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### Original Research

## Core Temperature and Metabolic Responses After Carbohydrate Intake During Exercise at 30°C

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### Abstract

**Context:** Carbohydrate ingestion has recently been associated with elevated core temperature during exercise in the heat when testing for ergogenic effects. Whether the association holds when metabolic rate is controlled is unclear. Such an effect would have undesirable consequences for the safety of the athlete.

**Objective:** To examine whether ingesting fluids containing carbohydrate contributed to an accelerated rise in core temperature and greater overall body heat production during 1 hour of exercise at 30°C when the effort was maintained at steady state.

**Design:** Crossover design (repeated measures) in randomized order of treatments of drinking fluids with carbohydrate and electrolytes (CHO) or flavored-water placebo with electrolytes (PLA). The beverages were identical except for the carbohydrate content: CHO = 93.7 ± 11.2 g, PLA = 0 g.

**Setting:** Research laboratory.

**Patients or Other Participants:** Nine physically fit, endurance-trained adult males.

**Intervention(s):** Using rectal temperature sensors, we measured core temperature during 30 minutes of rest and 60 minutes of exercise at 65% of maximal oxygen uptake ( $\dot{V}O_2$  max) in the heat (30.6°C, 51.8% relative humidity). Participants drank equal volumes (1.6 L) of 2 beverages in aliquots 30 minutes before and every 15 minutes during exercise. Volumes were fixed to approximate sweat rates and minimize dehydration.

**Main Outcome Measure(s):** Rectal temperature and metabolic response ( $\dot{V}O_2$ , heart rate).

**Results:** Peak temperature, rate of temperature increase, and metabolic responses did not differ between beverage treatments. Initial hydration status, sweat rate, and fluid replacement were also not different between trials, as

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**Conclusions:** Ingestion of carbohydrate in fluid volumes that minimized dehydration during 1 hour of steady-state exercise at 30°C did not elicit an increase in metabolic rate or core temperature.

**Keywords:** [rectal temperature](#), [glucose](#), [fructose](#), [thermoregulation](#), [heat stress](#)

Craig A. Horswill, PhD, contributed to conception and design; analysis and interpretation of the data; and drafting, critical revision, and final approval of the manuscript. John R. Stofan, MS, contributed to conception and design; acquisition and analysis and interpretation of the data; and drafting, critical revision, and final approval of the article. Shannon C. Lovett contributed to conception and design, acquisition and analysis and interpretation of the data, and final approval of the article. Chris Hannasch contributed to acquisition and analysis and interpretation of the data and drafting and final approval of the article.

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