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ORIGINAL

MILK CONSUMPTION AFTER EXERCISE DECREASES ELECTROLYTE EXCRETION

EL CONSUMO DE LECHE POSTERIOR AL EJERCICIO DISMINUYE LA EXCRECIÓN DE ELECTROLITOS

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ABSTRACT

Rehydration is essential for post-exercise and sport recovery. Milk seems to be a good option like sport drinks after exercise, yet the rehydration mechanisms are still not fully understood. The aim of this study was to measure the effect of drinking low-fat milk and an isotonic beverage after intermittent exercise on urine

electrolytes. 14 physically active men (23 ± 4 y) were split into two groups: 1) rehydration with isotonic drink (ISO), and 2) rehydration with low-fat milk (LBG). Specific gravity (GEO) and electrolytes (Na+ and K+) were measured in urine before and after exercise with rehydration. Significant differences were found for the GEO and in K+ excretion in the LBG group ($p < 0.05$). Both groups showed significant differences for Na+ excretion concentrations. We conclude that drinking low fat milk after exercise when compared to an isotonic drink, improves GEO and K excretion.

KEYWORDS: milk, electrolytes, rehydration, isotonic drink, urine specific gravity.

RESUMEN

La rehidratación es fundamental para la correcta recuperación posterior al ejercicio físico y el deporte. Las bebidas lácteas parecen ser una buena opción como bebidas rehidratantes después del ejercicio, pero aún los mecanismos no están completamente dilucidados. El presente estudio tiene por objetivo medir los efectos en la excreción de electrolitos en la orina al rehidratar con una bebida láctea baja en grasa o una bebida isotónica tras la realización de una sesión de ejercicio intermitente. 14 sujetos físicamente activos (23 ± 4 años), se dividieron en dos grupos: 1) rehidratación con bebida isotónica (ISO) y 2) rehidratación con bebida láctea baja en grasa (LBG). Se evaluó la gravedad específica de la orina (GEO), electrolitos (Na+ y K+) en orina y retención de fluidos, después del ejercicio y 4 horas posterior a la rehidratación. Se encontraron diferencias significativas en la GEO y en la excreción de K+ en el grupo LBG ($p<0.005$), ambos grupos muestran diferencias significativas en la excreción de Na+. Los resultados muestran que la rehidratación con bebida láctea mejora la GEO y disminuyen la excreción de K+ de forma más eficiente que la bebida isotónica posterior al ejercicio.

PALABRAS CLAVE: bebida láctea, electrolitos, rehidratación, bebida isotónica, gravedad especifica de la orina.

1. INTRODUCTION

In sports performance, optimal hydration state of the athlete plays a key role. (Cheuvront, Carter, & Sawka, 2003; Coyle, 2004). Hydration depends on strategies used before, during and after the exercise performed. It has been shown that fluid loss during exercise can be up to 5% of body weight (Sawka et al. 2007). The loss of essential minerals and electrolytes, such as sodium (Na^+) and potassium (K^+) through sweat is also important to consider while performing exercise. (Noakes, 1993; Barr, Costill & Fink. 1991). A decrease in these electrolytes may cause hyponatremia or hypokalemia (Allan, Wilson, 1971), which can affect the athlete's performance or even cause health problems (Casa, Clarkson & Roberts, 2005;

Hew, Chorley, Cianca & Divine, 2003; Castro-Sepulveda et al. 2014). A correct decision regarding rehydrating beverages is essential to maintain hydration status. The level of macronutrients and the concentration of electrolytes within the beverage should always be considered to avoid future complications related to dehydration and exercise (Casa, Clarkson & Roberts, 2005; Mayol & Aragon, 2009). A proper combination of nutrients allows proper rehydration at a cellular level (Baker & Jeukendrup, 2014). Today, there is a great diversity of isotonic drinks, commonly called “sports drinks”. They allow a proper rehydration status following exercise due to its balanced composition of carbohydrates (CHO) and electrolytes.

Some studies have shown that milk has rehydrating properties after exercise (Roy, 2008; Shirreffs, Watson & Maughan, 2003). It has been observed that drinking milk after exercise has a stronger effect over body fluids when compared to sports drinks. To date, the mechanisms which explain the rehydrating properties of milk are stull unknown. Regarding its nutrition compounds, when compared to sports drinks, milk presents higher levels of proteins but similar carbohydrates, sodium and potassium (James, 2012). To further understand the mechanisms for which milk acts as an effective rehydrating beverage, it is necessary to study fluid retention, specific urine gravity and both sodium and potassium reabsorption after exercise.

2. STUDY OBJECTIVE

To determine the effects of an isotonic drink and a low fat milk beverage on fluid retention, GEO and electrolyte excretion (Na^+ and K^+) after an intermittent bout of exercise.

3. METHODS

3.1 Participants

14 young physically active volunteers (age 23 ± 4 years, height 174 ± 3 cm, whom performed exercise 4 times a week, 2 hours per session) were included in the study. They were separated into two groups, and were given a rehydrating beverage after exercise. Depending on their taste preference of the rehydrating beverage, one group was given low fat chocolate milk (LBG) for rehydrating, and the other group was given an isotonic drink (ISO) after exercise. Subjects taking vitamin supplements or which presented renal pathologies were excluded from the study. All participants were informed of the procedures and risks related to the study and provided written informed consent prior to participation.

3.2 Urine samples

A simple urine sample was taken after performing the intermittent exercise and 4 hours after taking the rehydrating beverage. Na^+ and K^+ concentrations were measured with the MINI ISE, an automatic electrolyte analyzer. Specific gravity was measure with a refractometer ROBINAR, SPX model.

3.3 STUDY DESIGN

All subjects were asked to perform an intermittent “Spinning” class for 60 minutes. Prior to the exercise, they were divided into two groups: one group had to consume a low fat chocolate milk beverage for rehydration (LBG), and the other group had to consume an isotonic drink for rehydration (ISO).They were asked to abstain from alcoholic beverages for 72 hours prior the exercise session. To assure same hydration status between subjects, a hydration protocol was given for the participants to follow 48 hours proceeding to the exercise. During the session, participants were allowed to drink all the isotonic drink they wanted. Immediately after the exercise session, a simple urine sample was obtained for measurements of GEO, Na^+ and K^+. Body weight was measured before and after the exercise session (Tanita model TBF 300 A). The difference in weight was considered the total water loss throughout the exercise (dehydration volume) and was used to estimate the total rehydration volume. Therefore, the assigned rehydration beverage was given in the amount equivalent to the total weight lost during the exercise. Four hours after the exercise session (rehydration period, 3 hours for drinking the beverage and 1 hour for digestion and absorption) another urine sample was taken to measure GEO, Na^+ and K^+. Total fluid retention was estimated as the difference between the total volumes of the rehydration beverage consumed (100% of weight lost throughout the exercise session) and the total urine produced during the rehydration period.

3.4. STATISTICAL ANALYSIS

A pairwise Student t-test was used to compare both groups (LBG and ISO) for all variables (weight loss, fluid retention, GEO, and electrolyte excretion). The significance level was set at $P<0.05$. All statistical analyses were performed with Graphpad InStat 5. Data are presented as mean ± standard deviation.

4. RESULTS

No statistical difference was observed between groups regarding weight loss after exercise session ($P=0.6$). The ISO group lost 3.4 ± 0.5 kg and the LBG group lost

3.2 ± 0.7 kg. Fluid retention was 25% for the ISO group and 71% for the LBG group.

The results for GEO are presented in figure 1. The LBG group showed statistical difference for immediately post exercise session and 4 hours after rehydration (P=0.02), whereas in the ISO group no statistical differences were observed (P=0.08).

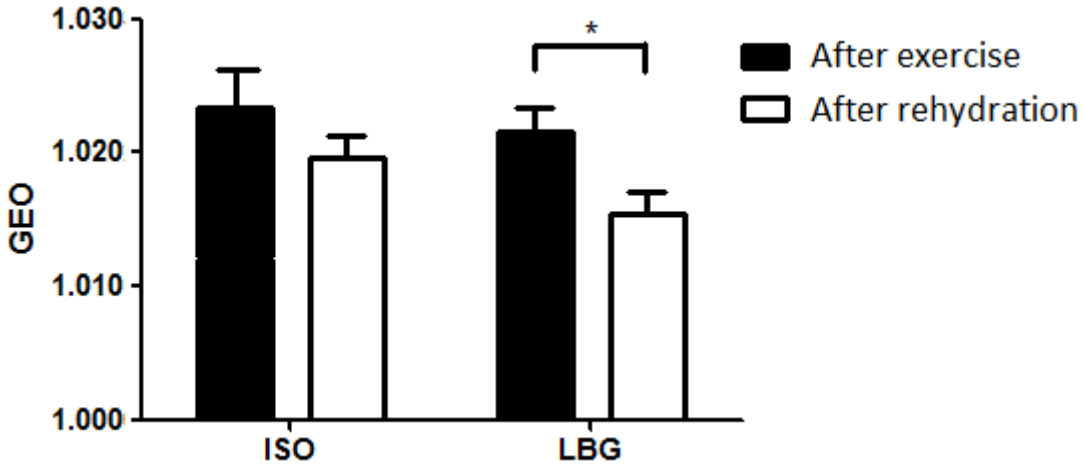

Figure Nº1: Comparisons of specific urine gravity immediately after exercise and 4 hours after rehydration.

Differences in electrolyte excretion immediately after exercise and 4 hours after rehydration can be seen in Figure 2. The ISO group presented a significant decrease in Na^+ excretion 4 hours post rehydration (P=0.03). K^+ excretion for the ISO group did not show difference (P=0.64). Furthermore, both Na^+ and K^+ excretion presented a significant decrease in the LBG group (P=0.0004 and P=0.006, respectively).

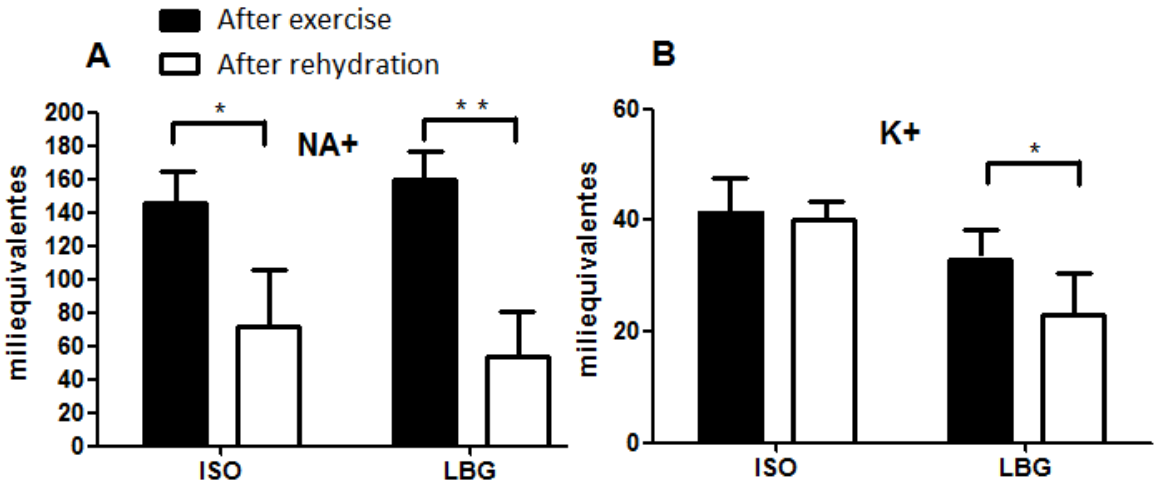

Figure Nº2: Comparisons of electrolyte excretion of Na^+ (A) and K^+ (B) in urine immediately after exercise and 4 hours after rehydration.

5. DISCUSSION

The main findings from this study are that low fat chocolate milk improved GEO, decreased Na+ and K+ excretion and improved fluid retention more efficiently than a regular isotonic beverage after a 60 minute session of intermittent exercise. Our results agree with the one found from Shirreffs, Watson & Maughan (2003), whom compared fluid loss after consuming 4 different possible rehydrating beverages: milk, milk plus sodium, carbohydrate beverage and water. They concluded that milk was better than the other 3 beverage in preventing fluid loss. In the present study, similar results were observed, where fluid retention was 71% for milk and only 25% for isotonic drink. An increased fluid retention appears to have a direct effect over decreasing the excretion of electrolytes in urine, it may be due to increases of electrolyte reabsorption. The mechanisms behind the effect of fluid retention and electrolyte excretion is still yet to be studied. Thus, milk acts as an efficient rehydration beverage which prevents fluid loss and stimulates proper electrolyte recovery after exercise.

The composition of rehydrating beverages have been based on the amounts of electrolytes and carbohydrates, but it seems that protein content may play a key role in rehydration. (Volterman, Obeid, Wilk & Timmons, 2014; James, 2012). In the present study, from a nutritional point of view, the main difference between both beverages chosen (low fat chocolate milk vs. isotonic drink) was protein content. Considering that carbohydrate and electrolyte content is similar for both beverages, it could be possible that the high content of protein in milk may be the cause for better GEO, fluid retention and electrolyte excretion after exercise when compared to an isotonic drink.

Other benefits in drinking milk as a rehydration beverage could be related to body composition. A study by Hartman el al. (2007) evaluated the effects of drinking 500 cc of different beverages after training. A total of 56 subjects trained 5 times per week during 12 weeks and were given after each training session low fat milk, low fat soy milk or a maltodextrin isocaloric control drink. Their results show that drinking low fat milk after each training session caused higher muscle hypertrophy and fat mass loss compared to the other two beverages. Authors suggest these effects are related to the protein and calcium content present in milk. Furthermore, the muscle hypertrophy may be due to the "Whey" proteins and the branch-chained aminoacids (Leucine, Isoleucine and Valine) present in milk, both which play an important role promoting protein synthesis and muscle anabolism.

6. CONCLUSIONS

Our results show that both low fat chocolate milk and the isotonic drink reduced Na^+ and increased fluid retention when taken after a 60 minutes session of intermittent training. However, rehydration with low fat chocolate milk decreased K^+ excretion and Na^+, plus showed lower GEO and caused higher fluid retention than the isotonic beverage. Protein content of milk may play a key role in explaining better rehydration after exercise, but further research is needed to understand the underlying mechanisms.

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