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The impact of dietary restraint and moderate-intensity exercise on post-exercise energy intake in sedentary males

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ABSTRACT

Exercise is often used for successful weight management, particularly by males. However, exercise may have the potential to promote counter-regulatory eating, because of certain cognitive and psychological factors. The purpose of this study was to investigate the unknown role of dietary restraint, BMI, and dieting status on acute and 12-hour post-exercise energy intake (PE-EI) in sedentary males following moderate-intensity exercise. The study consisted of two experimental conditions, exercise and rest, in a counterbalanced-crossover design on two days. Exercise consisted of walking on a treadmill for 60 min. Acute and 12-hour PE-EI were compared on exercise and rest days. Eighty males, mean age 30±8 years, participated in the study and were categorized by dietary restraint level, BMI, and dieting status. The main effects of condition and group, and the interaction were not significant for acute or 12-hour PE-EI, suggesting that a single bout of moderate-intensity exercise did not influence PE-EI in sedentary males in reference to dietary restraint, BMI, and dieting status. Therefore, moderate-intensity exercise as a prescription for weight loss does not appear to promote counter-regulatory eating in sedentary males.

1. Introduction

According to the most recent data from the National Health and Examination Survey, the prevalence of overweight and obesity among men 20 to 60 years old has increased, to 39.7% and 31.1%, respectively (Ogden et al., 2006). This is of concern as both overweight and obesity are strongly related to an increased risk for several chronic conditions including cardiovascular disease, diabetes, high blood pressure, stroke, asthma, arthritis, certain cancers, and gallbladder disease (Mokdad, Marks, Stroup, & Gerberding, 2004).

The ultimate cause of overweight and obesity is a sustained energy imbalance in which energy intake (EI) exceeds energy expenditure (EE) (Bray & Champagne, 2005). The weight loss literature suggests that "lifestyle modification," or the combination of healthy diet, regular exercise, and behavior therapy is the foundation of obesity treatment (Fabricatore & Wadden, 2003) and successful long-term weight loss maintenance (Phelan, Wyatt, Hill, & Wing, 2006). There have been some studies that have examined the relationship between physical activity and food intake, and a few studies have specifically addressed how individuals respond to exercise in terms of food intake.

A review of the effects of physical activity on food intake (Melzer, Kayser, Saris, & Pichard, 2005) indicates that acute post-exercise energy intake (PE-EI) is weakly coupled with exercise-induced EE. This means that EI does not match EE for some

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individuals and can lead to one of two scenarios. An increase in EE due to physical activity without a corresponding increase in EI could facilitate a negative energy balance (Stubbs et al., 2002), which has beneficial implications for the role of physical activity in managing body weight. On the other hand, a decrease in physical activity resulting in a reduced EE, without a corresponding decrease in EI may lead to a positive energy balance and, ultimately, weight gain (Stubbs et al., 2004).

One of the few studies that examined PE-EI in overweight males (athletes) reported a weak coupling, or under-compensation, of EI in relation to EE when moderate-intensity exercise was followed by a low fat diet manipulation (Dionne, Johnson, White, St-Pierre, & Tremblay, 1997). In this study of six young males (mean age ~23 years), 60 min of treadmill exercise was followed by a low fat diet, and 60 min of rest was followed by a mixed diet in a crossover design. Exercise or rest sessions concluded with a 24-hour stay in a whole body indirect calorimeter, during which time the study meals and snacks were provided. Results indicated that although the confined testing environment promoted overfeeding, fat and energy balance were significantly lower after the exercise–low fat diet condition than after the rest–mixed diet condition, demonstrating that exercise and a low fat diet can facilitate a substantial energy deficit and consequently, promote successful weight management.

Studies of normal weight individuals have had varying results with regard to PE-EI. Some reports have indicated that exercise-induced EE is compensated in the short term by a corresponding increase in EI among normal weight, physically active males (Verger, Lanteaume, & Louis-Sylvestre, 1994) and among normal weight, physically active males and females (Verger, Lanteaume, & Louis-Sylvestre, 1992). In contrast, it was recently demonstrated that relative EI was reduced following a single bout of moderate-intensity cycling exercise, facilitating a short term negative energy balance among normal weight males and females (Martins, Morgan, Bloom, & Robertson, 2007).

The results of some studies suggest that weight status may be a factor that influences PE-EI. Compared to their lean counterparts, it has been reported that overweight individuals are less likely to increase EI in response to an increase in EE due to physical activity (Melzer et al., 2005). However, the results of a recent study of overweight and obese sedentary males and females demonstrated considerable individual variability in weight change following a 12-week program of moderate- to high-intensity exercise, suggesting that some overweight and obese individuals who experience lower than expected weight loss do increase EI to compensate for the increase in EE (King, Hopkins, Caudwell, Stubbs, & Blundell, 2007).

The results of other studies suggest that among lean, healthy males, the intensity and/or duration of exercise may be factors that influence PE-EI. In one report (King, Burley, & Blundell, 1994), participants were randomly assigned to either a resting control, low intensity, or high intensity exercise condition in the first study; and assigned to a resting control, short duration exercise, or long duration exercise (both high intensity) condition in the second study. Each condition was followed by an *ad libitum* test meal. Results indicated that absolute EI was not different among treatment conditions, indicating that the varying exercise protocols did not influence absolute PE-EI among lean, healthy males. Other studies have demonstrated that continuous, sub-maximal exercise for 2 h in lean, active males resulted in a higher PE-EI after exercise than after rest (Verger et al., 1992, 1994). However, the effect of exercise on PE-EI may be dose-dependent. In another study, treadmill running for 50 min twice in one day in lean, active males had no effect on absolute PE-EI on the same day or the day after (King, Lluch, Stubbs, & Blundell, 1997).

It has been proposed that one reason for the discrepancy in the findings among studies may be that physical activity acts as a *disinhibitor* in some adults (Hill, Melby, Johnson, & Peters, 1995). In other words, a bout of exercise or physical activity may lead some individuals to relinquish control over food intake, resulting in overeating. The term disinhibition is often used in relation to *dietary restraint*, which has been defined as the deliberate, conscious control over food intake in order to lose body weight or prevent weight gain (King, 1999). It has been suggested that factors such as current dieting status (Hill et al., 1995) may also influence an individual's PE-EI. For example, it may be that some restrained, overweight individuals alternate between periods of restraint and disinhibition, and maintain or decrease PE-EI based on current dieting status (Hill et al., 1995). Therefore, some individuals may be unable to successfully manage their body weight due to certain psychological and cognitive factors that trigger them to overeat after participating in exercise. If this is true, it would mean that these individuals may not be able to use exercise effectively as a weight management tool without understanding their behavioral response to exercise.

While the relationship between physical activity, psychological and cognitive factors, dieting status, and PE-EI has been studied to some extent in women (Visona & George, 2002; George & Morganstein, 2003), less is known about how these factors influence PE-EI in males. This is a particularly relevant topic with regard to males in that it has been reported that males are more likely to use physical activity specifically for weight control than females (Weiss, Galuska, Khan, & Serdula, 2006). In order to understand more about these issues a study was designed to investigate the relationship between weight status, dietary restraint, and dieting status on PE-EI acutely (lunch) and during the 12 h following exercise in sedentary males. The following differences in PE-EI between exercise and resting conditions among the groups were hypothesized: a) overweight males with high restraint and categorized as dieting would become disinhibited by exercise and would, therefore, have a significantly greater PE-EI than those with high or low restraint who were not dieting at the time of the study; and b) normal weight males with low restraint would have a significantly higher PE-EI than normal weight males with high restraint.

2. Methods

2.1. Participants

Participants were recruited from the student, faculty and staff population at a large, urban university in South Florida. Announcements for recruitment were sent out through flyers and e-mail messages explaining that participants were needed for an