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RESEARCH ARTICLE

Effect of the glycemic index of pre-exercise snack bars on substrate utilization during subsequent exercise

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Abstract

Purpose: To investigate the effect of the glycemic index (GI) of pre-exercise snack bars on substrate utilization during subsequent moderate intensity exercise. *Methods*: Fourteen male participants (Age: 27 ± 5 yr; BMI: 22.5 ± 2.7 kg m^{-2}; $\dot{V}O_{2\,max}$: 48.7 ± 6.1 mL kg^{-1} min^{-1}) completed two trials in a randomized and counterbalanced crossover design. Two iso-caloric snack bars with different GI values (20, LGI versus 68, HGI) were provided to the participants. Ninety minutes later, all participants completed 45 minutes of ergometer cycling at 65% $\dot{V}O_{2\,max}$. Substrate utilization was measured using indirect calorimetry. *Results*: During exercise, higher fat oxidation and lower carbohydrate (CHO) oxidation were observed in the LGI trial (LGI versus HGI: CHO, 87.3 ± 20.1 versus 99.2 ± 19.0 g, $p < 0.05$; Fat, 15.0 ± 5.8 versus 9.7 ± 7.0 g, $p < 0.05$). *Conclusion*: Compared with an iso-caloric HGI snack bar, pre-exercise LGI snack bar consumption may facilitate a shift of substrate utilization from CHO to fat during subsequent moderate intensity exercise.

Keywords

Carbohydrate oxidation, cycling, fat oxidation, healthy males

History

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Introduction

Energy used to sustain steady state aerobic exercise in humans is derived predominantly from the oxidation of carbohydrate (CHO) and fat (Coyle, 1995). Shifts in substrate utilization from CHO to fat during exercise is important for not only athletes but also general population, especially those aiming to reduce body fat mass. Moderate intensity exercise – usually between 45% and 65% maximal oxygen consumption ($\dot{V}O_{2\,max}$) – has been suggested to be most favorable for eliciting substantial short-term increases in fat oxidation (Achten & Jeukendrup, 2004; Venables et al., 2005) and can be sustained by non-trained individuals. In addition, although exercising in a fasted state has been suggested to maximize fat oxidation (Achten & Jeukendrup, 2004; Bennard & Doucet, 2006), from a practical perspective, people are more likely to consume a small amount of food before exercising than opt to exercise in a fasted state. Furthermore, in the context of physical activity, a moderate or high CHO meal may simply be a more natural choice because it should maintain adequate levels of muscle glycogen for sustained activities (Coyle, 1995).

Glycemic index (GI) was first introduced by Jenkins and his colleagues (Jenkins et al., 1981). In general, low-GI (LGI) (GI $<$ 55) foods were digested and absorbed slowly and high-GI (HGI) (GI $>$ 70) foods were rapidly digested and absorbed, resulting in different glycemic responses (Brouns et al., 2005). The different characters of LGI and HGI foods may induce different physiological responses, which has recently raised the level of interest among sports scientists. Several recent studies suggested that, compared with a HGI CHO meal, pre-exercise LGI CHO meal consumption could increase fat oxidation and decrease CHO oxidation during subsequent moderate intensity exercise (Stevenson et al., 2009; Sun et al., 2012b) and moderate to high intensity exercise (Chen et al., 2008; Stevenson et al., 2006; Wee et al., 2005; Wong et al., 2008; Wu et al., 2003). However, not all the previous studies have supported this contention (Backhouse et al., 2007; Bennard & Doucet, 2006; Moore et al., 2010). In general, although pre-exercise CHO ingestion may suppress fat oxidation during subsequent exercise (Achten & Jeukendrup, 2004; Bennard et al., 2005; Coyle, 1995), LGI CHO foods have been recommended as a suitable source of CHO before exercise for athletes (O'Reilly et al., 2010; Wong et al., 2008) and indeed, for weight management purpose (Brand-Miller et al., 2002).

In a few hours prior to exercise, many people may prefer consuming snacks rather than large size CHO meals. Snack bar is a convenient, portable and portion-controlled fuel source, which makes it attractive to many consumers (Miller et al., 2006). However, to our knowledge, the influence of GI of snack bars ingestion on substrate utilization during subsequent moderate intensity exercise has not been examined. Therefore, the aim of the present study was to investigate the metabolic responses to the ingestion of snack bars with different GI 90 minutes before exercise, and their effect on substrate utilization during subsequent moderate intensity exercise. It was hypothesized that consumption of LGI snack bar could increase fat oxidation and decrease CHO oxidation, compared with the consumption of an iso-caloric HGI snack bar. In addition, recent evidence suggest that the GI of foods may play a key role in appetite control (Arumugam et al., 2008; Pereira et al., 2011), which can regulate *ad lib* foods and total energy intake (Brand-Miller et al., 2002). However, it is still unclear whether this effect can be influenced

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