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THE MONITORING OF WEIGHT FLUCTUATION AND HYDRATION STATUS IN CADET WRESTLERS (AGES 14-17) DURING A TRAINING CAMP PERIOD LEADING UP TO COMPETITION

Erkan DEMİRKAN¹, Mitat KOZ¹, Cengiz ARSLAN², Gülfem ERSÖZ¹, Mehmet Kutlu³

¹ Ankara University, School of Physical Education and Sports, Turkey; ² School of Physical Education and Sports, Malatya, TURKEY; ³ Department of Physical Education and Sport, The University of Kırıkkale, TURKEY

erkandemirkan_1979@hotmail.com

ABSTRACT

This study aims to determine the body weight and hydration levels of wrestlers within the cadet super league and to investigate their effects upon performance. Measurements were recorded four times: on the first day of training, which is 17 days prior to competition, three days out from weigh ins, immediately prior to weigh-in and immediately before the competition. During these study periods, body weight and urine specific gravity (Usg) were measured. Body composition was measured in the first round of testing. Results of these measurements were compared to competition results. Body weight and hydration levels did not change significantly until the third day before weigh in ($P > 0.05$). A significant level of weight loss ($\% 3.9 \pm 2, 7$) and an increase in Usg levels ($1.024-1.028 \text{ g/cm}^3$) were discovered in the last three days before official weigh-ins. However, no significant change in Usg values ($P > 0.05$) were observed between weigh in and the competition, although a significant weight gain ($P < 0.05$) was observed. Consequently, it can be shown that although the rapid weight loss and dehydration observed in cadet wrestlers just prior to weigh-ins was followed by a rapid weight gain between weigh-ins and the competition; there was no improvement in the hydration status.

KEYWORDS: Cadet Wrestlers, Hydration, Urine Specific Gravity, Body Weight

INTRODUCTION

Wrestling is a primarily anaerobic sport characterized by repeated high force and power outputs while attacking and defending during the competition. However, a significant aerobic fitness level is also required in order to maintain performance over the course of a 2 hour competition (9). Most athletes will subject themselves to rapid weight loss methods just before weigh in, in order to compete in the weight categories they, and their coaches, believe are best suited for them. Despite evidence indicating that, rapid weight loss is not a healthy practice. Weight loss prior to competition is typically achieved by restricting fluid and food ingestion, in conjunction with acute dehydration by strenuous exercise in hot environments (e.g., saunas, steam rooms). In addition, wrestlers have been known to wear extra clothes or vapor-impermeable suits during exercise to increase core temperature and stimulate greater perspiration (31). This rapid weight loss in wrestlers may cause dehydration and possibly a decrease in physical performance. Dehydration resulting from rapid weight loss causes changes such as a decrease in blood plasma volume, increased rectal heat, an increased heart rate and a decrease in cardiac output. In addition, the distributions of nourishment / energy resources are affected, the removal of metabolic wastes are slowed down and cellular metabolism changes have also been observed (11). The most striking result of this rapid weight loss was the death of 3 college wrestlers in the USA when they lost 15% of their body weight as a consequence of food restriction and dehydration in 1997 (19). Such practices result in a decrease in body water volume and muscle mass, as these kinds of rapid weight loss methods are carried out by limiting nourishment and fluid in-take. Therefore, it is important to evaluate the body composition of the athlete to determine their physical condition during weight-loss periods (15). As previously described, such rapid weight loss methods have serious implications concerning their health (1).

It is suggested that weight loss per week should not exceed 1.5 % of body weight by Wrestling Weight Certification (WWC) program instituted by the National Collegiate Athletic Association (NCAA) (28, 17). Meanwhile, it is also required to determine the hydration level as well as body weight and body composition for each wrestler at the beginning of the season by NCAA in accordance with weight loss protocols to establish a wrestler's minimal wrestling weight (29, 17). The NCAA's WWC uses urine specific gravity (Usg) as the most practical and effective measurement to determine hydration level during the weight classification period (26, 5). The NCAA accepts 1.020 g/cm^3 and smaller values as the limit criteria to demonstrate a euhydrated condition (28, 26, 5). In addition, skin fold methodology is used to determine body fat percentage and establish the minimal weight class using the weight of the wrestler at a minimum of 5 % body fat (17). Although weight loss problems are known in our country, scientific research or data are scarce. Although there is significant research concerning

adults, there is very little, if any concerning the hydration status and weight loss patterns of young elite wrestlers either in our country or abroad (28, 5, 24, 15). Significant relationships have been observed between weight loss before weigh-in and subsequent weight gain before the competition, and the scores achieved in wrestling competition (32, 15).

The aim of this study is to identify the hydration status of cadet wrestlers during the training camp period and to evaluate the changes in their body weight and hydration level prior to the league competition. In addition, a further aim was to investigate the relationships among the changes in the wrestlers' body weight, hydration levels and their scores in league competition.

MATERIALS AND METHODS

This study was conducted with 13 elite cadet wrestlers whose ages range from 14 to 17 (14.7 ± 0.8) from the Corum Wrestling Education Centre who compete in the Turkey Cadet Super League. Subjects were representative of all weight categories (39 - 69 kg), with the exception of heavyweight. The heavyweight wrestlers were excluded because they typically do not have weight loss concerns. This study covers a 17-day period before the league competitions planned by the Turkish Wrestling Federation at the Corum Wrestling Education Centre. Measurements were made on the 17th day before the competition (first measurement), third day before weigh-in (second measurement), immediately preceding the official weigh-in (third measurement) and before the competition (fourth measurement). An ethics committee approval was obtained from the Ethics Committee of Medicine Faculty of Ankara University and an informed consent form was provided to each athlete requiring their signature. All of the researchers involved in the study have signed the Helsinki Declaration.

Measurements and Evaluations

Measurements of Height and Body Weight: Body weight measurements were made using a digital scale (Seca 664, Hamburg, Germany) in bare feet and wearing only shorts. *Determination of Body Fat Percentage:* Three body sites (abdominal, triceps, subscapular) were measured in mm by using a skin fold caliper (Holtain Ltd.UK). These measurements were converted into body-fat percentage by using the Lohman and Brozek equations (14).

Urine Measurement: Urine samples were taken from all of the athletes during the periods mentioned-before weigh-in (after a 12 hour fast) upon waking up 17 days before the league competition, 3 days before the competition, before weigh-in and just before the competition, the next day. With these samples, urine specific gravity (Usg) was determined using a refractometer (Atago Digital Urine S.G. UG- α alpha). In addition, color identification was made using 8 different color scales belonging to these samples (4). All subjects were considered to be adequately hydrated based upon a urine Usg less than or equal to 1.020 g/cm^3 (28). Meanwhile, ≥ 4 level in urine color is associated with dehydration level (23).

Evaluation of The Scores: The athletes were assigned their points according to their scores in Cadet Super League competitions in compliance with FILA (International Federation of Associated Wrestling Styles) scoring system.

Classification points at the end of a bout were as follows;

5 points for the winner and 0 for the loser: victory by fall, injury, withdrawal, default, disqualification.

4 points for the winner and 0 for the loser: victory by technical superiority (6 points difference, 5 points hold or 2 holds with 3 points), with the loser scoring no technical points.

4 points for the winner and 1 for the loser: victory by technical superiority (6 points difference, 5 points hold or 2 holds with 3 points during two periods) with loser scoring technical points.

3 points for the winner and 0 point for the loser: when out of three periods, the wrestler wins two periods of 1 to 5 points and the loser scoring no point.

3 points for the winner and 1 point for the loser: when during two periods the bout ends by a victory by points during regular time or by an ordered hold and the loser scoring one or several technical points.

Evaluation of the Data: All measurements (body weight, Usg and color) were compared with the one before and after using the T-test (paired t-test in group). The relationship between variables was analyzed through the Pearson correlation test. The correlation values above 0.65 were judged as strong relation, those around 0.50 as a moderate relation and the below 0.35 were judged as low relation. Statistical significance was accepted as $P < 0.05$.

RESULTS

A description of the subjects is presented in Table 1.

Table 1. Anthropometric Characteristics of the Wrestlers.

N=13	Minimum	Maximum	Mean	Standard deviation (\pm)
Age	14	16	14.7	0.9
Height (cm)	145,5	177	165.2	9.2
Fat%	5.7	10.5	8.1	1.6
Weight (kg)	41.3	77.3	58.3	11.5

The fluctuations in body weight and Usg in the wrestlers during the four measurement periods are shown in table 2.

Table 2. Body Weight and Urine Density in Wrestlers during the Study

	1 st Measurement Before 17 Days	2 nd Measurement Before 3 Days	3 rd Measurement Before Weigh in	4 th Measurement Before Competition
Body weight(kg)	58.3 \pm 11.5 ∞	58.2 \pm 11.2*	56.0 \pm 11.4 * ∞ ●	57.4 \pm 11.2●
Usg (g/cm ³)	1.025	1.024	1.028	1.027

● ∞ *P<0.05

There is not a statistically significant difference between the body weight of wrestlers at the beginning of the study (58 \pm 11.5 kg) and 3 days before weigh in (58.2 \pm 11.2 kg), (P>0.05). However, there was a statistically significant difference between body weight at competition weigh-in (56.0 \pm 11,4 kg) and 3 days before weigh-ins (58.2 \pm 11.2 kg), (P< 0.05). The percentage difference was -3.9 \pm 2.7. The difference between the amount of weight change and percentage rate of change (+2.6 \pm 1.9 kg), between the 3rd weigh-in (56.0 \pm 11.4 kg) and the weigh-in just before the competition (57.4 \pm 11.2 kg) was also found to be statistically significant (P<0.05). There was no statistically significant difference was found between urine measurement results (Usg and color) (P> 0.05).

The relationship between the urine color scale and Usg measurement scores of the cadet wrestlers are illustrated in table 3 and the relationship between Usg, changes in body weight and match scores are illustrated in table 4. It was found that the correlation between two measurement methods (urine color and Usg) was strong. No significant relationship was found between changes in Usg and body weight with match scores.

Table 3. The Correlation Between Urine Measurement Methods

	Usg 1	Usg 2	Usg 3	Usg 4
Color 1	0.75**	0.25	0.27	0.46
Color 2	0.59*	0.90**	-0.40	0.52
Color 3	0.19	-0.12	0.70**	0.50
Color 4	0.47	0.38	0.23	0.91**

** Correlation Significance Level P< 0.01

* Correlation Significance Level P< 0.05

Table 4. The Correlation between Match Points, Body Weight Changes, and Urine Specific Gravity Changes

	Competition Points	Weight difference between 3 days before and competition	First weight and weigh in	The difference between first weight and competition
Urine 1	.084	-.028	.135	.395
Urine 2	.492	-.260	.021	.470
Urine 3	-.056	.596*	.602*	.354
Urine 4	.300	.499	.613*	.650*
Competition Points	1.000	.325	.300	.449

* Correlation Significance Level P< 0.05

DISCUSSION

The effects of rapid and excessive weight loss on performance have been the focus of attention of researchers for many years. The potential damages on physiological parameters resulting from weight loss and the changes in body composition during a competition season, have been studied and conflicting results were found (24). There is very little research studying the relationship between weight loss and performance during competition or tournaments (32). The National Wrestling Coaches Association (NWCA) in the USA has stated that a college wrestler may have a minimum body fat level of 5% (33). We have found out that the body fat percentage of the wrestlers were above the value ($8.1\% \pm 1.6$) used by the NWCA (Table 1). The studies revealed that most of the wrestlers lost 2 kg in a week and 20 % of them lost 2.7 kg. It has stated that one out of three wrestlers underwent rapid weight loss more than 10 times during the season (2). Another study, Oppliger et al. (20) found that as many as 80% of college wrestlers engage in dieting, with more than 50% use fasting, and approximately 75% increasing their training load to lose weight. The study revealed that there was not a significant change in the body weight of wrestlers between the beginning of the study and 3 days before weigh-in (58.3 ± 11.5 kg - 58.2 ± 11.2 kg), but there was a significant weight loss in the period between 3 day before weigh in and just before weigh-in (58.2 ± 11.2 kg - 56.0 ± 11.4 kg (- 3.9 %)) ($P < 0.05$) (Table 2). In addition, a significant time effect was found for Usg, which was demonstrated by an increase in Usg from baseline after the 3% reduction in body mass. This supports the practical use of Usg to identify hydration status in both athletic and clinical populations (31). In this study, there was an increase in Usg values (1.024 g/cm³ - 1.028 g/cm³) between 3 day before weigh in and just before weigh in, but there was not a significant difference. These results show that wrestlers often lose weight using the food and fluid restriction and using dehydration methods one or two days before competition. Meanwhile, it was found that they demonstrated significant weight gain when the values of their body weight after weigh in and before the competition were examined. Kukidome et al., (15) observed that there was not a significant change between the values one week before weigh-in (74.3 ± 9.4 kg) and one month before weigh in (74.5 ± 9.2 kg) in their research on 12 wrestlers (ages 18-22). In contrast, the results obtained from weigh-in for competition (69.1 ± 9.0 kg), an average decrease of 5.4 kg was recorded in comparison to the measurements one month before equating to an approximately 7.3 % weight loss. Kukidome et al., revealed a 3.1 kg increase in body weight on the day of competition. Wroble and Moxley (32) found that college wrestlers gained 1.3 ± 1.1 kgs between the night of weigh-in and the following morning. Ransome and Hughes (22) reported that 78 male wrestlers (ages 21.3 ± 1.5) weighed 73.93 ± 11.62 kg 24 hours before the competition, 72.53 ± 11.66 kg at the moment of weigh-in and 73.65 ± 13.58 kg 24 hours after the competition. Kraemer et al., (13) reported that wrestlers lose 6% of their weight between one week before the tournament and weigh-in. After which, they gain approximately 1.8 % of their weight until the time before the competition (13). An increase of 1.4 kg occurred between the period after weigh in and the competition (56.00 ± 11.4 kg - 57.4 ± 11.2 kg) in accordance with the literature, it is thought that wrestlers lose weight rapidly with the thought of regaining the weight they lost between weigh-in and the competition based on the results.

It is doubtful that if the wrestlers completely regain their body water, electrolyte and glycogen storage despite their regaining of weight. It has been found that there is no change in the level of glycogen in skeleton muscle before weight loss when compared with 17 hour recovery period after losing weight (30, 15). Meanwhile, it is stated that liquid homeostasis can only be renewed in 24 to 48 hours and the muscle glycogen can be replaced in 72 hours (2). Similarly, no significant change can be seen in hydration status (1.028 g/cm³- 1.027 g/cm³) despite a 1.4 kg weight gain occurring during the 14-hour time between post weigh-in and the competition (Table 2). This supports the concept that the hydration status of rapid weight gain after weigh-in cannot be renewed before 24-48 hours. Another study proving weight gain has no effect on hydration level is Buford et al., (2006). In this study, it was observed that although there was a 6.9 % increase in wrestlers' body weight (75.11 ± 3.53 – 80.30 ± 2.98 kg) in the 3 weeks following the competition season. No significant change was recorded in hydration levels from the middle of the season to the end (1.024 ± 0.001 g/cm³- 1.022 ± 0.001 g/cm³). The fact that there is no change in hydration level in spite of 7% increase in body weight in 3 weeks makes it ambiguous if this increase is only water or not. On the other hand, it has been found that wrestlers have higher Usg levels even in normal hydration when compared with non- wrestlers. The fact underlying this phenomenon is unknown. However, it is put forward that this may be related rapid weight loss of wrestlers before every competition and weight gain after each one during the season (6). Finn et al. (8) have found that carbohydrate intake (1.5 g/kg) after rapid weight loss in wrestlers and periodical sprint exercise performances have no positive effect on blood-lactate response and psychological well-being of the athletes. In consequence, studies showing that weight gain after rapid weight loss can not completely renew body liquid- glycogen storage and its effects on performance remain ambiguous.

The results of the study are important in that they support the concept that some urine variables as well as the change of body weight can be used as a significant sign of body hydration status. It has been seen in 4 different Usg measurements done to determine hydration status; that wrestlers face a light chronic dehydration and an

increase in the values between 3 days before weigh in and during weigh-in. These values are seen to be above 1.020 g/cm³, which is accepted as euhydration level for the athlete by NCAA (28, 26, 5). Meanwhile, ≥ 4 level in urine color is associated with dehydration level in other studies about the issue (23, 19). Armstrong et al (4), state that higher urine color than the 3 level can be a sign of dehydration status on a Likert color measure (4, 19). According to this, values found in our study, are rarely above normal limits. Also, Armstrong et al (4) put forward that there is a significant relationship between urine color, specific gravity and osmolality in hydration status in urine indicators studies, and that these methods can be used in sport related field researches. It has been established that there is a high correlation level between Usg and color measurements and that the result supports the literature.

In this study, we have attempted to prove the relationship between body composition and hydration status of cadet wrestlers and their scores in league matches with the positive points gained at the end of the competition. Although there is a meaningful relationship between weight loss and gain before weigh-in and the competition, no meaningful relationship has been found when compared with positive points gained. It is perhaps because the majority of wrestlers are in the same dehydrated state. There are few studies investigating the effect of weight loss before weigh in on the competition. Wroble and Moxley (32) have reported in their research among 260 college wrestlers that winners gain 1.5 ± 1.1 kg while losers gain 1.2 ± 1.0 kg. They have found a significant difference in the weight gain of winners and losers ($P < 0.05$). Choma et al (7) have reported that rapid weight loss results in damage in short term memory and breakdown of mental balance as well as a number of physiological effects, and they conclude that this can lead to anxiety before the competition. As well as a 6.9 % increase in the wrestlers' body weight (75.11 ± 3.53 - 80.30 ± 2.98 kg) in 3 weeks following the completion of the season, a significant increase (28%) was found in isometric leg force (Buford, 2006). Kraemer et al., (13) have diagnosed a significant decrease in the level of lower and upper body isometric force during the 2 day- wrestling-tournament period after 6% body weight loss in one week before the weigh-in. Consequently, they have found out that rapid weight loss before the tournament has a decreasing effect in performance parameters during the 2 days- wrestling tournament (13). Schoffstall et al., (25) have found that there is a decrease in bench press maximum as a result of approximately 1.7% (1.5 kg) weight loss and acute hydration. The laboratory research studying effects of dehydration on performance has proved that body water loss has very little effect on muscle force and ballistic power while it deteriorates aerobic exercise performance (16).

These studies show that weight loss can have negative effects on performance parameters while weight gain before the competition can have positive effects. However, in our study, no such effects of the changes in body weight have been observed on competition performance. Many factors such as skill, ability, experience, wrestling age and physiological condition of the rival at that moment affect the scores in wrestling. These factors mentioned should be taken into account when the performance is evaluated.

Consequently, it has been seen that cadet wrestlers lose weight more than what NCAA suggests (maximum 1.5 % per week), then gain weight rapidly after weigh-in but the weight gained does not have a completely positive effect on the hydration level of the athletes. On the other hand, these changes do not appear to have a direct effect on the matches. Other studies that use more subjects, use control groups, and longer in duration are needed to find out the effects of the rapid changes on match performance completely. Moreover, it should be considered that physiological condition, wrestling age and skill of the rival affect the score of the competition when the performance is evaluated.

PRACTICAL IMPLICATIONS/ADVICE FOR ATHLETES AND COACHES

In wrestlers, rapid weight loss is generally carried out just prior to weigh-in. Since the time between weigh-in and competition is not enough for wrestlers to rehydrate. Wrestlers will often participate in the competitions in a dehydrated state. The process of weight cutting should be monitored by coaches and/or trainers and take place for an extended period of time (1.5 % body weight per week). Otherwise, wrestlers may be at risk of dehydration. Urinary markers, including Usg and urine color, can be used to determine hydration status. In addition, acute weight change can also help to evaluate body water loss during practice. Weight fluctuations can be monitored by weighing before and after all practices. A refractometer may be provided for all teams or urine color chart may be placed on the wall of the locker room for athletes read. All of these methods to assess hydration level in wrestlers are practical, non-invasive and do not require technical skills.

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