



A Comparison of the Effects of a Carbohydrate Mouth Rinse on Cycling Performance in Depleted and Non-Depleted Glycogen States

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Abstract

Performance improvements have been reported when mouth rinsing with a carbohydrate solution during short duration, high intensity endurance exercise. Limited research has been conducted in this area when endogenous carbohydrate stores are depleted. PURPOSE: The purpose of this study was to assess the effects of a carbohydrate mouth rinse on endurance-trained cyclists during a 30-kilometer time trial in depleted vs. non-depleted glycogen states. METHODS: 5 endurance-trained men (28±7 years; 179.32±8.15 cm; 68.65±8.16 kg; 54.00±5.95 mL/kg/min VO₂ max) participated in a repeated measures crossover study using a CHO mouth rinse (6.4% maltodextrin) or placebo. RESULTS: Subjects completed the time trial faster (p=0.033) in the non-depleted state, despite reporting lower RPE (p=0.010). There was no significant treatment effect, but subjects completed the time trial 20 seconds faster in the depleted CHO mouth-rinse condition. Power output was significantly higher (p=0.010) in non-depleted than depleted conditions; no significant treatment effect was observed. RER was significantly higher (p=0.001) in the non-depleted state; no significant differences were observed between mouth rinses. A mouth rinse segment interaction (p=0.028) was observed for heart rate in the last 6k for the CHO mouth-rinse condition, indicating a possible increase in effort over the last segment of the time trial. CONCLUSION: CHO mouth rinse may be a valuable tool for performance enhancement in suboptimal nutrition states. Further, the results supported current knowledge regarding performance in depleted and non-depleted glycogen states.

Methods

SUBJECTS
5 endurance trained men (Table 1) participated after signing an informed consent form approved by the Texas Christian University IRB.

	Mean	Minimum	Maximum	N
Age	27.80±7.09	22	36	5
Height (cm)	179.32±8.15	170.18	190.15	5
Weight (kg)	68.65±8.16	59.32	78.00	5
BMI	21.47±2.01	18.70	23.90	5
VO ₂ max (mL/kg/min)	54.00±5.95	47.31	60.23	5
VO ₂ max (L/min)	3.68±0.14	3.87	3.68	5

TABLE 1 – Subject characteristics.

EXPERIMENTAL DESIGN

The study followed a two-factor repeated-measures, randomized design (Fig. 1).

Dietary CHO Status	Mouth Rinse	
	CHO	Placebo
Depleted	D CHO	D Placebo
Non-Depleted	ND CHO	ND Placebo

FIGURE 1 – Experimental design

PRELIMINARY TESTING

Participants completed medical history and activity questionnaires before undergoing a VO₂ max test on the Velotron cycle ergometer. They were familiarized with the 30-kilometer time trial course and time trial protocol while warming up for the VO₂ max test.

EXPERIMENTAL TESTING

Each participant underwent 4 trials, separated by a minimum of one week. Each trial consisted of a 2 day protocol. The first day was a glucose depletion bout, in which subjects cycled 60 minutes at 70% of VO₂ max, followed by 6x1 minute sprints at 120% of VO₂ max. For the next 24 hours, participants followed either a high CHO (75%) or low CHO (5%) diet. After this period, each subject completed a 30k time trial. During the time trial, participants rinsed with either 25 mL of CHO (6.4% maltodextrin) or placebo solutions for 10 seconds every 6k.

MEASUREMENTS

Metabolic data, heart rate and RPE were collected every 15 minutes during the depletion bout. Macronutrients for the 24-hour dietary control period were tracked with MyFitnessPal. Blood glucose was collected pre and post 30k time trial. During the 30k time trial, metabolic data was collected at 3k, 9k, 15k, 21k, and 27k. Heart rate and RPE were collected every 3k.

STATISTICS

A multifactorial analysis of variance (ANOVA) with repeated measures was used to determine the statistical significance of our findings. A Bonferroni post hoc analysis was performed to isolate differences detected by the ANOVA. An alpha level of p<0.05 was used.

Results

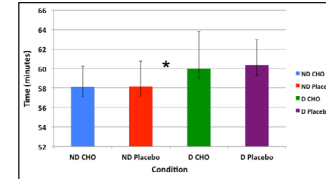


FIGURE 2 – Time to Completion. * = diet main effect; p = 0.033. Non-significant difference between D CHO and Placebo (20 seconds)

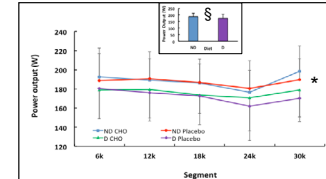


FIGURE 3 – Power Output. * = sig. difference (segment main effect); p = 0.010. § = diet main effect; p = 0.010

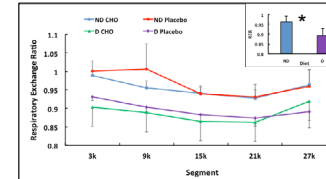


FIGURE 4 – RER. * = sig. difference (diet main effect); p = 0.001.

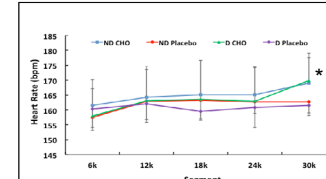


FIGURE 5 – Heart Rate. * = mouth-rinse segment interaction; p = 0.028.

Results cont'd

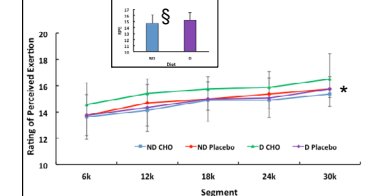


FIGURE 6 – RPE. * = segment main effect; p<0.001. § diet main effect; p = 0.010.

Conclusions & Applications

Diet-based main effects were found in time to completion, watts, RER, and RPE. Participants performed faster, had greater power, higher RER, and lower RPE in conditions with sufficient glycogen stores than in depleted states. These findings support previous research.

However, the main purpose of this study was to determine time to completion (TTC) differences in placebo vs. CHO mouth rinse, particularly in the glycogen depleted state. No statistically significant difference was found in TTC between CHO and placebo mouth rinse in either condition. This is in contrast with previous findings (3) (5). Yet, an increase in effort over the last 6k with the CHO mouth rinse may have been observed. Possible support for this conclusion arises from the statistically significant difference in heart rate observed between CHO and placebo conditions at the end of the time trials.

Despite the lack of significant findings in most variables between the CHO and mouth rinse conditions, this study provided valuable insight into a possible mechanism for performance enhancement. TTCs were an average of 20 seconds faster in CHO than placebo. At elite levels of endurance competition, small time differences can provide notable advantages.

As this study was limited by a small sample size and a lack of complete control over extraneous influences (diet, sleep, stress, etc.), further investigation on this topic is warranted to provide valuable insight on the mechanisms of the central effect and how it can be used to improve exercise and sport performance.

References

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