results, it was reported that the subjects who lost weight had a decrease in the final test fat ratios. In the study conducted by Yoon [36], most of wrestlers stated that they want to keep their body fat ratio to a minimum, and therefore, generally, wrestlers believe that having a low-fat percentage would be advantageous. Today, body fat percentage is seen to be an important factor in achieving optimal efficiency and physical performance, as well as being one of the health criteria [37]. Bağatır [38] investigated the effect of short-term fluid loss on performance in university level wrestlers and 10 wrestlers lost 3% body weight using sauna method and 10 wrestler using training method. As a result of the study, it was found that there was no significant difference between the groups in the mean values of body weight and body fat percentage. Türkyılmaz [39] in his study investigating the effect of short-term weight loss on anaerobic performance and reaction time under tournament conditions in elite wrestlers; Athletes were asked to lose 5% of their body weight within 48 hours; while total body fluid and muscle mass were found to be significant, percentage of body fat was not found to be statistically significant as result of the study. Considering these studies conducted, it is thought that the results are similar to our study and that the reason for the different results is due to factors such as the difference in training method, age, height, gender and training age.

In this study, while agility and visual quickness pre-post test average values of acute dehydration were statistically significant on elite wrestlers, there was no statistically significant difference between the average values of auditory quickness. Aydos [26] applied the standing long jump and standing vertical jump tests to examine the effect of dehydration on the rapid strength performance in his study in which he examined the effect of weight loss in a short time on strength and endurance in wrestlers. At the end of the study, he reported that the pre-test and post-test mean values were at the level of 0.05 significance and found that this effect continued to decrease after recovery. Akyüz [40], in his study titled the effect of rapid weight loss on physical physiological and biochemical parameters in elite wrestlers, reported that there was a significant difference between body weight and reaction left auditory values before and after weight loss, and reported that there was no difference between pre-post test right-left visual and reaction right auditory values Şahin [41], in his study investigating the effect of acute weight loss on performance of wrestlers in the developmental age, determined in the results of 11-16 years old male athletes competing in the category

of little and stars that after losing 4% weight through training, the visual and auditory stimulus reaction time is the first measurement and the second measurement is the average. Found that there is a significant difference between the values. Bağatır [38], in his study examining the effect of short-term fluid loss on performance in university-level wrestlers, reported that there was no significant difference between the measurements in the mean values of the standing long jump, vertical jump test, both visual and auditory reaction tests. Bayer [33], in his study investigating the effect of acute dehydration in young wrestlers studying in high school, reported that he founded a statistically significant difference between the agility pre-test and post-test mean values of the experimental group, however there was no significant difference in the control group. Türkyılmaz [39] found that there is no significant difference in the effects of weight loss on performance in wrestlers in terms of visual and auditory reaction times.

In our study, while acute dehydration eyes open balance mean values were statistically significant before and after training, no significant difference was found between pre-post test mean values of eyes closed. Erkmén et al. [42] in their study on 17 active athletes, investigated the effect on balance performance before and after training and recovery period by using the Biodex Balance System balance device where the subjects were at 3-day intervals, by dehydrated on the 1st day the hydration with sports drink on the 2nd day, and the hydration with water on the 3rd day. As a result of the study, it was determined that OSI scores were significantly higher before and after exercise in the dehydration condition with eyes open and eyes closed. They reported that there was no significant difference between the values obtained after a 20-minute recovery after exercise and pre-exercise values. The findings of the study conducted by Derave et al. [43] indicate that the balance performance decreases immediately after the exercise applied without fluid administration and balance recovery occurs after 20 minutes. However, McKinney et al. [44] applied an exercise protocol on the treadmill to create dehydration in subjects in a study in which postural oscillation was measured with the Balance Error Scoring System (BESS). This exercise protocol was continued until the body weight loss rate reached 3%, the exercise lasted approximately 75-120 minutes depending on the sweat loss, postural oscillation measurements were repeated after a 20-minute recovery period after exercise in order to eliminate the effects of fatigue. As a result of the study, they stated that dehydration induced by exercise decreased balance performance after a 20-minute recovery period. Gauchard et al. [45] reported that subjects who take fluid after 45 minutes of exercise had higher balance performance than those who did not drink fluids. Bayer [33] used the flamingo test to evaluate the balance performance before and after training in his study investigating the effect of acute dehydration in young wrestlers, while the average values of the dehydrated group were found to be significant, no difference was observed in the non-dehydrated control group. Judelson

et al. [46] investigated the physiological effects of weight loss and its effect on performance in amateur wrestlers. According to results of the study, they reported that 6% weight loss of the total body weight before the two-day freestyle wrestling tournament significantly decreased the lower body strength of the wrestlers as the tournament progressed. Studies have found that when fluid loss is in the range of 3-4%, both aerobic and anaerobic performance are affected, but anaerobic performance is affected more [47, 48, 49, 50]. In other studies, conducted on wrestlers, Alderman et al. [51] 5.27 kg, Brito et al. [52] 7.25 kg, Oppliger et al. [53] reported that 5.3 kg weight loss occurred in short periods of time. In these studies, it was reported that there were higher amounts of weight loss compared to the results of the research. The reason for this can be shown that wrestlers try to cause weight loss with traditional methods and do not apply an adequate and balanced nutrition program. Too much weight loss in a short time puts wrestlers at risk in terms of performance and health.

### Conclusions

It is thought that the acute dehydration training applied

in this study affected the average values of body weight, body mass index, total body fluid, agility, visual quickness and balance with eyes open, whereas it did not affect muscle mass, body fat percentage, auditory quickness and balance performances with eyes closed. It can be said that one unit of high intensity training causes a decrease in body fluid and consequently, athletes have difficulty in maintaining the position of the body. Considering this situation, it is thought that trainers should include balance and direction-changing exercises in their exercises, and fluid supplements should be provided during the training.

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### Conflicts of Interest

The authors declare no conflict of interest.

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