ORIGINAL RESEARCH PAPER

BODY HYDRATION DEGREE CHANGES DURING TRAINING IN FOOTBALL PLAYERS IN WINTER CONDITIONS

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Abstract

Body hypohydration degree significantly influences the athletes' performance, which is especially important for sport game players. The hydration degree of athlete's body determines his aerobic endurance and the ability to perform psychomotor tests. Thirst sensation cannot be plausible indicator to regulate water uptake, because plain water suppresses thirst (thus further drinking) therefore the water uptake will be twice smaller than necessary. The aim of our investigation is to determine the effect of 1.5 hours football training on urine specific gravity and hydration degree of athlete in winter conditions. Forty football players from the first league teams participated in the investigation voluntarily. Their mean age was 20.5 ± 3.5 years; height – 180.7 ± 6.2cm and mean body mass – 76.4 ± 8.2kg. The players are weighed using precise scales. Urine samples were collected before and after the training. Urine specific gravity was measured by urine refractometer. Results show that before training 14 (35%) athletes were euhydrated, 24 athletes (60%) were hypohydrated and two athletes (5%) were seriously hypohydrated. After training 4 (10%) athletes were euhydrated, 22 athletes (55%) were hypohydrated and 14 (35%) were seriously hypohydrated. The mean weight loss during the training was 0.80 ± 0.55kg, but the mean water loss – 0.53l/h. Even 1.5 hours prolonged training changes urine specific gravity. Results show that more than half of players were hypohydrated even before the training and body hydration degree worsens after the training. The recommendation is to uptake greater amount of mineral water before, during and after training.

Keywords: *hydration status, urine specific gravity, urine refractometry, football players, winter.*

Introduction

Body hypohydration degree significantly effects the athletes performance, which is especially important for sport games players – male football players during the game in summer lose 0.99 –1.93l of water per hour, the mean loss of water is 1.46l/h, but during training in winter – 0.71–1.77l/h, the mean loss – 1.13l/h (Sawka et al., 2007). The hydration degree of athlete's body determines his aerobic endurance and the ability to perform psychomotor tests (Mendez-Villanueva et al., 2007). Small degree of the body hypohydration (loss of 1.5 – 2.0% of the body weight caused by water loss) causes significant decrease of the performance of football players and their psychological state (Edwards et al., 2007). A loss of 2% body weight causes an increase in perceived effort and is claimed to reduce performance by 10 – 20%. A fluid loss exceeding 3 – 5% body weight reduces aerobic exercise performance noticeably and impairs reaction times, judgement, concentration and decision making – vital elements in all sports, from pole-vaulting to football (Wright, 2004).

One universal method to determine the body hydration degree is not elaborated. It is not possible to do it by only one characteristic measurement, for example, from the body water content or from urine osmolarity (Armstrong, 2007).

Three methods are available to measure the urine specific gravity: hydrometry, refractometry and reagent strips. The German authors (Stuempfle & Drury, 2003) compared the precision of these three methods by testing wrestlers before and during the competitions. It was concluded that only urine refractometry is a precise method to measure urine specific gravity. Using hydrometry – 28% of results were false positive and 2% – false negative, but by strips of reagents – 15% of results were false positive and 9% – false negative.

According to the data of National Collegiate Athletic Association the hydration degree of the body is in norm if the urine specific weight is below 1020 (Stover et al., 2006). Athletes trained in different sports differ in their body mass composition (mass of skeletal muscles), uptake of water and food or restriction of water and food uptake. Therefore the body hydration degree and loss of mineral salts before competitions, during competitions and after sports loads differs in wide range in different sport specialization athletes (Maughan & Shirreffs, 2008).

The aim of our investigation is to determine the effect of 1.5 hours football training on urine specific gravity and hydration degree of athlete in winter conditions.

Material and methods

Subjects. Forty male football players from two first league teams participated in our investigation voluntary. They trained regularly five times per week and participated in the competitions on weekends. Their mean age was 20.5 ± 3.5 years, height – 180.7 ± 6.2cm and the mean body mass at rest – 76.7 ± 8.4kg.

Methods. The anthropometric data were measured before training: height and body mass. The football players were weighed using special scales Midrics1 (Sartorius, Germany) with precision 10g and maximal weight of measurement of 150kg. The weighting of the athletes was repeated after 1.5 hours duration training.

Every athlete collected mid – stream specimens of urine before and after the training. Urine samples were collected in 15ml sterile tubes (Sarsted Aktiengesellschaft & Co, Germany). Urine specific gravity was measured by urine refractometer PAL - 10S (Atago, USA) with precision ± 0.001, at ± 0.1^{o}C.

Evaluation of athlete's hydration degree is performed by using National Athletic Trainers' Association and American College of Sports Medicine used scale, were USG (urine specific gravity) under 1.020 means euhydration, USG in range 1.020 – 1.029 means hypohydration and USG equal or higher than 1.030 means serious hypohydration (Armstrong, 2007). All football players could uptake mineral water or sports drinks during the training without any limitation. The SPSS version 20 programs were used for statistical analysis of the data.

Results

The specific gravity of athletes' urine samples was greater after the training than before it in the greatest number of cases (Fig. 1)

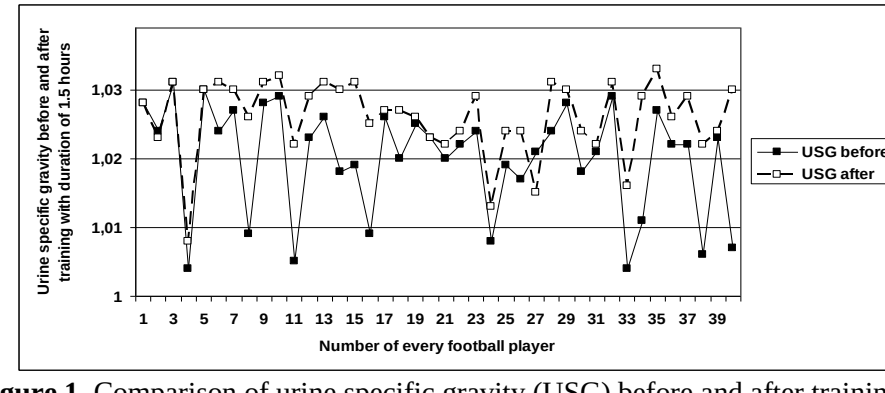

Figure 1. Comparison of urine specific gravity (USG) before and after training for each football player

The urine specific gravity did not changed for four football players and decreased in two players. The mean changes of the urine specific gravity were + 0,006 units.

Alteration of the body mass of players varied – from decrease after the training for 1.89kg in comparison with their mass before training – to increase of the body mass for 0.51kg after training in comparison with the rest mass, see Table 1.

Table 1

The body mass (BM) and urine specific gravity (USG) before and after the training for football players

BM (kg) before training	**BM changes, kg**	**BM (kg) after training**	**BM changes, %**	**USG before training**	**USG after training**
78.14	- 0.28	77.86	- 0.36	1.028*	1.028*
73.48	- 0.80	72.68	- 1.09	1.024*	1.023*
79.05	- 0.63	78.42	- 0.80	1.031**	1.031**
70.91	- 0.54	70.37	- 0.76	1.004	1.008
73.00	- 1.59	71.41	- 2.18	1.030**	1.030**
92.11	- 0.33	91.78	- 0.36	1.024*	1.031**
68.51	- 0.65	67.86	- 0.95	1.027*	1.030**
89.21	- 0.62	88.59	- 0.69	1.009	1.026*
78.98	**+ 0.45**	79.43	**+ 0.57**	1.028*	1.031**
72.59	**+ 0.51**	73.10	**+ 0.70**	1.029*	1.032**
65.60	- 0.60	65.00	- 0.91	1.005	1.022*
75.01	- 0.57	74.44	- 0.76	1.023*	1.029*
71.64	- 0.36	71.28	- 0.50	1.026*	1.031**
80.55	- 0.95	79.6	- 1.18	1.018	1.030**
72.47	- 0.82	71.65	- 1.13	1.019	1.031**
79.85	- 1.14	78.71	- 1.43	1.009	1.025*
84.11	- 0.39	83.72	- 0.46	1.026*	1.027*
85.15	- 1.51	83.64	- 1.77	1.020*	1.027*
77.06	- 0.14	76.92	- 0.18	1.025*	1.026*
73.27	- 0.58	72.69	- 0.79	1.023*	1.023*
71.19	- 0.61	70.58	- 0.86	1.020*	1.022*
81.95	- 1.37	80.58	- 1.67	1.022*	1.024*
81.12	- 0.57	80.55	- 0.70	1.024*	1.029*
67.62	- 1.37	66.25	- 2.03	1.008	1.013
85.67	- 1.76	83.91	- 2.05	1.019	1.024*
83.46	- 1.50	81.96	- 1.80	1.017	1.024*
85.40	- 1.53	83.87	- 1.79	1.021*	1.015
73.78	- 0.84	72.94	- 1.14	1.024*	1.031**
70.97	- 0.93	70.04	- 1.31	1.028*	1.030**
82.45	- 1.89	80.56	- 2.29	1.018*	1.024*

Table 1 continuation

The body mass (BM) and urine specific gravity (USG) before and after the training for football players

BM (kg) before training	BM changes, kg	BM (kg) after training	BM changes, %	USG before training	USG after training
92.39	- 0.47	91.92	- 0.51	1.021*	1.022*
89.92	- 0.46	89.46	- 0.51	1.029*	1.031**
83.35	- 1.24	82.11	- 1.49	1.004	1.016
70.36	- 1.56	68.80	- 2.22	1.011	1.029*
84.03	- 0.33	83.7	- 0.39	1.027*	1.033**
71.79	- 0.53	71.26	- 0.74	1.022*	1.026*
69.35	- 0.88	68.47	- 1.27	1.022*	1.029*
58.82	- 0.51	58.31	- 0.87	1.006	1.022*
64.80	- 0.93	63.87	- 1.44	1.023*	1.024*
59.04	- 1.27	57.77	- 2.15	1.007	1.030**
76.7 ± 8.4	**0.80 ± 0.55**	**75.9 ± 8.4**	**1.06 ± 0.71**	**1.020 ± 0.008**	**1.026 ± 0.006**

From the data of USG: * - hypohydration, ** - seriously hypohydration of the body; **bold – the mean values ± SD**

These changes in body mass indicated that greatest number of football players did not consumed enough fluid before and during the training because their body mass diminished. The largest water loss by sweating was approximately 1.8l per 1.5 hours. The mean body mass decrease was 0.80 ± 0.55kg. This means that the mean water loss by sweating in winter conditions in all players was close to 0.8l per 1.5 hours. This means that average water loss by sweating was 0.53l per hour.

The mean body mass decrease was 1.06 ± 0.71%. This proved that football players' body hypohydration degree worsened after training in comparison with the body hydration degree before the training, Table 1. The variation of body mass changes is shown in the Fig.2.

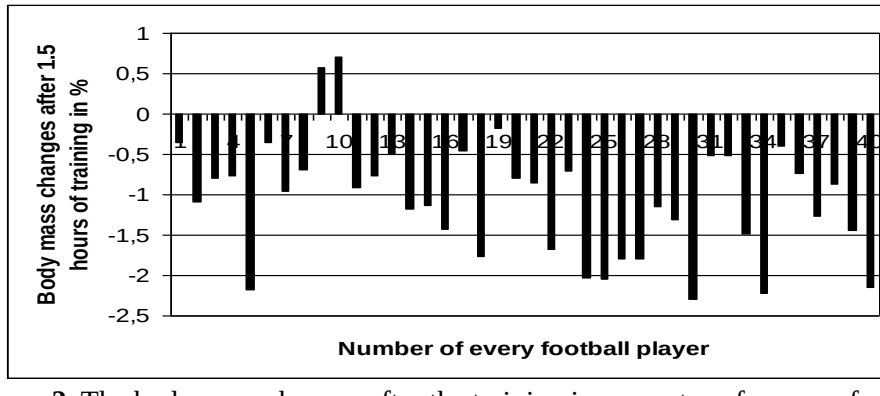

Figure 2. The body mass changes after the training in percentage for every football player

The players' body mass changes in percentages and increase of urine specific gravity after training are dependent on the body hydration degree changes.

Before the training 14 (35%) athletes were euhydrated, 24 athletes (60%) were hypohydrated and two athletes (5%) – seriously hypohydrated. After the training four (10%) athletes were euhydrated, 22 athletes (55 %) were hypohydrated and 14 (35 %) were seriously hypohydrated (Fig.3.).

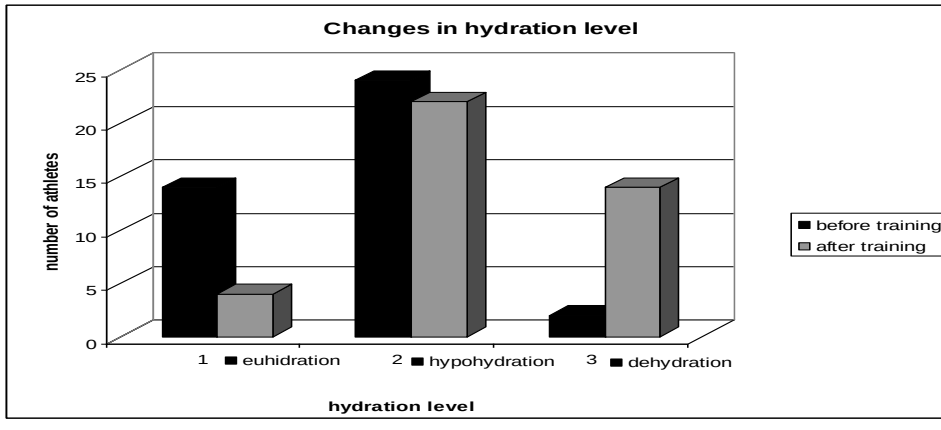

Figure 3. Changes of football players' body hydration degree using USG values.

If determining the athletes' body hydration degree from the urine specific gravity values, then the body hydration degree did not changed after training in 19 football players, the body hydration level of nine players from hypohydrated became seriously hypohydrated, but the body hydration level of eight euhydrated athletes before the training became hypohydrated after it. Three players were euhydrated before the training and became seriously hypohydrated after the training. One player, who was hypohydrated before the training consumed large amount of water and became euhydrated after the training. Evaluation of athlete's hydration status was made by using National Athletic Trainers' Association and American College of Sports Medicine used scale, were USG (urine specific gravity) under 1020 means euhydration, USG in range 1020-1029 means hypohydration and USG equal or higher than 1030 means serious hypohydration (Volpe et al, 2009)

Discussion

In our investigation we chosed to use urine refractometry and precise scale weighing to determine changes of body hydration level in football

players. Our results of football players' hydration degree before the training are in good agreement with the data of S.L. Volpe et al (2009), who determined that 66% of collegiate athletes appeared hypohydrated before training, but from our investigation – 60% of football players were hypohydrated before training. Stover et al (2006) assessed the urine specific gravity of recreational athletes before exercises. They examined 329 women and men from 2 fitness centres: one in Los Angeles, California, and another – in Chicago, Illinois. Similar to our results, they reported that 46% of the recreational athletes were hypohydrated before the training. It is obvious that professional and recreational athletes are not properly informed about correct fluid uptake before, during and after the training.

Male football players during the game in summer lose 0.99 – 1.93l of water per hour, the mean loss of water is 1.46l/h, but during training in winter – 0.71 – 1.77l/h, the mean loss – 1.13l/h (Sawka et al., 2007). From our investigation: the mean water loss by sweating was 0.53 l per hour, which is at least twice less than measured by M.N. Sawka et al (2007). This can be explained by less intensity of exercises during training in our players in comparison with the load intensity during the game in the athletes investigated by Sawka et al. (2007).

Conclusions

Only 14 (35%) of the first league football team players were euhydrated before the training. Twenty – four players (60%) were hypohydrated and two athletes (5%) were seriously hypohydrated before training. This proves that daily water uptake of players is not enough.

After the training four (10%) athletes were euhydrated, 22 athletes (55%) were hypohydrated and 14 (35%) were seriously hypohydrated. The mean weight loss during the training was 0.80 ± 0.55kg, but the mean water loss – 0.53l/h. This proves that the body hydration degree of athletes worsened after training.

The water and mineral salts consumption strategy and education of coaches and football players about uptake of liquids before, during and after training is very important.

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Acknowledgements

This research was supported by the European Social Fund within the project **"Support for Sport Science"** No. 2009/0155/1DP/1.1.2.1.2/09/IPIA/VIAA/010 action programme „Human resources and Employment" 1.1.2.1.2. sub-activity **„Support for Doctoral Study Programme Implementation"**

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Submitted: April 4, 2013
Accepted: October 31, 2013