The effects of physical activity on energy intake

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Abstract

Energy balance is determined by energy intake and energy expenditure. Physical activity is the major component of energy expenditure while food intake is the main component of energy intake. Based on this theory, promoting physical activity might be considered as one of the best strategy for weight control. However, it has been questioned if physical activity would induce appetite and further increase energy intake to compensate the energy expended in physical activities. This article discussed the effect of different types and lengths of physical activity on energy intake based on previous evidences.

Key words: *physical activity, energy compensation, energy balance*

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摘要

人類身體的能量主要取決於能量消耗和能量攝取之間的平衡。身體運動是能量消耗的主要管道；而飲食則是能量攝取的主要來源。根據這樣的理論，提倡身體運動將可視為有效控制健康體重的最佳策略之一。然而，許多研究者認為增加身體運動量的同時也會促進食慾的發展以補償運動時所消耗的能量，進而增加食物的攝取。本文將根據現今的文獻資料，探討不同型式的運動項目，以及短期或長期運動後對能量攝取的影響。

關鍵字：*身體運動，能量補償，能量平衡*

Introduction

Obesity has been considered as the most important public health issue around the world. In past three decades, the prevalence of obesity in the Unites States has increased dramatically in both children and adults. In 1976-1980, 15% of American age 20 to 74 was obese; however, the prevalence has more than doubled to 32.9% in 2003-2004. The increased prevalence of overweight in children and adolescents was even worse, particularly in children age 6 to 11 years old, from 6.5% in 1976-1980 to 18.8% in 2003-2004 (Ogden, Carroll, Curtin, McDowell, Tabak, & Flegal, 2006). Thus, this epidemic issue increases the awareness of health professionals and governmental health organizations to conduct strategies to improve the weight status.

As it is the time of great interest of the regulation of energy balance and weight control, the interaction of energy expenditure (i.e. physical activity) and energy intake (i.e. food intake) can not be ignored. Decreasing physical activity or increasing energy intake results a positive energy balance, which lead to weight gain, while increasing physical activity or decreasing energy intake leads to weight loss. It seems like no doubt to promote physical activity as an effective strategy to lose or maintain healthy weight. However, it has been argued that the post-exercise compensatory of energy intake might make the expected negative energy balance smaller. Although the relationship of physical activity and energy intake has been studied widely, the findings are not elusive. In most of the studies, the intervention of physical activity was only last for a short period of time, which might explain the absence of the post-exercise energy compensation (Maraki, Tsofliou, Pitsiladis, Malkova, Mutrie, & Higgins, 2005; Moore, Dodd, Welsman, & Armstrong, 2004; Pomerleau, Imbeault, Parker, & Doucet, 2004). Longer term of physical activity interventions following the relative long-term observations on energy intake patterns might show different results. However, the influence of energy intake is not clear whether it is the actual influence or it is due to the established habitual behaviors. Thus, the purpose of this article is to discuss the effect of the length of physical activity session on energy intake.

Findings from different length of the physical activity interventional studies were various. We discussed both short-term (<10 days) and long-term (>2 weeks) physical activity studies as follows:

Short-term physical activity on energy intake

Moore, Dodd, Welsman, and Armstrong (2004) examined the effects of different intensities of physical activity: sedentary, low-intensity (50% of peak oxygen uptake), and high-intensity (75% of peak oxygen uptake) on the same day post-exercise energy intake and hunger feelings in lean girls age 9-10. They found that the significantly less “relative” energy consumption at lunch after both exercise sessions than in sedentary condition (the “relative” energy consumption was defined as the energy intake corrected for the energy expended

during exercise above the resting level). However, the energy intake of dinner was not significantly different across three conditions. Some similar studies conducted in young women have similar results on post-exercise energy intake. Pomerleau, Imbeault, Parker, and Doucet (2004) observed the negative energy compensation after both low- and high-intensity physical activity sessions while the actual energy intake following high-intensity physical activity was increased. Maraki, Tsofliou, Pitsiladis, Malkova, Mutrie, and Higgins (2005) showed a negative relative energy intake in women of exercise groups as well. Subjects reported their increased appetite sensations after the exercise session with no actual alteration of post-exercise energy intake. These studies indicated that no acute energy compensation found in post-exercise meals on the same day regardless of the intensity of physical activity.

Studies discussed above were all between-subject study design. To avoid the influence of individual difference, Stubbs and his colleagues conducted two within-subject repeated studies in young women and men with healthy weight. All of the subjects were assigned to all three graded levels of exercise protocols: no-exercise, medium- (1.6-1.9 MJ/day) and high- (3.2-3.4 MJ/day) level of exercise for 7-9 days. The results showed that men did not alter their total energy intake and dietary patters while women partially compensated in energy intake (Stubbs, Sepp, Hughes, Johnstone, Horgan, King, & Blundell, 2002a; Stubbs, Sepp, Hughes, Johnstone, King, Horgan, & Blundell, 2002b). However, these two studies only targeted to lean or normal weight population, it would be necessary to understand if overweight or obese people have the same effect on post-exercise energy intake. An old study recruited both lean and obese young women and men to examine the effect of physical activity on energy intake (Durrant, Royston, & Wloch, 1982). Subjects increased their energy expenditure by cycling, expending 100kcal/day for three days in a total six-day study period. On exercise days, obese subjects ate less and lean subjects ate more than they ate on non-exercise days. In terms of energy balance, lean subjects over-compensated and obese subjects under-compensated in energy intake. But the relative energy intake did not significantly differ on exercise days comparing to non-exercise days in both groups. Interestingly, all subjects in this study ate more frequent on exercise days than on non-exercise days. It might indicate that slight increase in voluntary exercise was not a good strategy to lose weight. However, the physical ability should be taken into account. It might be difficult to increase a relative high amount of physical activity for obese people particularly. A small sample size or a large dropout rate might be expected due to their inability to complete the designed energy expenditure session.

Long-term physical activity on energy intake

Due to the questionable effect of short-term physical activity, some other studies used long-term (more than 10 days) exercise protocols to investigate the effect of physical activity on energy intake. Andersson, Xu, Rebuffe-Scrive, Terning, Krotkiewski, and Bjorntorp (1991) recruited obese men and women in three-month physical training program. After three-month

program, both men and women lost weight about two kilograms (kg) with decreased 2.6-2.9 kg body fat. The expected exercise-induced energy intake was absence and most obese women even decreased their energy intake during the study period. Van Etten, Westerterp, Verstappen, Boon, and Saris (1997) showed the similar results for lean subjects who participated in the 18-wk weight-training program. No significant difference was found in energy intake at week 0, 8 and 18. Broeder, Burrhus, Svanevik, and Wilmore (1992) found a small decrease in energy intake after high-intensity resistance- and endurance training in young lean college students. But no significant difference in post-exercise energy intake was observed in either training group comparing to control group.

Conclusions

Although post-exercise energy intake was thought to compensate the energy expended during exercise, previous studies showed no difference in energy intake regardless of the intensity of the physical activity as well as the length of the training program in children and adults. After the training, lean people tended to regulate the energy balance more accurate, while obese people tended to decrease energy intake. However, the scientific evidences did not show significant difference on post-exercise energy intake between lean and obese people. Types of physical activity seemed not alter the results, whereas the duration of physical activity protocol might make slightly different in energy compensation. People followed long-term training, more than 10 days, tended to compensate more energy intake comparing to those only followed a short period of training, same day or less than 10 days.

In summary, the interaction between physical activity and energy intake needs to be further investigated in order to understand how these two factors influence the weight status more clearly. Based on previous findings, it seems like physical activity does not induce energy intake significantly in young adult populations. However, the proper length of the physical activity program and the valid measurements of physical activity and energy intake were inconsistent. In addition, the types, intensity and the length of physical activities should be specific to different populations, particularly for overweight or obese subjects. Current scientific studies limited to young adult population only. Future studies should consist the measurements of physical activity and energy intake. More longitudinal studies targeting to children and adolescents are necessary as well.

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