Research Report

VOLUNTARY FLUID INTAKE WITH MILK OR CHOCOLATE MILK IN BOYS EXERCISING IN THE HEAT

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It is well known that boys, on average, do not consume enough water to replace sweat losses when exercising in the heat. Voluntary fluid intake can be improved by using flavored drinks, typically sports drinks or water with carbohydrates that improve the palatability of the drinks. One alternative, already studied to some extent in adults but not in children or adolescents, is to rehydrate with milk; because of its electrolyte composition, milk works reasonably well as a rehydration beverage. This option would be particularly attractive to parents who want to offer the best nutrition to their children, provided the drink is palatable. While regular milk might not be palatable enough to boys, perhaps chocolate milk would be better.

Therefore, the main goal of this study was to compare fluid balance (FB) and voluntary intake (VI) in 10-to 14-year-old boys, when they combine partially skimmed milk or chocolate milk with water during exercise in the heat, as an alternative to using sports drinks. In addition, palatability and gastrointestinal (GI) symptoms were compared.

Methods

Thirty-one boys between 10 and 14 years old (12.6 ± 1.4 y.o.) (Mean ± S.D.), body weight = 42.69 ± 2.09 kg and height = 147.8 ± 10.0 cm, participated in the study. As members of an organized soccer team, the boys trained for 120 minutes at a moderate intensity a minimum of three times per week. Informed consent was obtained from a parent or legal guardian and each boy gave his own assent to participate in the study, according to the policies of the Science and Ethics Committee of the University of Costa Rica.

Upon arrival in the laboratory, each boy voided and provided a urine sample for urine specific gravity (USG) analysis. Nude baseline body weight (BBW) and body height were obtained. A 400 kcal standardized snack was provided (54% CHO, 18% protein and 27% fat; 515 mg sodium, 1074 mg potassium and 347 mg calcium; 250 mL fluid). This was the only control measure prior to starting the study protocol.

The boys exercised in a controlled environment chamber at 31.6 ± 0.36 °C dry bulb and 47.3 ± 2% relative humidity, at a moderate intensity (target heart rate = 65% of age-predicted maximum heart rate), using a cycle ergometer and a treadmill. They alternated 20 minutes of exercise with 10 minutes of rest on four consecutive times, for a total of 120 minutes. During this time, they either drank water and partially skimmed milk (session A)

or water and partially skimmed chocolate milk (session B); fluid intake was *ad libitum* and the drinks had a temperature of 15.9 ± 0.12°C. Each flavored drink was always presented simultaneously with water to avoid producing a *floor effect*, that is, that boys would drink more of a beverage they don't like simply because they are hot and thirsty.

Fluid intake was monitored as boys consumed their bottles. Fluid balance was calculated from body weight differences. Palatability and GI symptoms were reported by the participants at four points: upon arrival in the laboratory, and before, after 60 minutes, and at the end of the exercise protocol (120 minutes).

Results

Sessions A and B were practically identical in terms of the boys' arrival conditions, exercise intensity, and thermal stress and were, therefore, comparable. No significant differences were found in the initial conditions between sessions A and B (table 1). No significant difference ($p = 0.98$) was found between sweat rates during session A (460.8±217.4 $ml_{*}h^{-1}$) and session B (459.8±229.4 $ml_{*}h^{-1}$).

Table 1.
Initial conditions.

	Session A		Session B		p-value
	Mean	**SD**	**Mean**	**SD**	
BBW (Kg)	41.97	10.5	42.10	10.6	0.28
USG (u)	1.024	0.015	1.023	0.011	0.74
HR (b/min.)	139.3	7.0	140.5	10.1	0.53
Fluid Temp. (°C)	15.1	1.4	15.6	1.6	0.24

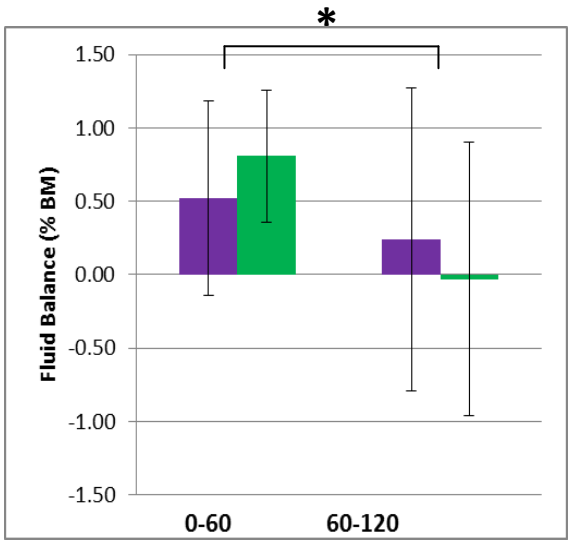
Fluid Balance (FB)

As shown in Figure 1, fluid balance was positive and the same for both sessions (0.76 ± 0.80 %BW vs. 0.77 ± 0.76 %BW, $p = 0.94$). A significant difference was found between measurements: boys showed a positive fluid balance during the first hour of exercise, that is, they overhydrated, but not in the second hour. This was independent from the drink. There was a very small dehydration in session B during the second hour of exercise.

Voluntary Intake

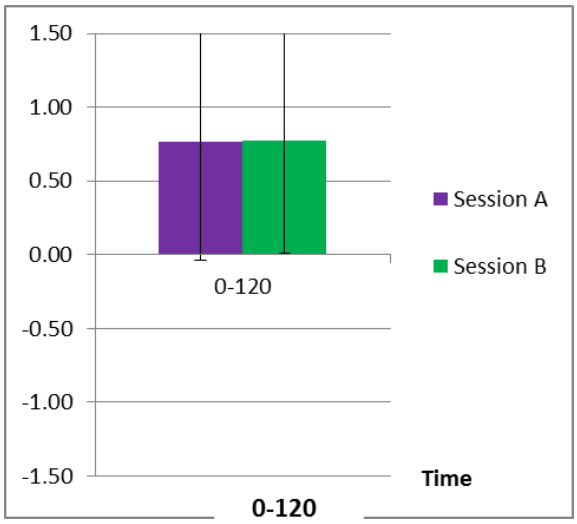
Boys drank the same volume of water, milk, and chocolate milk. They drank more fluid during the first hour than the second one, independently of the beverage used (see Figure 2).

Figure 1a.
Fluid Balance over time (first, second hour)



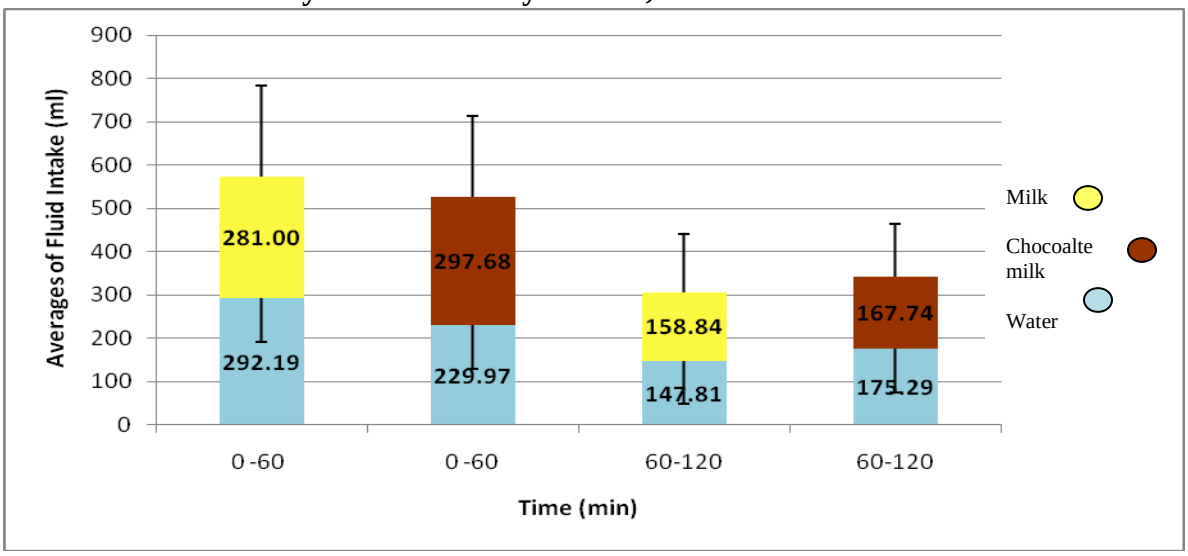
*Interaction: F= 2.51, p = 0.12. Session: F = 0.15, p = 0.904. *Measurement: F = 9.52, p = 0.004*

Figure 1b.
Fluid Balance over time (total)



T-test for total Fluid Balance: t= 0.075, p = 0.94

Figure 2.
Voluntary Fluid Intake by Session, First and Second Hours.



Interaction: F = 1.6, p = 0.197. Measurement: F = 64.61, p<0.001. Beverage: F = 0.24, p = 0.87.

Palatability

Palatability scores are shown in figure 3. In general terms, milk and chocolate milk scored better than water. Chocolate milk was assigned higher scores for sweetness (7.6, $p<0.001$), flavor intensity (5.8, $p<0.001$), liking (7.9, $p<0.001$) and overall acceptance (8.7, $p<0.001$) when compared with milk and water. Milk had a higher score for flavor intensity than water ($p<0.001$). In terms of overall acceptance, though, chocolate milk showed declining scores over time, while milk remained constant and water increased over time. There were no differences in terms of perceived saltiness or tartness among beverages.

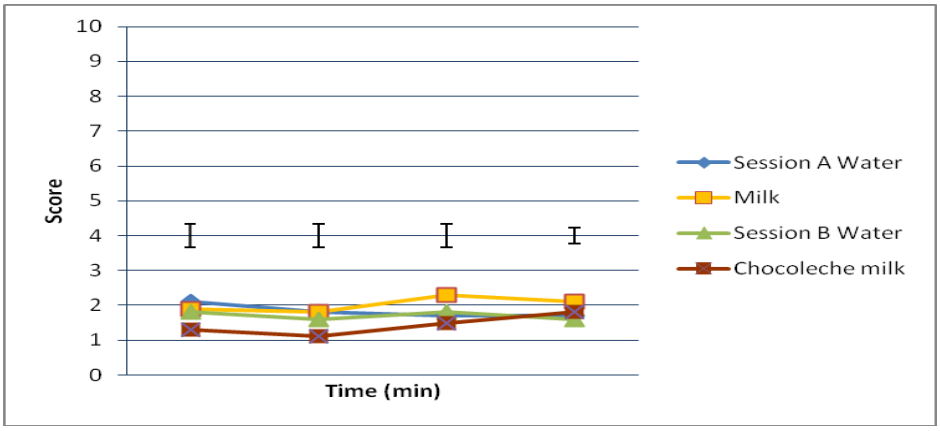
GI symptoms

Figure 4 shows that gastrointestinal symptoms scored very low regardless of the drink. They are considered to be low enough not to be relevant.

To summarize, no difference in voluntary intake was found between the flavored drinks. Fluid balance was positive for both sessions, and no difference was found between session A (milk and water) and session B (chocolate milk and water). When presented simultaneously with water, both partially skimmed milk and chocolate milk were effective in preventing voluntary dehydration in boys exercising in the heat. Palatability scores were favorable and GI symptoms were not clinically relevant.

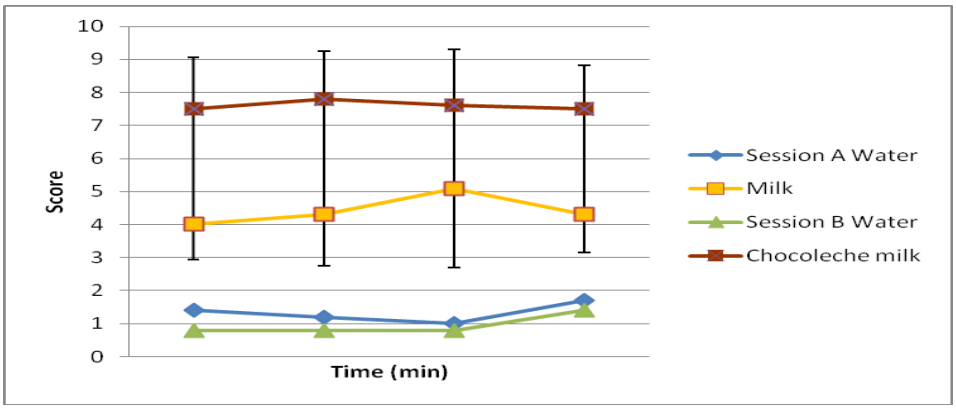
Figure 3.
Palatability.

a. Saltiness



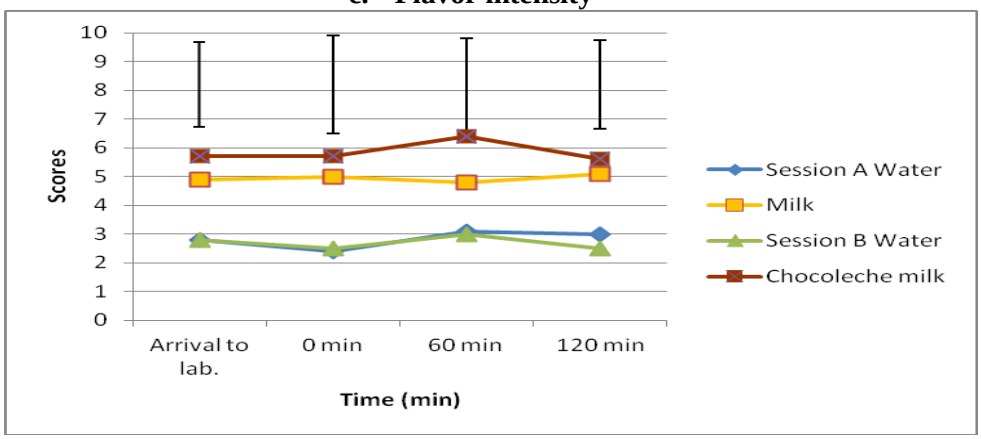
Interaction: F = 0.78, p = 0.637. Beverage: F = 1.3, p = 0.280. Measurement: F = 1.6, p = 0.260.

b. Sweetness



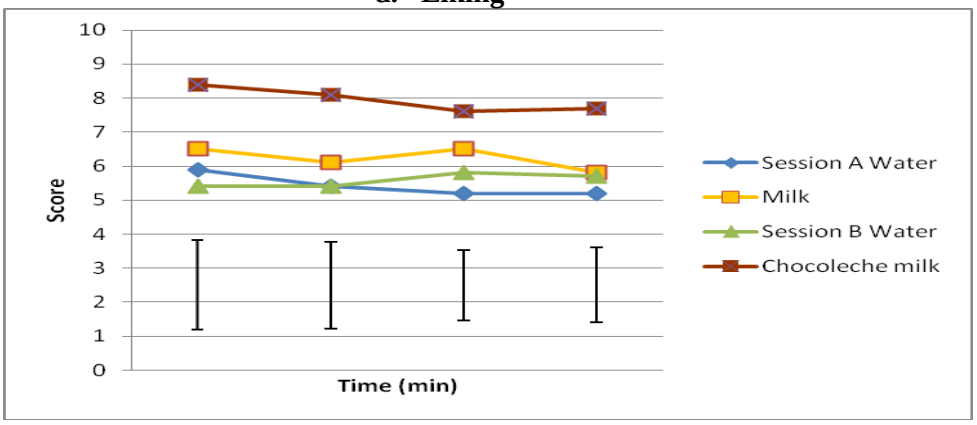
Interaction: F = 1.6, p = 0.107. Beverage: F = 94.0, p <0.001. Measurement: F = 1.2, p = 0.308

c. Flavor intensity



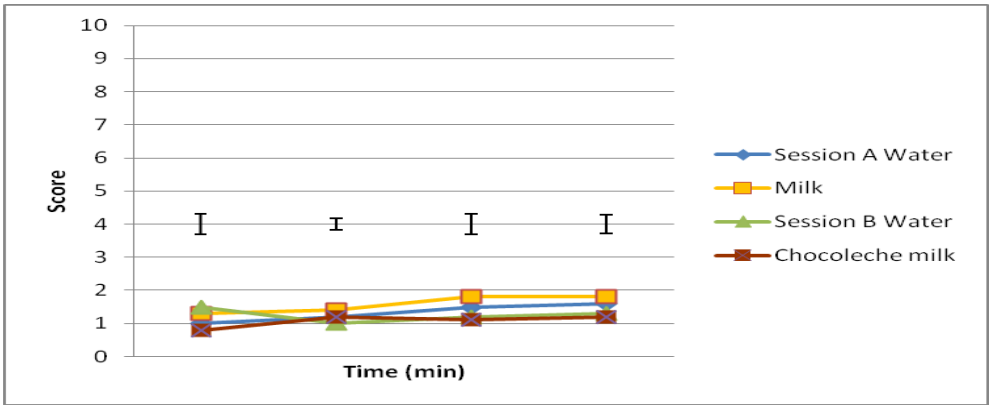
Interaction: F = 0.82, p = 0.602. Beverage: F = 18.7, p <0.001. Measurement: F = 1.1, p = 0.364.

d. Liking



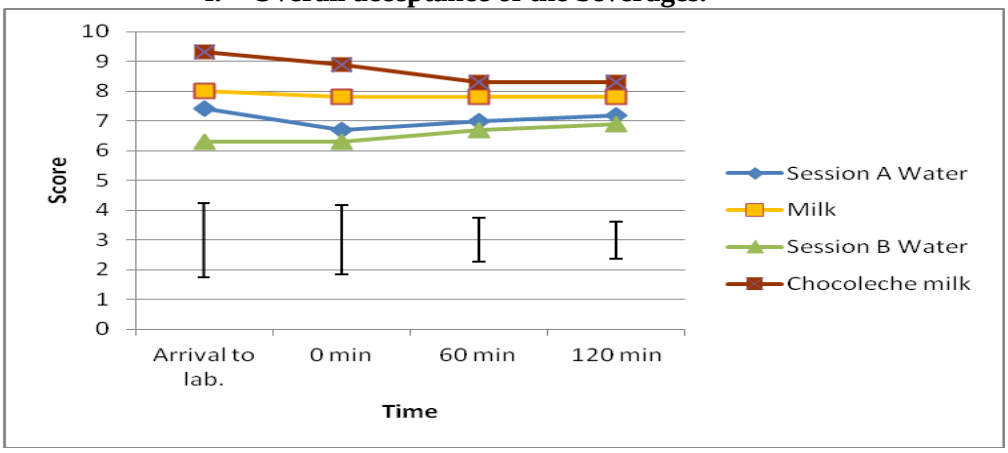
Interaction: F = 1.23, p = 0.266. Beverage: F = 9.0, p <0.001. Measurement: F = 1.33, p = 0.269.

e. Tartness



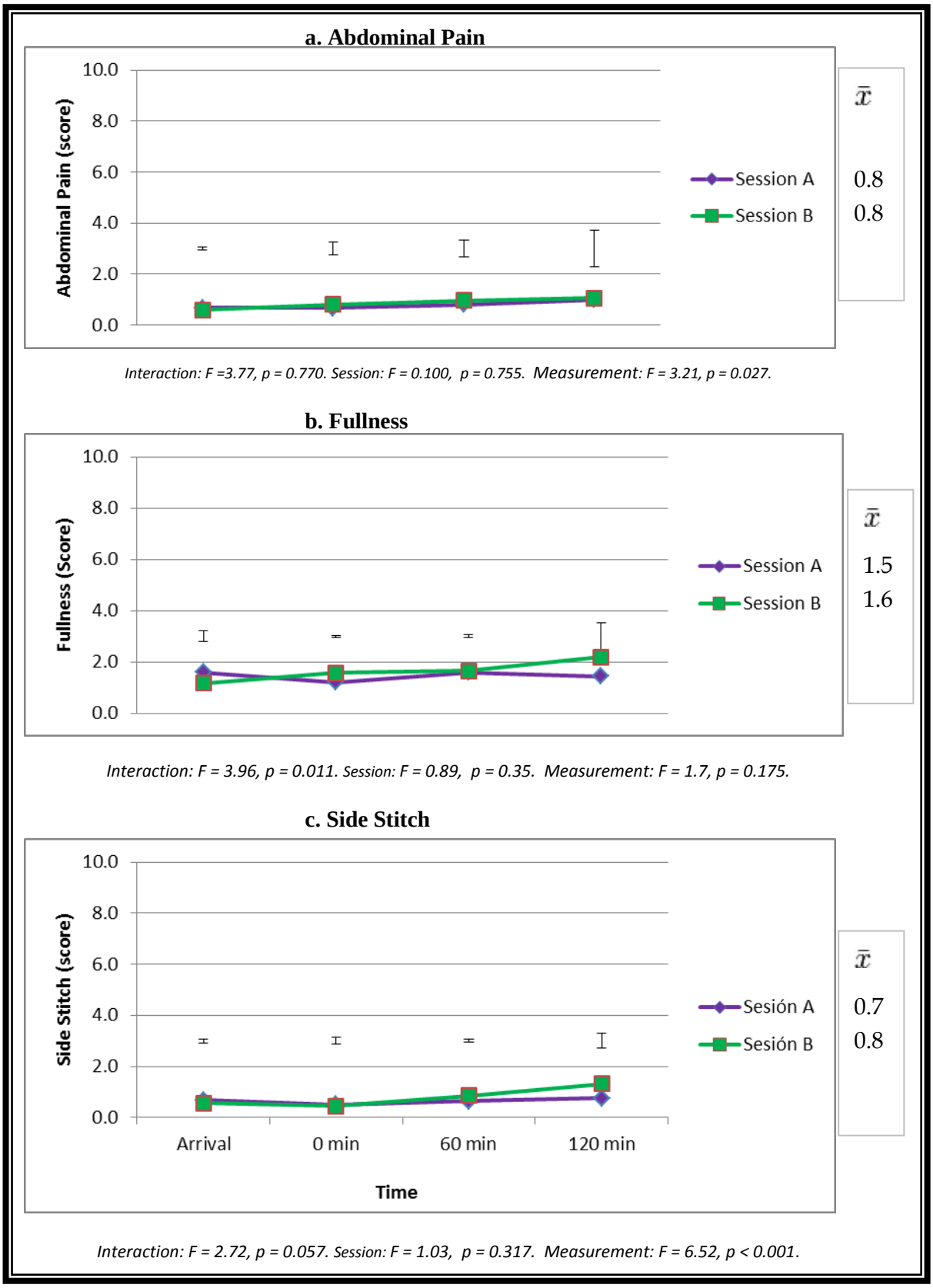
Interaction: F = 1.14, p = 0.332. Beverage: F = 2.2, p = 0.90. Measurement: F = 2.5, p = 0.65.

f. Overall acceptance of the beverages.



Interaction: F = 2.9, p = 0.039. Beverage: F = 20.6, p <0.001. Measurement: F = 1.43, p = 0.239.

Figure 4.
Gastro Intestinal Symptoms.



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