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Research Article

Urine Osmolarity in Street Runners

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Abstract

The hydroelectrolytic balance during the run is essential to a good performance and to the athlete's health, especially for street runner fans who increase annually. Thereby, we aim to evaluate the hydration state by urine osmolarity in street runners. 62 volunteers (49M/13W, over 18 years) provided urine samples before(a) and after(b) the run. There was a decrease in urine osmolarity (UO) (mOsm/L) after the run (601+34a vs. 692+33b). Men exhibited higher UO than women (750+30b vs 476+88b) and a decrease after the run (631+36a), while women presented no alterations (487+90a). 30% of volunteers started the run with diluted urine (334+35, G1) and 70% in concentrated status (839+17, G2). The G1 group kept their UO in diluted state (267+32) even sweating during the run, while G2 group presented a decrease in UO, however it kept the concentrated status (738+27). Women and G1 start in a water loss state, which was maintained thought-out the run, leading to dehydration. Men and G2 started with high ADH levels, producing concentrated urine and, different than expected, they had urine dilution during the run. Considering this, we could identify an excess of hydration, before and during the exercise. This leads to the hydro-electrolytic disturbance, compromising the athlete performance.

Keywords: Street run; Hydration; Osmolarity; Urine; Runner

Introduction

Regular exercise is recommended for people of all age groups, showing beneficial effects in many diseases, such as diabetes, hypertension, coronary heart disease and heart failure [1-3]. The number of streets run fans increases every year, which is evidenced by the increase of the street races competitions around the world [4].

During exercise, muscle contraction increases the heat production, leading to an increase in body temperature and consequently the production of sweat, helping to cool the skin and lower body temperature [5]. The blood redistribution to the muscle leads to reduced blood flow to the kidney, decreasing the glomerular filtration rate, producing less urine. At the same time, there is an increase in blood osmolarity, triggering an increase in the synthesis of antidiuretic hormone (ADH), which will increase the reabsorption of water in the kidneys, especially in the collecting duct, resulting in hyperosmotic urine [6]. That's why rehydration is so important after any exercise. The mechanisms involved in urine volume changes and its concentration after water intake are already well described in the literature [7].

The urine osmolarity should average twice the plasma osmolarity (278 to 298mOsm/Kg) and its ideal concentration should be around 600mOsm/L [8,9]. In extreme situations, urine may reach a minimum of 50mOsm/L, indicating an ADH inhibition, reflecting in extremely dilute urine. On the other hand, in situations of dehydration, the body is able to concentrate the urine, reaching values up to 1200mOsm/L [10,11]. Variations of 1% in plasma concentration are sufficient to cause thirst, followed by an increase in ADH levels [12]. The sympathetic nervous system tone is increased during exercise in order to improve cardiac function, pulmonary ventilation and redirect blood flow to the muscles and brain. These changes decrease the blood flow to the gastrointestinal tract, thus hindering gastric absorption throughout the sporting practice [13]. Therefore, the aim of the current study was to analyze the hydration status of the street runners before and after a test, using urine osmolarity as a reference.

Methods

Subjects

Sixty-two volunteers (49 men, 13 women) over 18 years signed the free and informed consent, declaring understanding on the procedures that would be performed during the protocol. The study was conducted according to the guidelines laid down in the Declaration of Helsinki and ethical approval was granted from Research Ethics Committee of the School of Medical Sciences/ University of Campinas (CAAE: 0917.0.146.000-11). The present study was conducted during the 2013 "Volta Unicamp" run, at University of Campinas (Unicamp) in October and the volunteers participated in 10km category started at 8 am.

Procedure

All volunteers collected a urine sample one hour before the race. The research was conducted anonymously. At the end of the race, a new urine sample was collected. All samples were kept on ice and then stored at 4 °C. Osmolarity analysis was performed on Fiske Model OS osmometer.

Statistical analysis

Results for urinary osmolarity (mOsm/L) are presented as mean±SD. Normality test was performed by D'Agostino & Pearson test, followed by paired Student t-test when normality data was detected and Mann Whitney or Wilcoxon test when normality was not detected. Statistical analysis and figures were performed using GraphPad Prism software version 7.00 for Windows (GraphPad Software, San Diego, California, USA). The acceptance level of significance was set at $p<0.05$.

Results

The urine osmolarity (UO) results of all volunteers showed a significant decrease after the run (Figure 1). The men (M) presented higher OR than women (W) before (b) the race (M: 750±30b vs. W: 476±88b, Figure 2). We did not observe any differences when comparing women after (a) vs. before (b) the run (W: 476±88b vs. W: 487±90a, Figure 2). However, men presented significant decrease in UO after the run (M: 750±30b vs. M: 631±36a, Figure 2).

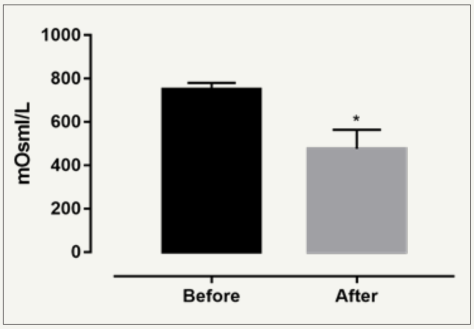

Figure 1: Urine osmolarity (mOsm/L) of the street runners before and after 10km run, n=62; *p<0.05.

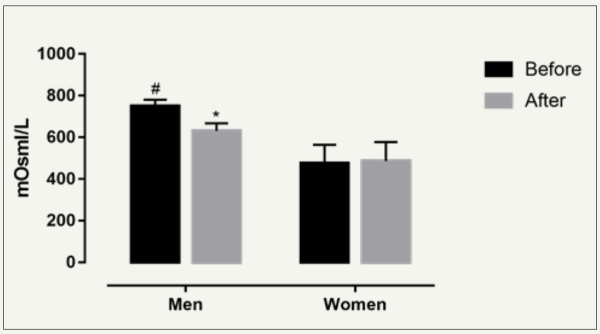

Figure 2: Urine osmolarity (mOsm/L) of street runners for women (n=13) and men (n=49) before and after the 10km run. *p<0,05: after vs before in the same group; #p<0.05 between sex.

We observed that 30% of all volunteers started the run with low UO (<600mOsm/L, diluted) (334±35, G1) and the majority (70%) in the concentrated state (836±17, G2, Figure 3). After the run, the G1 group maintained a low UO (267±32, Figure 3), while the G2 group presented a significant decrease in the UO values, but maintained a concentrated status (738±27, Figure 3).

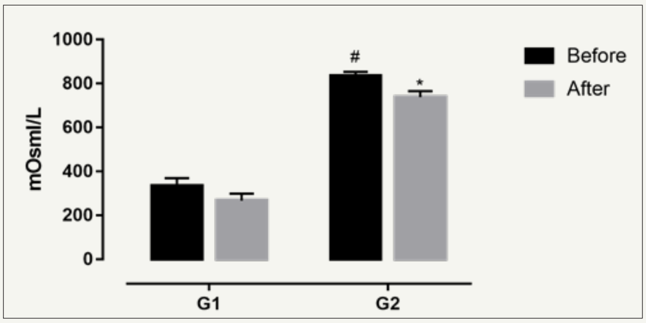

Figure 3: Urine osmolarity (mOsm/L) before and after runners who had their urine diluted at the end of the run, G1 (n=18), and concentrated after the run, G2 (n=44). *p<0.05: after vs before in the same group; #p<0,05: G1 vs G2.

Discussion

The main findings of this study are: 1) Urine osmolarity of most volunteers decreased after the run; 2) Men have higher pre-run urine osmolarity values than women. Many studies have shown that there are no changes in plasma osmolarity after exercise, but there was a reduction in body mass due to loss of water and electrolytes during exercise [9,14,15]. If this loss is greater than 2% of the body mass, a dehydration condition ensues and an increase in urine osmolarity is expected [5]. However, the present study introduces that the UO of most volunteers decreased after the run, probably due to fluid intake during the run. The women effort during the run was not enough to cause changes in the osmolarity after the run. A small fraction of the volunteers (30%) started the run with UO less than 600mOsm/L, indicating diluted urine. There are studies in the literature on pre-exercise hyperhydration, such as that of Goulet et al. [16] who found that pre-exercise hyperhydration has beneficial effects, improving the resilience of trained individuals. However, Gigou et al. [17] found no difference in the performance of heat-trained runners.

Minor changes in the hydration state can impair performance and physiological function by decreasing stroke volume, thermoregulation and fluid balance in the body [10,18,19]. We observed that most of the runners presented high values of UO at the beginning of the run (G2), which are usually accompanied by higher ADH levels and probable thirst sensation, contributing to the fluid intake during the run. This also corroborates with the UO values presented by men, since the literature indicates that they present higher rates of sweat production and incidence of dehydration after exercise compared to women [20,21]. There are some limitations in this work that should be considered. During the protocol, we did not observe possible changes in the runner's performance, we did not evaluate ADH and plasma osmolarity before and after the run, as well as the fluid consumption during the protocol. In addition,

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we did not investigate the urinary flow, which limited the free water clearance analysis. The absence of such data could improve the accuracy of the discussion but did not compromise the results obtained and the interpretation of the data.

Conclusion

This study provides physiological support to improve the knowledge of athlete support staff, such as physiologists, nutritionists and physicians, and to alert athletes' habits and prescriptions of hydration. It is important that health professionals become aware of the importance of hydration before, during and after runs, as well as properly advise athletes to acquire adequate hydration habits to improve their health and also their performance during the run, taking into account the liquids ingestion and to avoid the state of super hydration observed in our study.

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