Appetite 123 (2018) 120–127

Contents lists available at ScienceDirect

Appetite

journal homepage: www.elsevier.com/locate/appet

When exercise does not pay: Counterproductive effects of impending exercise on energy intake among restrained eaters

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ARTICLE INFO

Article history:
Received 22 May 2017
Received in revised form
13 December 2017
Accepted 15 December 2017
Available online 16 December 2017

Keywords:
Dietary restraint
Compensatory health beliefs
Exercise
Energy balance
Meal-planning

ABSTRACT

Evidence suggests people may overestimate the effectiveness of future positive behaviour, leading to counterproductive behaviours in the present. Applied to weight-management, we hypothesize that inaccurate expectations about impending exercise may impede weight management by promoting overconsumption prior to exercise. This study aimed to determine how expectations about impending exercise and its potential ability to expend energy may influence i) energy intake before exercise and ii) overall energy balance (energy intake minus energy expended via exercise). Using a randomised, counterbalanced design, 21 inactive, overweight males, following a baseline session, completed two experimental trials: i) *ad-libitum* snack meal (potato-crisps) followed by an exercise session (SE) and ii) *ad-libitum* snack meal only (SO). There was no main effect of condition (SE vs. SO) on *ad-libitum* snack intake ($p = .917$). However, after accounting for dietary restraint (covariate), a difference in snack intake between SE and SO was revealed ($p = .050$). Specifically, participants who scored higher in dietary restraint consumed more in the SE (vs. SO) session (162 ± 359 kcal more) compared with participants who scored lower in dietary restraint (89 ± 135 kcal less). Among restrained eaters, the relative (net) energy consumed after accounting for energy expended from exercise in SE was not different from the energy consumed in the SO condition, suggesting that energy expended via exercise in SE does not appear to negate extra energy consumed in this condition compared with SO. Of interest, desire to eat and prospective food consumption ratings at the start of the trial were greater ($p \leq .029$) in SE compared with SO. Findings suggest that restrained-eaters are at risk of adopting compensatory eating behaviour that may impede negative energy balance typically resulting from exercise (i.e. expending insufficient energy to negate compensatory energy intake).

1. Introduction

A decline in daily energy expenditure through physical activity, combined with an increased intake of energy dense food have largely been accepted to be the main causes of the rise in obesity levels (WHO., 2011). While there has been some evidence, encouragingly, pointing towards a stabilizing or a slight increase in leisure-time physical activity levels (Dwyer-Lindgren et al., 2013; Ministry of Health, 2010; Knuth & Hallal, 2009; Roehr, 2013), obesity levels have continued to increase (WHO., 2011), suggesting a trend of overconsumption. This decoupling between energy intake and expenditure may be explained, at least in part, by biases or inaccurate assumptions guiding the appraisal of appropriate energy intake and energy expenditure for weight loss and/or maintenance. While it is widely accepted that obesity is a complex and multifaceted issue, the compensatory health belief model (CHB) (Knäuper, Rabiau, Cohen, & Patriciu, 2004; Rabia, Knäuper, & Miquelon, 2006), provides a potential psychological framework that may contribute to explaining why even with increased levels of physical activity, obesity rates have increased. Accordingly, the CHB model proposes that when faced with temptations, individuals tend to form convictions that the negative consequences of present indulgent behaviour (e.g. consuming calorie-dense foods) may be compensated for by engaging in future positive behaviour (e.g. exercising) (Knäuper et al., 2004; Rabia et al., 2006).

There has been evidence showing a trend towards individuals

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https://doi.org/10.1016/j.appet.2017.12.017
0195-6663/

overestimating the amount of progress they would make towards a future goal compared with past or current goal progress, such that individuals generally appear to have an overoptimistic evaluation of the degree of success an impending effort may bring (Coelho, Roefs, Havermans, Salvy, & Jansen, 2011; Fishbach & Dhar, 2005). These inaccurate expectations about future progress, in this case impending exercise, can be counterproductive for weight-loss or weight-maintenance goals if they lead individuals to display obesogenic eating behaviour. For example, a study by Fishbach and Dhar (2005) demonstrated that individuals on the way to exercise indicated a greater intent to consume a heavy, high-caloric meal compared with individuals who have recently completed exercise. Similarly, Coelho et al. (2011) revealed that individuals who ate before exercising were observed to have higher expectations of the efficacy of the impending exercise session towards assisting them to reach their health goals compared with individuals who ate following exercise. This compensatory link between exercise and food intake appears to be evident regardless of whether exercise was expected to be performed or not. Participants that merely thought of their exercise habits and read a brief description of an exercise session were more likely to increase snack consumption compared with a control group (Werle, Wansink, & Payne, 2011).

While the studies mentioned above provide useful preliminary insight into the psychological processes potentially governing the relationship between energy intake and energy expenditure, a number of methodological limitations prevent definitive conclusions to be drawn. For instance, in the study of Fishbach and Dhar (2005), only the influence of impending exercise on intentions to consume calorie-dense meals was assessed and not actual food intake. Of relevance, it has been shown previously that significant differences in intentions did not necessary translate to similar differences in food intake (Webb & Sheeran, 2006). This limitation was addressed by Coelho et al. (2011), who examined the influence of meal and exercise order on actual food intake. However, these authors' findings were contrary to their expectations. That is, they found no differences in energy intake in the test-meal between experimental conditions that involved exercising after eating, exercising before eating and control (no exercise). While this lack of difference in the findings may be due to the moderate sample size employed, a number of limitations of their study warrant a more thorough investigation of the topic. These include: i) employing a between-subject, rather than within-subject design which may have critically prevented the detection of intra-individual differences in eating behaviour ii) not standardizing pre-test meal dietary intake; an important feature in energy intake studies (Blundell et al., 2010; Gregersen et al., 2008) and iii) fixing exercise-intensity and duration for exercise testing since measuring self-regulated exercise would allow for a more ecologically valid investigation.

Crucially, previous research have not accounted for individual differences in attitudes towards eating when assessing study outcomes. One especially relevant variable is dietary restraint (individual's conscious efforts to restrict food intake for weight control – i.e. prevent weight gain and/or weight loss), which has been shown to influence eating behaviour, especially when provided triggers to justify overconsumption (Eldredge, Agras, & Arnow, 1994; Urbszat, Herman, & Polivy, 2002). For instance, individuals with high dietary restraint have been shown to display counter-regulatory eating behaviour (increased consumption) when presented with opportunities to carry out goal-favourable behaviour (e.g. anticipating an upcoming diet or period of calorie restriction which may be favourable for weight-maintenance/loss goals). CHBs have been identified to function as strategies to reconcile conflicts emerging from desires for indulgence and pleasure (e.g., eating unhealthy yet palatable foods) and competing motivations to adhere to broader health goals (e.g., limiting excess caloric intake) (Rabia et al., 2006). As such, restrained-eaters, who maintain active goals to monitor and regulate their caloric intake; (despite underlying desire to eat) may be especially vulnerable to adopting counterproductive CHBs to justify or negate immediate indulgence when confronted with future opportunities for energy expenditure.

Therefore, the main aim of this study was to investigate the influence of impending exercise and the opportunity to expend energy on prior eating behaviour. It is hypothesized that there is a compensatory effect of impending exercise on energy intake, that is, participants will show an increase in appetite and energy intake in anticipation of impending exercise. It is also predicted that this compensatory effect will be especially prominent among those exhibiting dietary restraint, given that restrained eaters may experience especially strong goals to reconcile competing motivations for indulgence and restricting caloric intake. Lastly, it is hypothesized that the predicted increase in appetite and energy intake (as hypothesised above) will result in participants being at a greater risk of being in a state of positive energy balance.

2. Methods

2.1. Participants

Twenty-one overweight and physically inactive men (age: 24 ± 2 y; BMI: 26.7 ± 1.8 kg/m^2; body fat: 24.6 ± 2.5%; VO_{2Peak}: 29.3 ± 3.0 mL/kg/min) from the local community were recruited for the present study. Sample size was based on calculations from previous research (Gregersen et al., 2008) that state a repeated-measures study design requires 17 participants to detect differences in energy intake between ad-libitum meals. Overweight was defined as having a BMI of 23 kg/m^2 and above; evidence suggests an increased risk of weight-related co-morbidities in the Singaporean population at this cut-off index (WHO., 2004). Participants' physical activity levels were assessed using the International Physical Activity Questionnaire (IPAQ – Short Form) (Craig et al., 2003). Physical inactivity was defined as not engaging in moderate intensity exercise for more than 75 min per week – i.e. the lower threshold of the recommended levels of physical activity for an adult (WHO., 2016). Ethical approval was granted by the Institutional Review Board at the National University of Singapore and written consent was obtained from all recruited participants. Participants were naïve to the actual objective of the study and were told instead the study was about examining the relationship between post-meal activities (exercise) and blood pressure. A debrief and an end of study interview (funnel-type) revealed participants did not suspect and were not aware of the true aim of the study. Participants were each compensated $50 for completing the study.

2.2. Experimental design

Participants were required to attend an initial baseline and familiarisation session. Participants were then randomly (counterbalanced) (Urbaniak & Plous, 2011) assigned to either i) an *ad-libitum* snack meal (potato-crisps) followed by exercise (SE) or ii) an *ad-libitum* snack meal only (SO) experimental group.

2.3. Baseline testing and familiarisation

Aerobic fitness (estimated VO_{2Peak}) (corrected for a Singaporean sedentary male population) (Ong et al., 2002) was measured via a continuous maximal graded exercise test (Storer, Davis, & Caiozzo, 1990) performed on a mechanically-braked cycle ergometer (Monark 839E, AB, Vansbro, Sweden). This involved an initial