



Evaluation of water loss during high intensity rugby training

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ABSTRACT

Rugby is a sport where players spend most of their time performing aerobic activities but there are some moments that they are involved in anaerobic activities. According to body dehydration percentage related with weight, physiological symptoms can vary from thirst to kidney and blood circulation insufficiency. The objective of this study was to verify the sweat rate of rugby female athletes. The athletes were weighted and submitted to a BIA test before and after training. The body fat percentage reduced 0.6% on average and the dehydration percentage related with weight reduced 1.5% on average. Physiological sensations of thirst described by the athletes agree with the dehydration degree found. It does not present risks to the athletes' health, but nevertheless, it is necessary that they get conscious about the importance of an adequate hydration for the improvement of the physical performance.

INTRODUCTION

Rugby

The rugby league became professional in 1995, sports practiced worldwide and includes the Rugby International Committee and 92 national leagues. Two teams, each one with 15 players in the field play the game, and this number of players may be diminished by ousting due to inadequate behavior. The game is performed in 2 halves of 40 minutes each separated with a maximum interval of 10 minutes. There are no interruptions, except for the occurrence of bruise or wounds. During the 80 minutes, the ball remains in game for 30 minutes, on average, and the time left is spent with bruises, scores, penalties or offsides. Rugby is a sports modality that requires a variety of physiological responses from players as result of combined plays, high-intensity repetitive runs and contact frequency. Since each player may play distinct functions, specific physical conditioning and training levels become necessary⁽¹⁾. In rugby, there is a high incidence of collisions, what makes participants to present adequate characteristics of velocity, agility, resistance, strength, flexibility and own abilities. These characteristics in this or in other sportive modalities produce significant increase on body temperature. During physical activity, low levels of thermal stress may cause discomfort and fatigue, while higher levels may even decrease dramatically the performance⁽²⁾. The prolonged thermal stress leads to hypohydration resulting in decreased blood volume, cardiac yield, blood pressure and finally in the reduction of the sweat process efficiency⁽²⁾. In a rugby game or training, consid-

Key words: Hydration. Dehydration. Rugby. Sweat rate. BIA.

erable amounts of liquids and electrolytes are lost in sweat and the energy expenditure is high as well. The energetic fuel depletion results in muscular fatigue while the disturbances in the hydric and electrolytes balance may lead to more serious complications⁽³⁾. The exercise stress is intensified through dehydration that increases body temperature, impairs the physiological responses, the physical performance and brings health risks. These effects may occur even at light or moderate dehydration with up to 2% of body weight loss, and the higher the dehydration degree is, the more the body weight loss will be. With 1 to 2% of dehydration, the body temperature increases 0.4°C for each subsequent dehydration percentile. Around 3%, an important reduction on performance occurs; with 4 to 6% thermal fatigue may occur and from 6% on, risks of thermic shock, coma and death⁽⁴⁾. The thirst mechanism is sensitive to the sodium plasmatic concentrations, osmolality and to the blood volume. The increase on the sodium concentration and decrease on the blood volume result in higher thirst perception. If one only ingests water, the willing of drinking soon disappears due to alterations on the osmotic pressure and to the reduction on the total volume to be ingested. As result, an early decrease on the liquid ingestion occurs due to the disappearance of the thirst sensation even before adequate replacement⁽⁵⁾. The need of fluid and nutrient replacement during an event depends on its intensity and duration and on the room temperature. Humans do not have much ability to ingest liquids at the same proportion they are lost. The athlete should not depend on thirst to start fluid replacement during intense and prolonged exercise. The plenty ingestion before exercise may lead to a hyperhydration state, which protects against thermic stress by delaying dehydration, increases perspiration during exercise and minimizes the elevation on the central temperature, thus contributing for a better performance⁽⁶⁾. The success of an adequate hydration after exercise depends on the balance between ingestion and urinary losses. A replacement of 150% of the total volume lost during exercise is recommendable to occur.

The objectives of the present study were to calculate the sweat rate of female rugby athletes after one typical training day and to relate the weight percentage hydric reduction to subjective symptoms of dehydration as well as to verify how much the alteration on the body hydric content influences in the bioimpedance test.

METHODOLOGY

In a training day at 6:00 pm and room temperature at 10°C, a water loss evaluation of 11 female rugby players from a private rugby club in São Paulo was performed. The athletes wore using training uniforms and ingested 2 glasses of water 40 minutes before initial weighting. Training was intense, with duration of 120 minutes and no liquid was allowed for athletes during the entire training period. In order to evaluate the sweat rate (SR), the athletes were weighted 15 minutes before the beginning of training (BW) and shortly after training (AW) and were submitted to bio-

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Received in 8/2/05. 2nd version received in 3/5/05. Approved in 5/5/05.

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impedance test to determine the initial fat percentage (%IF) and final fat percentage (%FF), using scales *Tanita* with capacity of 150 kg model TF-551. The sweat rate expressed as mL/min was obtained as follows: $SR = (BW-AW)/total\ time\ of\ physical\ activity$. After final weighting, the athletes were asked to respond the dehydration questionnaire (board 1) for further relation between thirst symptomatology and body dehydration percentage. The differences between weight and fat percentage before and after intense training were detected using the t-distribution (paired Student t-test) with probability lower than 0.05 ($p < 0.05$) of null hypothesis verification.

The athletes signed a free and cleared consent term on the objectives and methodologies of this work, and after training, they received informative material containing the results presented.

RESULTS

Table 1 presents data of evaluation card performed at the training day. The athletes aged 18.9 ± 3.0 years, on average, with age variation between 16 and 26 years. The average stature was of 166.6 ± 8.0 cm with a small variation ($VC = 4.8\%$), and average weight of 64.6 ± 8.1 kg. The average fat percentage was of $23.4 \pm 4.4\%$, widely ranging from 17.7 to 30.0%.

After 2 h of rugby training, the % of water loss in relation to weight was of $1.5 \pm 0.7\%$, what corresponds to the unchaining of thirst symptomatology. Such training-induced reduction (active dehydration) was not statistically significant to change the %F from $23.4 \pm 4.4\%$ to $22.8 \pm 3.6\%$, performed through test with bio-impedance scale (table 1).

TABLE 1
Anthropometrical data of female rugby athletes. São Paulo, 2004.

Athlete	Age (years)	Stature (cm)	BW (kg)	AW (kg)	% weight loss	% IF*	% FF*	Sweat rate (mL/min)
1	22.0	172.0	69.0	68.6	0.6	24.4	25.5	3.3
2	26.0	175.0	65.4	63.9	2.3	17.7	18.9	12.5
3	20.0	169.0	81.0	79.5	1.9	29.1	27.3	12.5
4	17.0	175.0	67.4	67.0	0.6	20.6	20.7	3.3
5	16.0	174.0	61.9	61.2	1.1	18.1	18.6	5.8
6	16.0	168.0	62.8	62.1	1.1	20.9	20.2	5.8
7	19.0	156.0	49.8	48.6	2.4	19.7	17.7	10.0
8	19.0	158.0	59.8	58.4	2.3	23.8	23.1	11.7
9	18.0	157.0	62.6	61.2	2.2	28.2	27.0	11.7
10	19.0	172.0	72.7	72.0	1.0	24.7	25.8	5.8
11	16.0	157.0	58.5	57.9	1.0	30.0	25.7	5.0
Average	18.9	166.6	64.6	63.7 ^a	1.5	23.4	22.8 ^b	8.0
SD	3.0	8.0	8.1	8.1	0.7	4.4	3.6	3.7
VC (%)	15.9	4.8	12.5	12.7	48.4	18.7	16.1	46.7
Min	16.0	156.0	49.8	48.6	0.6	17.7	17.7	3.3
Max	26.0	175.0	81.0	79.5	2.4	30.0	27.3	12.5

^a Significant statistical difference ($p < 0.05$) in relation to BW.

^b with no significant statistical difference ($p < 0.05$) in relation to %IF.

* Scale *Tanita* TBF 551.

SD: standard deviation; VC: variation coefficient = (SD/average) x 100.

BOARD 1

Descriptive statistics of the hydration questionnaire applied to female rugby players. São Paulo, 2004.

Name: 11 female rugby players from a private rugby club in São Paulo.

Hydration questionnaire

- Have you ingested liquids before starting training?
 YES (100%) NO
 What liquid? water 2 glasses (100%)
 soft drink ___ glasses juice 1 glasses (9.09%)
 sportive beverage ___ glasses
 others. Which? _____
- How have you trained today?
 VERY LIGHT (9.09%) LIGHT MODERATE (9.09%)
 ALMOST INTENSE (63.64%) INTENSE (9.09%)
 VERY INTENSE FULLY INTENSE
- Do you have that "dry mouth" feeling?
 YES (45.45%) NO (54.55%)
- Are you thirsty?
 YES (63.64%) NO (36.36%)
- What would you like to drink now?
 nothing (9.09%) water (54.54%) juice (18.18%)
 soft drink (9.09%) sportive beverages others (9.09%)
 Which? **beer**
- Do you feel like eating?
 YES (45.45%) NO (54.55%)

The average sweat rate was of 8.0 ± 3.7 mL/min, ranging from 3.3 to 12.5 mL/min, representing significant reduction ($p < 0.05$) on the final weight.

Board 1 presents the thirst symptomatology subjective questionnaire to be filled out by the athletes themselves after training as well as the descriptive statistics of the responses reported. As detailed in methodology, the rugby players were told to ingest 2 glasses of water before training for standardization purposes. The vast majority of players reported to train almost intensely (63.4%) and to be thirsty at the end of training (63.4%), feeling like drinking water (54.5%) or juice (18.2%); however, without the dry mouth feeling (54.5%) or willing to eat (54.5%).

DISCUSSION

With regard to the anthropometrical evaluation, according to Duthie *et al.*⁽⁷⁾, the body weight of rugby players ranges according to game position: forwards 68.9 ± 6.6 kg and backs 60.8 ± 5.7 kg. The weight difference of forward players is lower in higher competitive levels. As observed through our results (table 1), weight presents a correlation coefficient of 12.5% between players. The increase on the competitive level and physical preparation may be the probable cause for weight gain among rugby players with higher weight for forward players. With regard to the average fat percentage of athletes (table 1), literature presents conflicting results; however, most authors agree that the fat percentage decreases with the increase on the competitive level of players. The differences on the body fat percentage may be directly related to the

increase on the training intensity and the more favorable dietary practices performed by elite athletes. While the additional body fat may serve as desirable protection in contact situations (backs), it becomes a disadvantage in sprint activities and runs (forward)⁽⁷⁾. Once the differences in the physical constitution between forward and back players are known, the observation of a large variation on their fat percentages (17.7 to 30.0%) does not surprise at all. Yet, there are no anthropometrical and fat percentage data of female rugby players in the national literature, and our initial results are significant to define the profile of athletes of this sportive modality.

Even in cold and moist weathers, the result of exhausting exercises leads to sweat. The amount of body fluid lost through sweat depends on the exercise intensity, duration, properties and amount of clothes. Similarly to the effect of hot weathers, the heat loss in activities above 30 minutes may result in reduction on the blood volume, which may lead to cardiovascular involvement⁽⁸⁾. The reduction on the body weight as indicative of fluid loss of athletes, according to Fleck & Figueira Júnior⁽⁹⁾ is one of the best evaluations. This evaluation does not occur linearly during exercise, and the comparison between initial weight (before physical activity) and final weight (after the end of physical activity) could aid in the fluid replacement during the rest period, once it is associated to the thirst symptoms. Male rugby athletes at temperature ranging from 18 to 23°C may present sweat rate of 26.6 to 36.7 mL/min.⁽⁹⁾ It is known that women tend to sweat less than men at the same standardized conditions. The differences may be intensified due to differences on the training level and acclimatization degree⁽¹⁰⁾. Considering this sweat rate (8.0 ± 3.7 mL/min) at the end of 2 h training, we could have an average water loss of 1 liter. The American College of Sports Medicine (ACSM) recommends a fluid replacement of 1.5 times the total amount lost, in other words, the ingestion of 1.5 liters of water after training is desirable. The dehydration percentile in relation to weight of players was of $1.5 \pm 0.7\%$ on average, with thirst as the main symptom. Small water losses (between 1-3% of the body weight) due to dehydration present small or null effect on the power output^(4,11). Board 1 demonstrates that 63.64% of athlete were thirsty, 54.5% presented no dry mouth sensation or will to eat, being in agreement with the physiological symptoms that this water loss percentage may bring⁽⁹⁾. It was observed that 54.5% of athletes would like to ingest water after training in order to supply losses during physical effort. According to Carvalho *et al.*⁽³⁾, water may be a good rehydration choice after exercise by being easily available, cheap and by causing quick gastric emptying. According to Kenney⁽¹²⁾, only when body weight reduces by 2%, there is a strong thirst sensation, dry mouth and reduced appetite. One may conclude that the symptoms presented by rugby players with $1.5 \pm 0.7\%$ of dehydration are in agreement with the expected result for this water loss and that, therefore, are related with the almost-intense training intensity reported by the majority (63.6%). Athletes must be oriented that, many times, the ingestion of hydroelectrolytic reposition drinks is not a suitable alternative to replace the ingestion of liquids and foods and that they may not have any relation with the strength sensation⁽¹³⁾. The best way to fight small water losses is through the ingestion of liquids. It must be sufficient to induce a quick gastric emptying, where volumes around 600 mL induce to an emptying rate of 30 mL/min. This means that larger ingestions may result in large volume in the digestive system with decreased absorption velocity⁽¹⁴⁾. An adequate hydration state is only reached by physically active individuals when sufficient amounts of liquids are ingested before, during and after physical activity. The water loss through sweat in function of physical activity will result in the ingestion of liquids that will take between 2 and 4 hours on average to balance the cytoplasmatic level of body tissues⁽¹⁵⁾. As already explained, the athletes should ingest 1.5 L of water on average in the period proposed, being a realistic goal for such population. We have also

emphasized that 9.09% of athletes reported to be willing to drink beer after training. Such behavior is absolutely improper, once alcohol induces to diuresis, thus impairing even more the hydration state. In relation to the BIA test, we have observed that this test should be performed under severe physiological standards, among them the hydration degree⁽¹⁶⁾, however, the BIA test presented no significant difference ($p < 0.05$) in the fat percentage with a significant reduction on the % hydration. Such result is not in agreement with literature, which reports that hydric alterations, especially those induced by active dehydration, result in significant alterations in the fat percentage in the BIA test. Such fact should be more investigated in other studies involving a larger number of athletes.

CONCLUSION

Although a significant water loss was observed in female rugby players during almost-intense training (active dehydration), no significant alteration in the fat percentage determined through the BIA test was observed, and one could not affirm that this loss would represent a potential risk to sportive performance and health. The rehydration after training may be conducted according to the option reported by the majority in questionnaire on the thirst symptomatology: water ingestion, once at the conditions in which this study was conducted, no sweat rate or water loss in relation to the body weight that would justify the use of sportive beverages was observed.

All the authors declared there is not any potential conflict of interests regarding this article.

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