

# The hydration status and thyroid hormones levels among elite wrestlers

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**Summary.** *Study Objectives:* Dehydration causes various loss of physical and physiological functions and also thyroid hormones are important for maintaining the normal physiological function of the body and regulate basic metabolism in the human body. The aim of this study was to examine the effect of pre-competition dehydration on elite wrestlers' thyroid hormones levels. Sixty-nine elite wrestlers participated in the study. *Methods:* The retrospective research model was used in the study. In previously obtained blood samples were determined Sodium (Na<sup>+</sup>), Blood Urea Nitrogen (BUN), Glucose, Potassium (K), Triiodothyronine (T3), Thyroxine (T4) and Thyroid Stimulating Hormone (TSH) levels. The wrestlers Posm levels were calculated using a mathematical formula and Posm levels >290 who wrestlers as the dehydration group and Posm levels ≤290 who wrestlers as the euhydration group were divided into two groups. The Kolmogorov-Smirnov test was used for the normality test of the data. The independent samples t-test was used in the analysis of the obtained data. Significance was set at 0.05. *Results:* According to the results of this study, it was determined that ~45% of pre-competition wrestlers were exposed to dehydration. When the dehydration and euhydration groups were compared, there was a significant difference in BUN and Na<sup>+</sup> levels as the hydration markers and there was no difference in Glucose and K levels. When the difference between thyroid hormones levels was examined, it was found that there was a statistical difference between T3 levels and there was no difference between T4 and TSH levels. *Conclusion:* T3 levels of elite wrestlers were lower in dehydration group than the euhydration group, whereas T4 and TSH levels were not different between both groups.

**Keywords:** Hydration status, Triiodothyronine, Thyroxine, Thyroid Stimulating Hormone, Wrestling

## Introduction

Exercise is a physical stressor that causes hormonal, metabolic, cardiovascular and immunological changes. The stress can affect the body during heavy exercise is the most prominent elements of stress that threaten homeostatic conditions (1). Preservation of hydration after exercise and exercise-induced dehydration is a common condition that should be minimized in the athletes. The hydration status is determined by Urine Osmolarity (U<sub>Osm</sub>), Saliva Osmolarity (S<sub>Osm</sub>) and Plasma Osmolarity (P<sub>Osm</sub>) in blood, and has a cut-off

point for each dehydration measurement method. For U<sub>Osm</sub> cut-off points are 850 mmol/kg, 50 mmol/kg for S<sub>Osm</sub>, and 290 mOsm/L for P<sub>Osm</sub> (2). The reference range of P<sub>Osm</sub> in blood is 280-290 mOsm/L (3).

Although dehydration has been explained by many studies that cause loss of physical and physiological functions in the athletes (4-8), it has been reported that the prevalence of rapid weight loss is very high (60-90% of competitors) in high school, university and international level wrestlers before the competition (9-11). Therefore, assessing the stress caused by changes in the dehydration-induced metabolism and

the adaptive response of the body to overcome this stress are the main fundamental problems for sports scientists and researchers.

During heavy exercises, the body tries to cope with all of the stresses such as increasing energy and oxygen demand, increasing the use of energy stores (12). In many body tissues, thyroid hormones are involved in maintaining normal physiological functions and regulating basic metabolism. Thyroid hormones affect a number of organs and systems in the neuroendocrine system, growth-development and, most importantly, energy metabolism (13). Moreover, an increase in pituitary-thyroid activity is very important in adaptation to physical exercises. Thyrotropin-releasing hormone is secreted from the hypothalamus, causing the secretion of thyroid stimulating hormone (TSH) from the anterior lobe of the pituitary gland and thus the basic steps in the regulation of thyroid gland functions. In the body, active circulating thyroid hormones are Triiodothyronine (T3) and Thyroxine (T4). T3 and T4 are involved in increasing the metabolic rate in many cells. TSH release is associated with reducing or increasing the level of thyroid hormone (T3 and T4) during circulating in the blood and thus TSH provides protection of basal thyroid hormone levels (14,15). Although there are a few studies investigating an increase in thyroid metabolism through the exercise in the sedentaries (1,16,17). Güllü et al., (2004) have reported that there is no evidence on how to affect changes in the thyroid hormones on the athletes at the risk (outside of the reference ranges) levels (18). Furthermore, it is not clear how dehydration-induced thyroid hormone activation in the weight class athletes. In this context, the adaptive responses of the dehydration-induced thyroid hormones in the organism constitute the hypothesis of the study. The aim of this study was to investigate the effect of dehydration on the thyroid hormone levels of elite wrestlers.

## Material and Methods

### *Participants*

The participants were 69 volunteer elite wrestlers (Age: 22.51±2.49 year; Height: 174.54±6.59 cm; Body weight: 78.98±15.87 kg; Body mass index: 25.73±3.77 kg/m<sup>2</sup>) who had at least 5 years sports experience and

did at least one exercise on a daily basis. During the study period, no disease that could affect the blood values of the wrestlers was detected. In this study, official permission for ethical approval of using data was obtained from the Turkey Wrestling Federation with the number of TGF/2171. Additionally, the study was conducted in accordance with the guidelines of the revised Helsinki Declaration.

### *Experimental Design*

The retrospective research model was used in the study. With the help of specialists (nurses), blood samples were taken from the wrestlers during the competition weigh-in time (one day before the competition, between 06:00 and 06:30 pm). In addition, the amount of body weight loss performed by the wrestlers was obtained using a personal information form. The percentage change of body weight loss was determined with the help of formula:

Percentage of body weight loss ( $\Delta$  %) = [(Normal Body Weight - Competition Weight) / Normal Body Weight] × 100.

Sodium (Na<sup>+</sup>), Blood Urea Nitrogen (BUN) and Glucose levels were determined from hydration markers in order to determine the P<sub>Osm</sub> levels in blood samples of the wrestlers and P<sub>Osm</sub> levels was calculated with the help of a mathematical formula:

$P_{Osm} = (2 \times Na^+) + (BUN / 2.8) + (Glucose / 18)$  (19).

In the literature for the status of euhydration, the P<sub>Osm</sub> reference range has been reported to be 280-290 mOsm/L. According to P<sub>Osm</sub> reference range, the group with P<sub>Osm</sub> level ≤290 was classified as "euhydration" and the group with P<sub>Osm</sub> >290 was classified as "dehydration" group (20).

### *Biochemical Analysis*

In the blood samples obtained previously, hydration markers (Na<sup>+</sup>, BUN, Glucose, and Potassium (K)) were analyzed using a Beckman Coulter AU 2700 Plus biochemical autoanalyzer with Beckman Coulter kits, while hormone analyses (T3, T4, and TSH) were Roche Cobas e601 autoanalyzer with Roche kits.

### *Statistical analysis*

The SPSS 18 was used for the statistical analysis. The normality test of obtained data was tested with

Kolmogorov-Smirnov test. Independent Samples T-test was used for analysis of data showing normal distribution. Significance was set at 0.05.

**Results**

Information on the research results is given below.

According to the research findings, ~ 45% of the wrestlers have exposed dehydration before the competition. When the amount of body weight lost was calculated, it was determined that dehydrated wrestlers performed weight loss of 4.55% of their body weight.

When the Dehydration and Euhydration groups were compared, there was a statistically significant difference between BUN and Na<sup>+</sup> levels, and there was no difference between Glucose and K levels among hy-

dration markers. When the difference between thyroid hormones was examined, it was found that there was a statistically significant difference between T3 levels, and there was no difference between T4 and TSH levels as thyroid hormones.

**Discussion**

Following the death of three wrestlers in 1997 in the United States of America due to dehydration, National Collegiate Athletic Association (NCAA), attempted to design new rules to ban of unhealthy weight loss practices (21) and decided that new weight classes should be designed by adding +3 kilos (22). Additionally, under Wrestling Weight Certification Program, it is recommended that weekly body weight loss should not exceed 1.5% of body weight (23). For this reason, the United World Wrestling decided in the most recent competition rules for finishing unhealthy weight loss practices to apply weigh-in held the competition morning of the concerned weight category (24). Because many studies have reported that biochemical markers and hormone levels change in the human body due to weight loss (4-6, 8, 25-27).

**Table 1.** Descriptive statistics on the classification of wrestlers and percentage of body weight loss

Groups	Frequency	Percentage	Δ% kg
Dehydration	31	44.9	4.55
Euhydration	38	55.1	0.97
Total	69	100.0	2.57

Δ%: change of body weight loss percentage

**Table 2.** Comparison of wrestlers' hydration markers and thyroid hormones

	Variables	Groups	N	Reference Range	Mean±S.D.	p
Hydration Markers	BUN (mg/dL)	Dehydration	31	8-20	16.44±3.44	<b>0.016*</b>
		Euhydration	38		14.31±3.63	
	Glucose (mg/dL)	Dehydration	31	74-106	97.00±15.77	0.951
		Euhydration	38		97.08±12.47	
	Na <sup>+</sup> (mmol/L)	Dehydration	31	136-146	142.45±1.61	<b>0.001*</b>
		Euhydration	38		137.45±2.74	
K (mmol/L)	Dehydration	31	3.5-5.1	4.18±0.31	0.951	
	Euhydration	38		4.18±0.35		
P <sub>osm</sub> (mOsm/L)	Dehydration	31	280-290	296.05±3.14	<b>0.001*</b>	
	Euhydration	38		285.29±5.24		
Thyroid Hormones	T3 (pg/ml)	Dehydration	31	2-4.4	3.38±0.37	<b>0.006*</b>
		Euhydration	38		3.67±0.47	
	T4 (ng/dl)	Dehydration	31	0.93-1.7	1.30±0.14	0.224
		Euhydration	38		1.34±0.16	
	TSH (μIU/ml)	Dehydration	31	0.27-4.2	2.23±1.49	0.908
		Euhydration	38		2.19±0.92	

S.D.: Standard Deviation; \*p<0.05

According to the primary findings of the study, the percentage of weight loss in the euhydration group before the competition was 0.97% kg. On the other hand, the percentage of weight loss in the dehydration group before the competition was 4.55% kg. Dehydration is a common condition encountered at the end of an exercise. Casa et al. (2000) have reported that 1% of exercise-induced dehydration is well dehydration and it will not cause function losses (28). According to the results of the primary findings of the present study, dehydration group may be exposed to physical and physiological function losses and this situation may cause a decrease in competitors' competition performance.

According to the main findings of the current study, BUN and Na<sup>+</sup> levels of the dehydration group were higher than the euhydration group and the difference between groups was significant. Furthermore, the T3 level of the dehydration group was lower than the euhydration group and the difference between groups was significant. Despite these findings, there was no significant difference between the two groups in terms of glucose, potassium, T4 and TSH levels.

Thyroid hormones are involved in the metabolism of vitamins and minerals, as well as the activity and control of many enzymes in different metabolic processes affecting the response of target tissues to different hormones. Therefore, regulation of general metabolism plays an important role in cell differentiation and growth, thermogenesis and oxygen consumption (29,30). To prevent thyroid disorder, monitoring gland and/or thyroid hormones levels in the blood for effective control of metabolism is necessary. Akander, Rosa, and Moretti (2017) have reported that there were many reports of control of thyroid hormones in the regulation of cardiac function, as an important factor in the control and prevention of diseases of the circulatory system. Furthermore, thyroid function is a new step to the discovery of great champions, since thyroid function is directly related to the athlete's performance, that is, increasingly necessary to control the thyroid gland given that the athlete must achieve greater performances in their competitions (31).

When the literature was investigated, some studies have indicated that the effect of exercise on thyroid hormone levels, whereas some studies have not reported that the effect of exercise on thyroid hormone

levels (32-39). These different findings suggest that the level of thyroid hormones may vary depending on factors such as frequency, volume, and content of training protocol, age, and gender. However, there are no studies investigating the relationship between dehydration and thyroid hormones.

In the present study, although there was no significant difference in T4 and TSH levels between dehydration and euhydration groups, there was a significant change in the T3 level. Changes in T3 levels of elite wrestlers as a result of dehydration may result from decreased basal metabolic rate due to loss of body weight. Furthermore, T3 plays an important role in reducing peripheral resistance by altering the Na<sup>+</sup> and K input in smooth muscle cells, leading to a decrease in smooth muscle contractility and vascular tone (40,41). In the current study, a significant difference was found in Na<sup>+</sup> and T3 levels between the dehydration and euhydration groups and this difference caused by dehydration in elite wrestlers would result in a decrease in vascular tone.

In conclusion, dehydration caused a significant change in BUN, Na<sup>+</sup>, and T3 levels in elite wrestlers. According to this result, it is suggested to the wrestlers not lose weight before the competition. However, if weight loss is a necessity, weight loss must be carried out gradually according to the NCAA rules. Thus, the markers of hydration may remain within the reference range. This situation can help them to lead a healthy life in the future and maximize their competition performance. Furthermore, further detail studies should be carried out to determine the molecular mechanisms of the effect of dehydration on T3, T4, and TSH levels in elite wrestlers. In addition, determination of the relationship between thyroid hormones and dehydration due to rapid and/or gradual weight loss in other combat sports (Boxing, Judo, Jiu-Jitsu, Muay-thai etc.) will contribute to the sports sciences field.

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