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Original Research

Sodium Replacement and Plasma Sodium Drop During Exercise in the Heat When Fluid Intake Matches Fluid Loss

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Abstract

Context: Sodium replacement during prolonged exercise in the heat may be critically important to maintaining fluid and electrolyte balance and muscle contractility.

Objective: To examine the effectiveness of sodium-containing sports drinks in preventing hyponatremia and muscle cramping during prolonged exercise in the heat.

Design: Randomized crossover study.

Patients or Other Participants: Thirteen active men.

Intervention(s): Participants completed 4 trials of an exercise protocol in the heat (30°C) consisting of 3 hours of exercise (alternating 30 minutes of walking and cycling at a heart rate of 130 and 140 beats per minute, respectively); a set of standing calf raises (8 sets of 30 repetitions); and 45 minutes of steep, brisk walking (5.5 km·h⁻¹ on a 12% grade). During exercise, participants consumed fluids to match body mass loss. A different drink was consumed for each trial: carbohydrate-electrolyte drink containing 36.2 mmol/L sodium (HNa), carbohydrate-electrolyte drink containing 19.9 mmol/L sodium (LNa), mineral water (W), and colored and flavored distilled water (PL).

Main Outcome Measure(s): Serum sodium, plasma osmolality, plasma volume changes, and muscle cramping frequency.

Results: During both HNa and LNa trials, serum sodium remained relatively constant (serum sodium concentration at the end of the protocol was 137.3 mmol/L and 136.7 mmol/L, respectively). However, a clear decrease was observed in W (134.5 ± 0.8 mmol/L) and PL (134.4 ± 0.8 mmol/L) trials compared with HNa

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and LNa trials ($P < .05$). The same trends were observed for plasma osmolality ($P < .05$). Albeit not significant, plasma volume was preserved during the HNa and LNa trials, but a reduction of 2.5% was observed in the W and PL trials. None of the volunteers experienced cramping.

Conclusions: The data suggest that sodium intake during prolonged exercise in the heat plays a significant role in preventing sodium losses that may lead to hyponatremia when fluid intake matches sweat losses.

Keywords: [endurance](#), [fluid replacement](#), [hydration](#), [hyponatremia](#), [plasma volume](#), [sports drinks](#)

Costas A. Anastasiou, PhD, contributed to conception and design, analysis and interpretation of the data, and drafting and final approval of the article. Stavros A. Kavouras, PhD, contributed to conception and design, analysis and interpretation of the data, and critical revision and final approval of the article. Giannis Arnaoutis, MS; Aristeia Gioxari, MS; Maria Kollia, MS; and Efthimia Botoula, BS, contributed to acquisition and analysis and interpretation of the data and critical revision and final approval of the article. Labros S. Sidossis, PhD, contributed to conception and design, analysis and interpretation of the data, and critical revision and final approval of the article.

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