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Bidirectional Associations Between Physical Activity and Adiposity From Childhood to Early Adulthood

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Objective Inverse association between physical activity and adiposity in children and adolescents have been documented in numerous studies. However, few studies have examined the direction of causation between these two variables. We aimed to examine the prospective bidirectional associations between physical activity and adiposity from childhood to early adulthood.

Methods A total of 396 girls (mean age, 11.2 years at baseline) participated in a longitudinal study with 1, 2, 4, and 7 year follow-ups. Body height and weight were measured, body composition was assessed by DXA and BMI and fat mass index (FMI) were calculated. Leisure-time physical activity (LTPA) and physical inactivity was obtained from questionnaire and physical activity score and inactivity time was calculated. A bivariate cross-lagged panel model was used to estimate the bidirectional associations between physical activity and measures of adiposity across follow-up waves.

We further examined whether persistently high or persistently low physical activity or change of physical activity level from low to high and high to low during pubertal years had differential effects on adiposity. For this, the study participants were first divided into two groups according to the median values of their LTPA scores at baseline and at the 7 year follow-up visit. Then four activity groups were formed: consistently high (CH), consistently low (CL), change from high to low (HL), and change from low to high (LH). Analysis of variance (ANOVA) with least significant difference post hoc test was used to compare differences in adiposity between the LTPA groups.

Results BMI at each measurement wave strongly predicted subsequent BMI (standardized path coefficients ranged from 0.87 to 0.95, $p < 0.001$ for all). Similar pattern was observed for LTPA and physical inactivity, though the path coefficients tended to be notably smaller. This auto-regressive part of the model indicates that the temporal stability of BMI from childhood to early adulthood is higher than the temporal stability of LTPA or physical inactivity over the same time period.

The cross-lagged effects indicated that higher BMI at baseline and at 4-year follow-up predicted lower LTPA at 2-year and 7-year follow-ups, respectively ($p < 0.05$ for both), but LTPA did not predict subsequent BMI at any time point. Similarly, higher FMI at baseline and at 2-year follow-up predicted lower LTPA at subsequent follow-up waves ($p < 0.05$ for both). No associations were found between sedentary time and adiposity between any time points.

The difference in participation in LTPA between consistently high and consistently low PA groups were on average 4 hours per week ($p < 0.001$); however, no significant difference in FMI was found at baseline, 2-year or 7-year follow-up). Similarly, no significant difference in FMI was found between the groups whose LTPA level changed from high to low or from low to high.

Conclusions Our results suggest that reduced physical activity in children and adolescents is the result of increased fatness rather than its cause. Current physical activity recommendations may not be sufficient to combat pediatric obesity.