The effect of nutritional strategy on the distance covered during a simulated Sportive-like event

Introduction

The performance advantage gained by ingestion of carbohydrate (CHO, typically glucose or glucose polymers such as maltodextrin) during endurance events has been well established; with CHO supplementation consistently demonstrated to delay the onset of fatigue (e.g. Coyle et al., 1983; Coyle et al., 1986) when cycling to exhaustion at a fixed work rate. Until recently it was believed that there was an upper limit of 60 grams per hour in the rate at which the ingested CHO could be oxidised (burned to produce energy), such that ingesting additional CHO above 60g/hr during exercise has no additional benefit, and can actually lead to gastro-intestinal distress. This upper limit in the oxidation of exogenous CHO is thought to be the result of saturation of the intestinal transporter (SGLT-1) responsible for the absorption of glucose.

However, recently it has been demonstrated that there can be a further increase in the oxidation rate of exogenous CHO (i.e. the amount of ingested CHO burned to produce energy) when CHO's of different types are ingested (Jentjens et al., 2004; Wallis et al., 2005; Jentjens et al., 2006). This increase in the rate of exogenous CHO when ingesting "multiple transportable carbohydrates" (i.e. Glucose (or Maltodextrin) + Fructose) has also been demonstrated to result in a further improvement in performance above that seen with the ingestion of glucose alone (Currell and Jeukendrup, 2008). This is possible as, in contrast to the SGLT-1 intestinal transport mechanism utilised by glucose, fructose is absorbed in the intestine by a separate transporter (GLUT-5) allowing further absorption of CHO when the SGLT-1 transporter is saturated.

The finding of Currell and Jeukendrup (2008) of an 8% improvement in Time-Trial performance when ingesting multiple transportable carbohydrates at a rate of 108g/hr in a 2:1 ratio (intended to saturate the glucose transporter, and then provide additional CHO in the form of Fructose on top of this) is therefore vitally important for athletes competing in endurance events to maximise performance.

However, for some recreational athletes, it is not necessarily the goal to complete an event in a faster time, but rather to be able to complete greater feats of endurance- for example increasing the distance completed during sportive events. Therefore, the aim of this study was to investigate how much further cyclists could ride, at the same pace, when following a nutritional strategy based on the scientific literature and aimed at maximising CHO intake.

Methods

Ten healthy subjects (9 Male, 1 Female) volunteered for the study and, following familiarisation with the protocols and equipment (requiring a visit to the lab to complete a 60 mile ride on the same course used for the two experimental trials), participated in two experimental trials (OWN: subjects consumed their own nutrition and followed their own nutritional strategy; and SCI: subjects consumed High5 nutritional supplements following a strategy based on current scientific evidence). The order of SCI and OWN trials was randomised between participants.

Prior to each trial subjects were asked to follow the same diet in the preceding 24 hr, and follow the same training programme in the preceding 48hr. For the trials, subjects own bike was fitted to a Computrainer (Computrainer Lab, RacerMate, Seattle, USA) connected to a laptop, which simulated the cycling course. In the first experimental trial (OWN or SCI depending on randomisation), following a 10min warm-up, the Computrainer was calibrated and subjects were asked to complete a 60 mile ride at a pace they would normally ride a 60mile sportive (6 laps of the same 10 mile course which had a rolling profile including 2 sustained climbs, similar to what can be expected at a cyclo sportive type event). Following completion of the 60 miles, the performance from the 60 mile ride just completed was immediately loaded (represented by a 2nd computer generated cyclist on the computer screen; Figure 1), and subjects were asked to follow this performance for as long as possible, with the aim of maximising distance travelled.

Figure 1: Image of the computer screen during the 2nd part of the test showing the current performance on the left-hand side, with the "metal man image" on the right representing a playback of the initial 60 mile performance.

The test was terminated, and distance travelled recorded, when subjects fell 0.3miles behind the pacer. In the second test (to ensure the same effort throughout), subjects were asked to follow the 60mile performance from the first test for both the initial 60 miles, and for the 2nd part of the test where subjects followed the initial 60mile performance for as long as possible with the test again terminated when the subject fell 0.3 miles behind the pacer. This would represent the point in an event at which you would be fall behind the group, requiring the group to slow down or you to have to complete the course on your own.

During the OWN trial, subjects were asked to consume their own nutrition and follow their own nutritional strategy. During the SCI trial the aim was to maximise CHO intake throughout. While this is most effectively done with the consumption of a beverage containing both glucose (or maltodextrin) in a 2:1 ratio (as the majority of gels don't contain fructose as this makes the gel too sweet) from a practical perspective this would have required the consumption of 1litre per hour, which some subjects can struggle with. Therefore, during the SCI trial subjects were asked to drink 750ml of High 5 EnergySource (250ml every 20min) + 1 High 5 EnergyGel Plus per hour, which together provided CHO at a rate of 95g CHO/hr. This is the same as the advice given in the High5 race faster guide for this type of event:

http://www.highfive.co.uk/pdf's/RoadCycling_RFG_ENGLISH_LR.pdf, Page 20.

Throughout both trials, RPE (ratings of perceived exertion) and core temperature (measured using a thermal pill ingested the evening prior to the test) were recorded, along with heart rate every 5 miles. Any difference in the variables of interest was examined using paired t-tests. Statistical significance was set at $P < 0.05$.

Results

Importantly, during the initial 60 mile part of the test there was no difference in time to complete the initial 60 miles (SCI: 184.2 ± 29.3 vs. OWN: 177.2 ± 40.2 min; P = 0.381), average speed (SCI: 18.7 ± 1.9 vs. OWN: 18.7 ± 1.5 mph; P = 0.877), or work rate (SCI: 175 ± 31 vs. OWN: 176 ± 28; P = 0.719), confirming the same absolute work completed, at the same intensity in the initial part of the test for both SCI and OWN trials.

However, the main finding of the study was that, despite no difference in the first part of the test in HR (SCI: 162 ± 10 vs. OWN: 155 ± 14 beats/min; P = 0.172), RPE (SCI: 13.6 ± 1.3 vs. OWN: 14.4 ± 1.5; P = 0.172), when following the SCI nutritional strategy subjects were, on average, able to ride an additional 15.8 miles (26%) compared with distance travelled when following their own strategy (Total distance; SCI: 76.2 ± 20.0 vs. OWN: 60.5 ± 15.0 miles; P = 0.013; Figure 2).

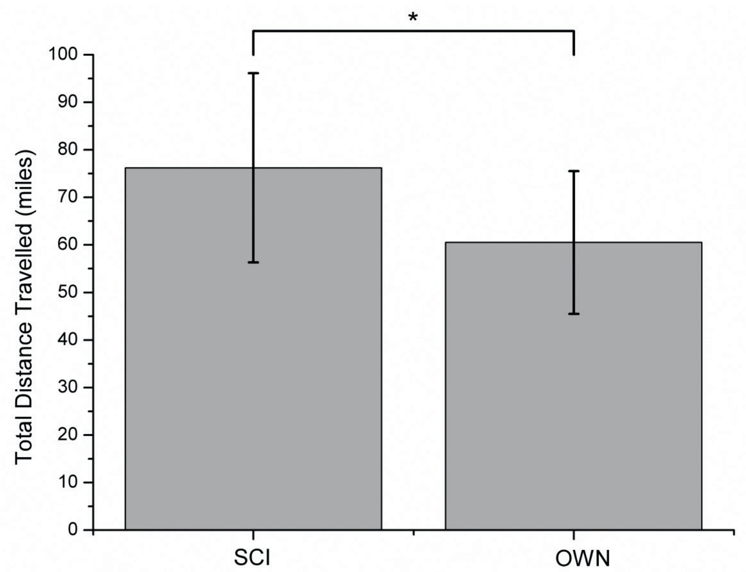

Figure 2: Comparison of the average total distance travelled (miles ± SD) when following SCI and OWN nutritional strategies. Note the average 15.8-mile (26%) increase in distance travelled when following the SCI nutritional strategy.

This finding can also be expressed as a significant increase in the duration that subjects were able to ride at the same pace when following the SCI nutritional strategy (SCI: 59.9 ± 47.8 vs. OWN: 17.1 ± 21.2 min; P = 0.017). There was also a significant increase in the rate of CHO intake when on the SCI strategy, compared with OWN (SCI: 93.7 ± 7.8 vs. OWN: 39.9 ± 17.3 g/hour; P = 0.000 Figure 3).

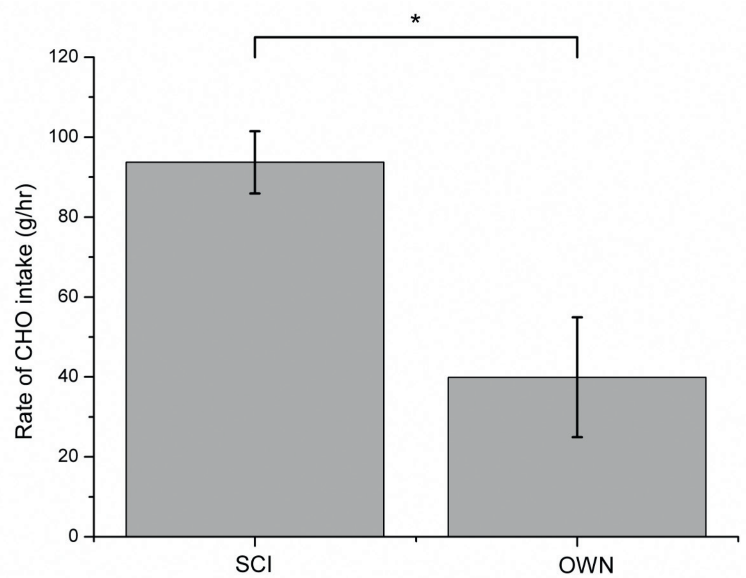

Figure 3: Comparison of the average rate of CHO intake (g.hr-1 ± SD) when following SCI and OWN nutritional strategies. Note the significant increase in the average rate of CHO intake when following the SCI nutritional strategy.

Conclusion

The main finding of this study was that when following a nutritional strategy intended to maximise CHO ingestion, and therefore the rate of exogenous CHO oxidation, subjects were able to cycle for an additional 15.8 miles (or 26% further) than they were able to ride when using their OWN strategy. This significant increase in the total distance travelled is consistent with the results of Currell and Jeukendrup (2008), and is likely a consequence of the ingestion of multiple transportable carbohydrates (i.e. Maltodextrin + Fructose) increasing the rate of exogenous CHO oxidation. This is expected to reducing the reliance on endogenous CHO stores (i.e. CHO stores within the body) throughout the ride, delaying the time it takes for these stores to become depleted, thus improving exercise tolerance and performance in this test.