Incomplete warm-climate post-exercise rehydration with water, coconut water, or a sports drink

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ABSTRACT

It is common to find mild to serious dehydration during exercise in hot, humid conditions. To restore euhydration, the literature shows that a fluid volume larger than sweat loss should be ingested post-exercise; ingestion of enough sodium is essential to support retention of the ingested fluid. PURPOSE AND METHODS. The purpose of this study was to compare the effectiveness of three fluids in promoting fluid retention and maintaining euhydration in a warm, humid environment. 19 heat-acclimated male athletes, 11-15 years old, drank a volume of water (W), coconut water (C) (0.9 mEqL-1 Na+, 63.3 mEqL-1 K+, 4% CHO), or sports drink (SD) (20.2 mEqL-1 Na+, 3.2 mEqL-1 K+, 6% CHO) equivalent to 125% of body weight loss, after exercise-induced dehydration to 2.3% body mass (BM). Natural wet bulb globe temperature (WBGT) in the shade for both the exercise and recovery periods was 26.5 ± 0.6°C. All subjects performed all trials, in random order, separated by at least 5 days. RESULTS. There were no significant differences ($p>0.05$) in initial body mass (50.62 ± 7 kg) for the three conditions. Urine production during the three-hour, at-rest follow up was 27.7 ± 16.8% (W), 25.2 ± 13.8% (C), and 22.2 ± 15.4% (SD) of fluid ingested ($p>0.05$). However, final body mass was significantly lower for W (49.6 ± 7.0 kg) than for either C (49.9 ± 7.1 kg) or SD (49.8 ± 7.0 kg) ($p<0.05$). After these 3 hours of recovery, hypohydration was worse for W (1.98%BM) than for both C (1.52%BM) and SD (1.46%BM) ($p<0.05$). CONCLUSIONS. Additional sweat output at rest prevented maintenance of euhydration after three hours of recovery in a warm, humid climate, in spite of ingestion of 125% of the volume lost in sweat during exercise. Water was less effective at fluid retention than either coconut water or a sports drink.

Background and Purpose

- During physical activity in hot, humid climates, human sweat loss can reach levels between 1 and 3 L per hour, resulting in mild to severe dehydration even when ingesting fluids during exercise.
- To restore fluid balance after exercise, a large consumption of fluid (≈150% of volume lost) is necessary. Because of ongoing obligatory urine losses, ingestion of enough sodium is considered essential to support retention of the ingested fluid.
- In real life situations, athletes will only drink beverages that are palatable. Both water and sports drinks are widely used, but coconut water is also a popular drink widely available in the tropics. These beverages are very different in sodium and potassium content.

Background and Purpose

- Most studies on rehydration after exercise are based on well-trained but not necessarily well-acclimated subjects exercising in a hot chamber and recovering in a cooler, dryer environment. However, in many situations the athletes must recover in the same environment where they trained. If these athletes are heat-acclimated, their sweat rates will be very high.
- Therefore, the purpose of this study was to compare the effectiveness of three common drinks in promoting fluid retention and maintaining euhydration in heat-acclimated athletes in a warm, humid environment.

Methods

Subjects:

- 19 heat-acclimated boys, 13 ± 0.8 years old; 50.7 ± 7 kg body weight. All attending an “athletics school” in the Atlantic coast of Costa Rica. Their daily schedule (7:30 to 16:30) combines three hours of sports practice with academics.

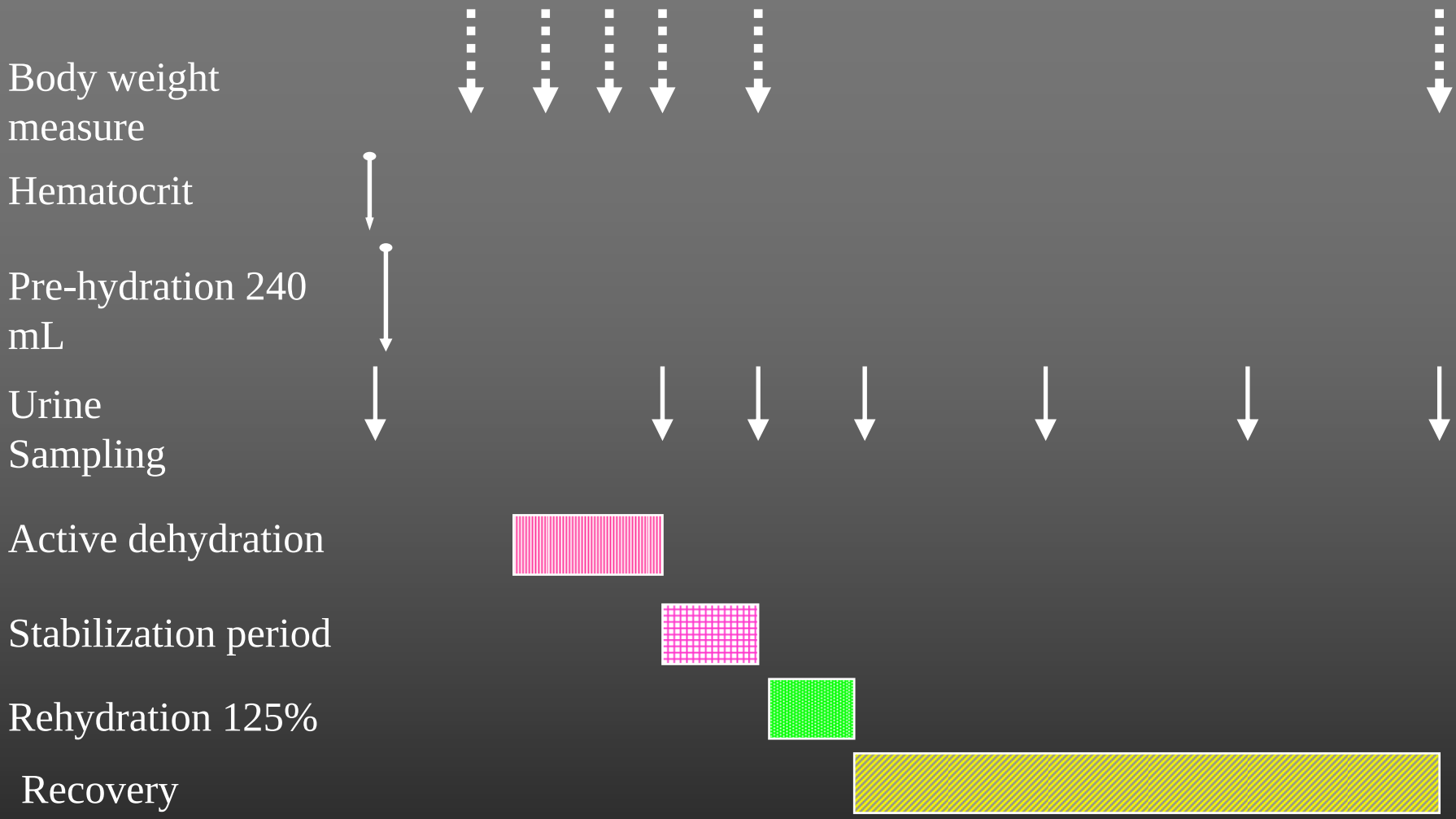
Design:

- Participants attended three trials each, separated by 5 to 7 days, after one familiarization trial. A different treatment was applied to each subject each trial.
- The order of treatments was randomized.
- Diet on the 48 hours prior to each trial was monitored using a dietary recall questionnaire and by specific instructions regarding fluid and sodium intake on the 24 hours prior to each trial.
- Body weight was registered with a digital scale with a resolution of 50g.
- Urine volumes were measured with a graduated test tube to the nearest 1 mL.

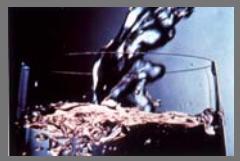
Methods

Protocol:

- After preliminary measurements, subjects exercised for several 20-minute bouts followed by body weight measurement, until they reached a dehydration of about 2% body mass.
- After a period of stabilization, participants drank a volume of water, coconut water, or sports drink, equivalent to 125% of body weight loss.
- Urine and body mass were monitored during the three-hour recovery period.



Trial Timeline. Only the first and the last three urine samples were measured.



Drink characteristics

DRINK	CHO (g/100mL)	Na+ (mg)	Na+ (mEq/L)	K+ (mg)	K+ (mEq/L)	Volume ingested (mL)
Water	0	---	---	---	---	1385
Coconut Water	4	1.9	0.8	248.0	63.3	1513
Sports Drink	6	46.5	20.2	12.7	3.2	1435

•Water was tap water, with negligible electrolyte and carbohydrate contents. Coconut water, from green coconuts about 6 to 9 months old, was low in sodium but high in potassium content. The sports drink used was orange-flavored Gatorade®

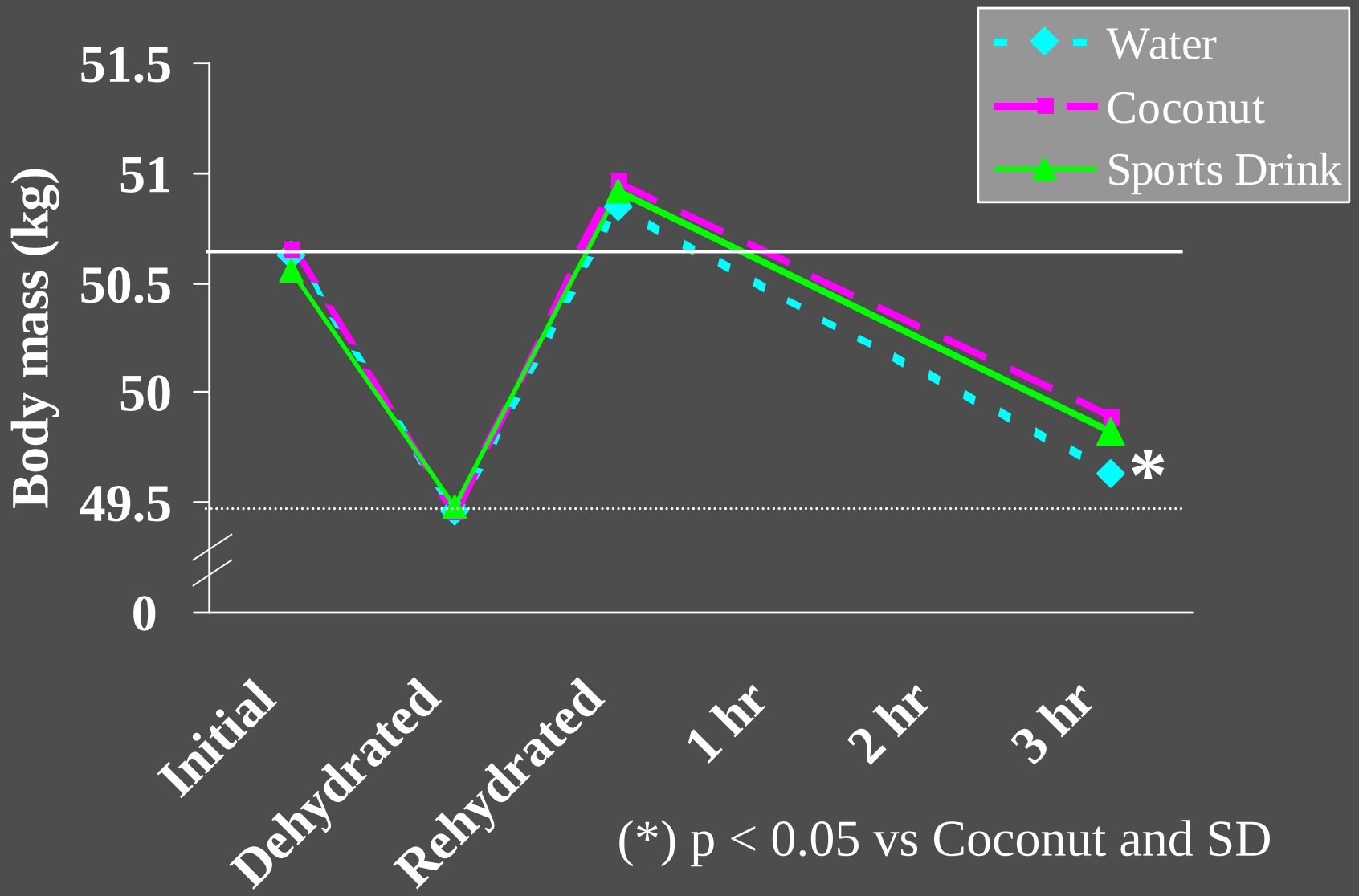
•All beverages had an average temperature of 18°C.

•There were no statistically significant differences between the volumes of fluid ingested ($p > 0.05$).

Results

- Environmental WBGT in the shade for both the exercise and the recovery periods was 26.5 ± 0.6°C.
- Initial body weight and haematocrit were not statistically different among treatments, suggesting a similar baseline hydration status.

FLUID BALANCE



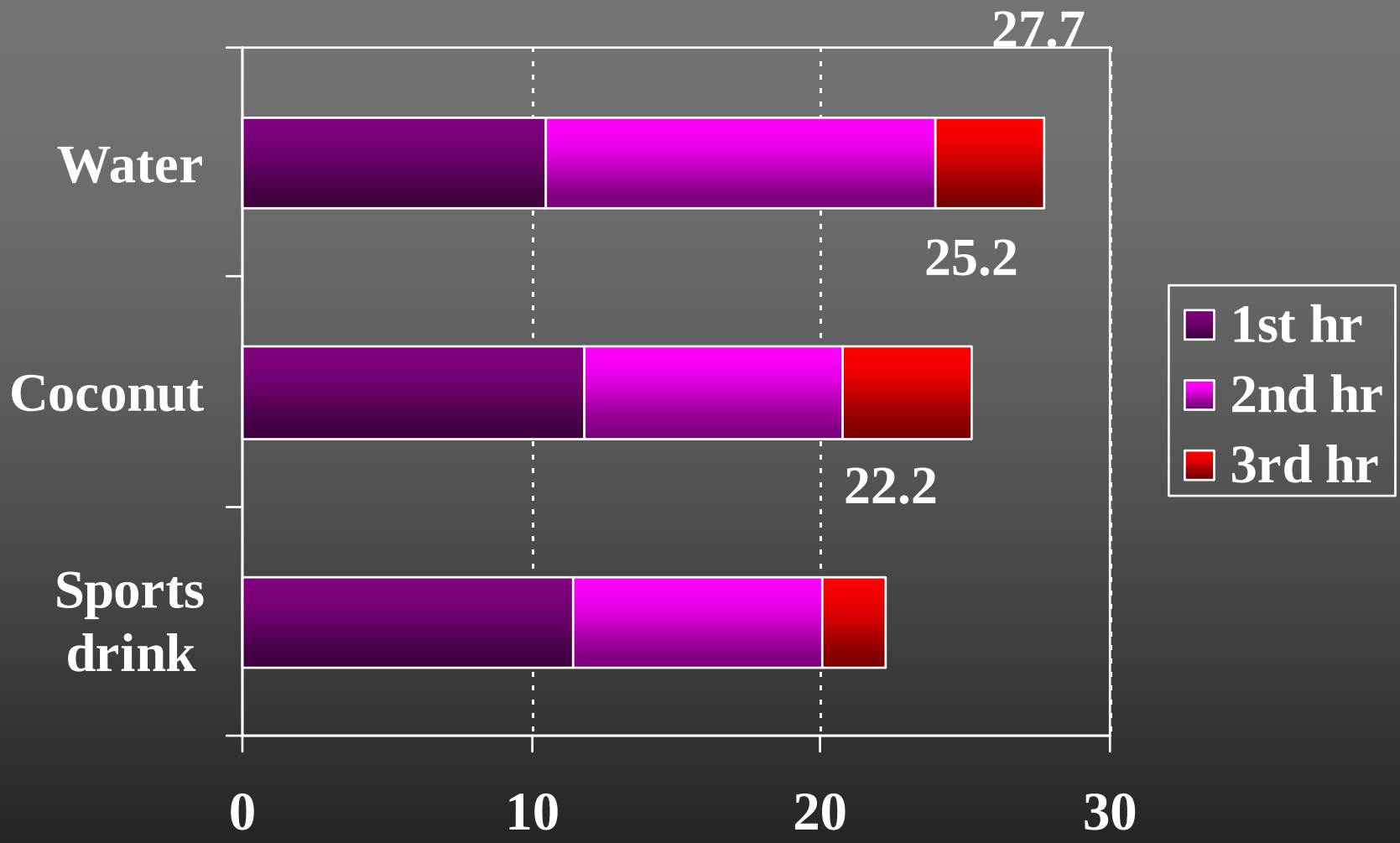
(*) $p < 0.05$ vs Coconut and SD

Results

Fluid Balance:

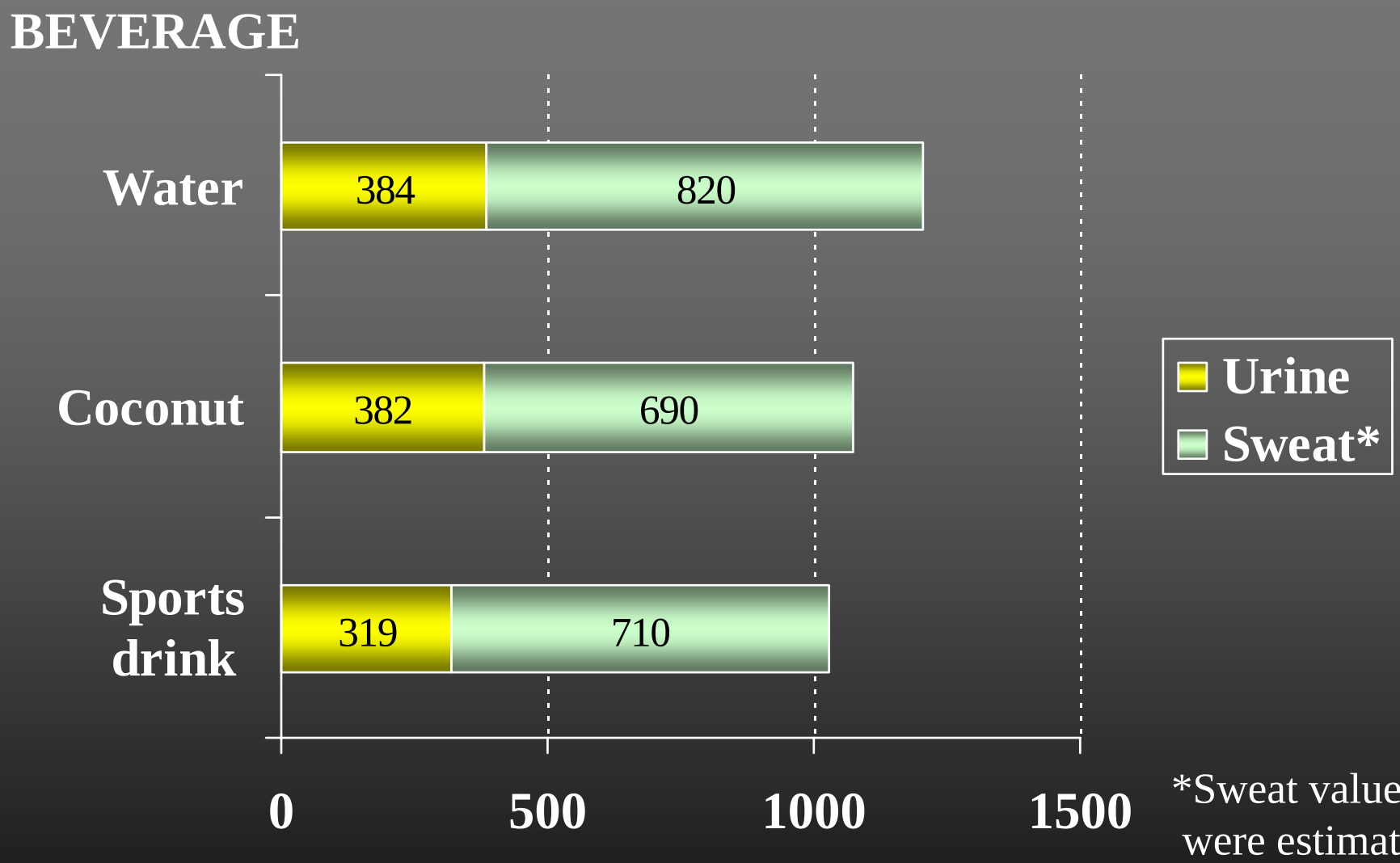
- Body mass during the experiment as an indication of hydration status.
- Final body mass after rehydration with water was lower ($p < 0.05$) than coconut water or sports drink.
- Before drinking, subjects were dehydrated to 2.3% BM (no difference among treatments).
- After 3 hours of recovery, hypohydration was worse for W (1.98%BM) than for both C (1.52%BM) and SD (1.46%BM) ($p<0.05$).

URINE LOSSES



Differences are not statistically significant ($p>0.05$)

FLUID LOSSES



Differences are not statistically significant ($p>0.05$)

Results

Total fluid loss during recovery.

- Sweat loss was estimated by subtracting urine volume from total weight loss, assuming a urine density of 1.0 g/mL.
- Differences among treatments were not statistically significant ($p > 0.05$).
- Additional sweat output at rest was twice as important as a way of fluid loss than obligatory urine production.

Conclusions

- Additional sweat output at rest prevented maintenance of euhydration after three hours of follow-up in a warm, humid climate, in spite of post-exercise ingestion of 125% of the volume lost in sweat during exercise
- The level of hypohydration at the end of the recovery was very close to the level of hypohydration before fluid ingestion.
- Water was less effective at fluid retention than either coconut water or a sports drink. However, this difference could only be detected by differences in final body mass, as urine volumes were not statistically different among beverages.

References

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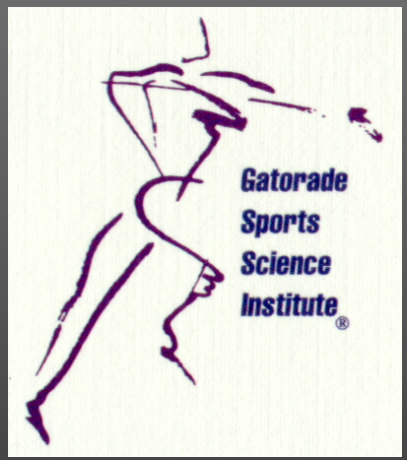
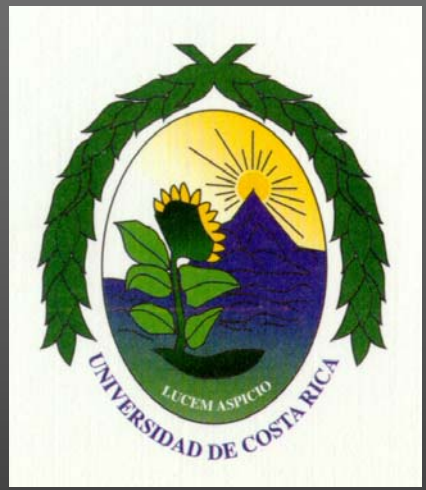
THANKS…





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