Individual Differences in Post-exercise *Ad Libitum* Energy Intake in Children

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Previous studies have shown individual differences in the energy intake (EI) response to exercise, but homeostatic or cognitive mechanisms underlying these differences are unclear, particularly in youth. Fat-free mass is a known predictor of daily EI in adolescents and adults, predominantly through its effects on resting metabolic rate and total energy expenditure. However, there may be cognitive factors that contribute to additional variability in EI. Studies in adults have shown that increased perceived difficulty of exercise is associated with caloric compensation. In particular, greater perceived difficulty of exercise has been shown to predict weight regain after successful weight loss. This is assumed to be related to greater EI, but has not been fully tested. In addition, the influence of these biological and psychological factors on post-exercise EI in children is unknown.

PURPOSE: To examine the homeostatic and cognitive predictors of post-exercise EI in a pilot study of children at risk for becoming overweight.

METHODS: We enrolled 20 children ages 9-12 years who were healthy-weight (< 85th BMI percentile) with at least one overweight or obese biological parent (BMI > 25 kg/m^2). Participants reported to the laboratory for 1 baseline and 2 experimental visits (EX = exercise, SED = sedentary). The experimental visits were separated by 1 week in a within-subjects design where the order of conditions was randomized. Percent body fat (bioelectrical impedance analysis), weight (kg), and height (m) were used to calculate fat-mass index (FMI) and fat-free mass index (FFMI; kg/m^2). Baseline fitness was measured with a submaximal graded cycle ergometer test. On the EX day, children exercised at 70% estimated VO_{2max} for 30 minutes on a cycle ergometer and gave ratings of perceived exertion (RPE) on the Borg Scale. Objective EI (kcal) was measured at identical meals on the EX and SED days: standard breakfast and *ad libitum* lunch, snack, and dinner. Paired *t*-tests, Pearson's correlations, and multiple linear regressions were performed using SPSS to compare differences in EI between the two days and examine whether body composition or RPE predicted individual variability in EI.

RESULTS: Total EI was not statistically different between the EX and SED days ($p > 0.05$). However, FFMI was positively associated with EI on the EX day ($r = 0.53$, $p = 0.02$), but not the SED day ($p > 0.05$). RPE was also positively associated with EI on the EX day ($r = 0.82$, $p < 0.001$) (**Figure 1**). This finding was not explained by children's baseline fitness level, activity-related energy expenditure, or cardiovascular responses to the exercise test. Together, FFMI and RPE explained 77% of the variability in EI on the EX day ($F_{(2,17)} = 26.4$, $p < 0.001$) (**Table 1**). For each unit increase in perceived difficulty of exercise on the RPE scale, children's EX Day EI increased by approximately 270 kcal.

Figure 1. Correlation between ratings of perceived exertion (RPE) and energy intake (EI) on the Exercise (EX) Day; $r = 0.82$, $p < 0.001$.

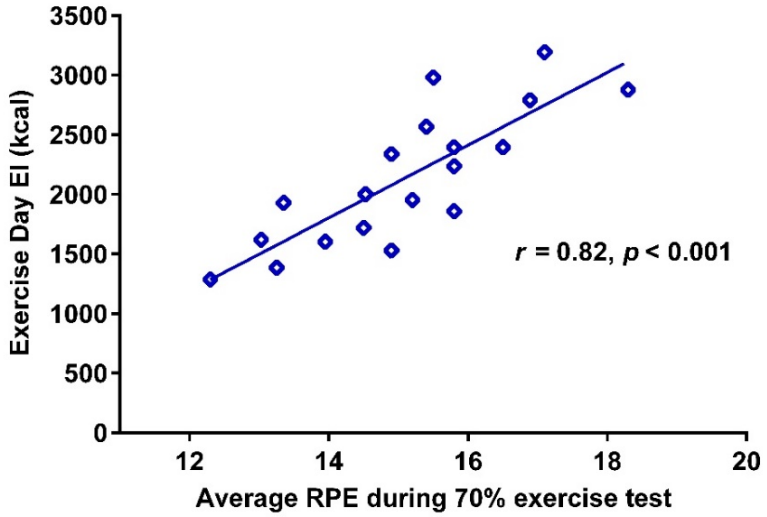

Table 1. Linear regression prediction of energy intake (EI) on the Exercise (EX) Day, using ratings of perceived exertion (RPE) and fat-free mass index (FFMI); $F_{(2,17)} = 26.4$, $p < 0.001$, $R^2 = 0.77$.

Model	Beta	Std. Error	*t*	Sig.
(Constant)	-3648.2	828.5.0	-4.4	0.001
RPE	271.1	46.7	5.8	0.001
FFMI (kg/m^2)	118.3	47.8	2.5	0.025

CONCLUSION: These findings demonstrate a role for both homeostatic and cognitive factors in post-exercise EI regulation in children. Fat-free mass was associated with EI on the EX day but not the SED day, suggesting better homeostatic regulation of EI with imposed exercise. Fat-free mass may exert its effects on EI through its influence on total energy expenditure, as seen in adolescents and adults. Energy intake and expenditure have previously been shown to have a stronger linear association at higher levels of energy expenditure. While EI is generally under good homeostatic control in healthy populations, cognitive factors can also influence eating behavior. Despite experiencing the same 70% relative exercise intensity, children varied in their perceived difficulty of the exercise. Increased perceived difficulty predicted greater *ad libitum* EI on the EX day. These findings suggest that greater perceived difficulty of exercise may result in overcompensation for the energy expended through greater EI at subsequent meals, at least in the short term. Fat-free mass and perceived exertion represent individual-level factors that may contribute to differences in post-exercise EI and eating behavior. These preliminary findings may be useful in future intervention research looking to incorporate exercise. Reducing perceived exertion could be one strategy to manage EI in children who are at risk for becoming overweight.
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