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Bicarbonate Ingestion May Improve Prolonged Intermittent Sprint Performance **CME**

News Author: Laurie Barclay, MD

CME Author: Désirée Lie, MD, MSED

Complete author [affiliations and disclosures, and other CME information](#), are available at the end of this activity.

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May 13, 2005 — Sodium bicarbonate (NaHCO_3) ingestion improves prolonged intermittent sprint performance, according to the results of a small randomized trial published in the May issue of *Medicine and Science in Sports and Exercise*.

"Previous studies have shown that induced metabolic alkalosis, via sodium bicarbonate (NaHCO_3) ingestion, can improve short-term, repeated-sprint ability," write David Bishop, PhD, from the University of Western Australia in Crawley, and colleagues. "It was hypothesized that NaHCO_3 ingestion would enhance the performance of the prolonged intermittent-sprint test (IST).

In this study, seven female team-sport athletes ingested two doses of either 0.2 g/kg of NaHCO_3 or 0.138 g/kg of NaCl (placebo), in a double-blind, random, counterbalanced order, 90 and 20 minutes before performing the IST on a cycle ergometer. Mean age was 19 ± 1 years, and mean peak oxygen consumption ($\text{VO}_{2\text{peak}}$) was 45.3 ± 3.1 mL/kg per minute. The IST consisted of two 36-minute halves of repeated blocks approximately two minutes long: all-out four-second sprint, 100 seconds of active recovery at 35% $\text{VO}_{2\text{peak}}$, and 20 seconds of rest. Subjects provided capillary blood samples drawn from the earlobe before ingestion, and before, during, and after each half of the IST. Throughout the IST, $\text{VO}_{2\text{peak}}$ was also recorded at regular intervals.

Mean plasma bicarbonate concentration (HCO_3^-) was 22.6 ± 0.9 mmol/L at rest, and at 90 minutes after ingestion it was 21.4 ± 1.5 mmol/L for placebo and 28.9 ± 2.8 mmol/L for NaHCO_3 ($P < .05$). Plasma HCO_3^- during the NaHCO_3 condition remained significantly higher throughout the IST compared with both placebo and preingestion. After NaHCO_3 ingestion, there was a trend toward improved total work in the second ($P = .08$), but not first, half of the IST. After NaHCO_3 ingestion, study subjects also completed significantly more work in seven of 18 second-half four-second sprints.

"The results of this study suggest that NaHCO_3 ingestion can improve intermittent-sprint performance and may be a useful supplement for team-sport athletes," the authors write. "The preexercise ingestion of NaHCO_3 affected a significant increase in the extracellular [HCO_3^-] and improved the performance of the IST."

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Learning Objectives for This Educational Activity

Upon completion of this activity, participants will be able to:

- Describe the effect of pretest NaHCO_3 on athletes in a prolonged IST.
- Evaluate the potential benefit of NaHCO_3 on endurance performance in athletes.

Clinical Context

Various intracellular and extracellular mechanisms buffer the release and removal of H^+ (acid) during high-intensity exercise. According to Bishop and colleagues, increases in the extracellular buffer concentration via the ingestion of an alkaline solution such as NaHCO_3 , may improve H^+ efflux out of the muscle cell and improve repeated sprint performance.

This is an experimental study of seven female athletes to examine the effect of NaHCO_3 ingestion prior to a repeated sprint protocol designed to replicate the average profile of a typical team-sport game.

Study Highlights

- 7 female team-sport athletes with a mean age of 19 years, mean mass of 58 kg, and mean $\text{VO}_{2\text{peak}}$ of 45.3 mL/kg per minute were recruited as volunteers to be tested on 3 separate occasions.
- They each performed in both experimental conditions (preingestion of NaHCO_3 and of NaCl).
- On day 1 they performed a graded exercise test (GXT) to determine $\text{VO}_{2\text{peak}}$. At least 48 hours later, they performed an IST after the ingestion of either NaHCO_3 or a placebo solution of NaCl. Another week later, the IST was repeated with the preingestion solution not yet used.
- The exercises used air-braked cycle ergometers. The GXT consisted of graded steps in 3-minute stages, using an intermittent protocol with 1-minute breaks between stages, commencing at 40 W (peak power) and increasing by 30 W every 3 minutes until volitional exhaustion.
- The IST consisted of two 36-minute halves of IST divided into 2-minute blocks of sprinting, active recovery and passive rest. Each block started with a 4-second all-out sprint with 100 seconds of recovery, requiring 35% of power output at $\text{VO}_{2\text{peak}}$. The 2-minute block was completed by 20 seconds of passive rest. There was a 10-minute recovery period between the two 36-minute halves.
- Work done (J) and peak power were calculated for each 36-minute half of the IST.
- Capillary blood was collected for pH, lactate (La), and HCO_3^- levels; expired air was analyzed for O_2 and CO_2 levels; and a heart rate monitor was used to store heart rate data throughout each test.
- Subjects maintained their usual diet and training schedules during the testing period and consumed no food or beverages other than water 2 hours before testing. Consumption of alcohol and rigorous exercise were not permitted within 24 hours of testing.
- NaHCO_3 was administered in 2 0.2g/kg doses taken 90 and 20 minutes before the IST started, to maintain elevated HCO_3^- levels throughout the IST. NaCl was administered in two 0.138g/kg doses taken 90 and 20 minutes before the start of the IST.
- There were no reported adverse side effects of the 2 solutions.
- Plasma HCO_3^- and La levels were similar in the 2 conditions preingestion.
- Postingestion plasma HCO_3^- and pH levels were significantly higher in the HCO_3^- condition compared with baseline ($P < .05$).
- There was no significant difference in La^- during either half of the IST, but the posttest La^- was significantly higher in the NaHCO_3 compared with the NaCl condition.
- There was no significant difference in total work completed between the conditions for the first or second half of the IST.
- Work completed during 7 of the 18 second-half sprints was significantly greater in the NaHCO_3 compared with the placebo condition ($P < .003$).
- There was no significant difference in peak power achieved between the 2 groups.
- The peak power achieved by individuals during 8 of the second-half sprints was significantly greater in the NaHCO_3 compared with the placebo condition.
- No differences were observed in the conditions for O_2 consumption and heart rate during each half of the IST.

Pearls for Practice

- Ingestion of NaHCO_3 before an IST is associated with elevated plasma HCO_3^- levels and elevated pH and elevated La levels posttest.
- Ingestion of HCO_3^- before an IST is associated with enhanced performance in the second half of a prolonged 36-minute split half IST, with higher total work and peak power achieved compared with ingestion of NaCl.

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News Author

Laurie Barclay, MD

is a freelance writer for Medscape.

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Clinical Reviewer

Gary Vogin, MD

Senior Medical Editor, Medscape

Disclosure: Gary Vogin, MD, has disclosed no relevant financial relationships.

CME Author

Desiree Lie, MD, MSED

Clinical Professor of Family Medicine; Director, Division of Faculty Development, University of California, Irvine School of Medicine, Irvine, California

Disclosure: Desiree Lie, MD, MSED, has disclosed no relevant financial relationships.

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