

The Association between Change in Physical Activity and Weight during Adolescence

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Abstract

Objective: To investigate the association between annual change in physical activity and subsequent annual change in weight status in adolescents over a 4 year period.

Design: Longitudinal study design with annual data collection over 4 years. Setting: Suburban school district in Pittsburgh, PA. Participants: 1245 adolescents aged 11-16 years. Main outcome measures: Physical activity and body mass index (BMI) percentile. Analysis: Generalized estimating equation (GEE).

Results: 994 participants (53% male) were included in the analyses. The longitudinal associations between changes in physical activity and BMI% were mostly small and non-significant. However, compared with those who did not change their physical activity, a large annual increase in physical activity (>10 hr/wk) was associated with a significant increase in BMI%. Results were broadly similar for total and vigorous physical activity, boys and girls and for healthy and unhealthy (>85th percentile) BMI%.

Conclusions and Implications: The role of physical activity in the development of obesity during adolescence therefore remains unclear. Further work is needed to elucidate the role of physical activity in the prevention of obesity.

Keywords: Adolescents; Longitudinal survey; Physical activity; Obesity; GEE

In 2014, the National Health and Nutrition Examination Survey (NHANES) reported that 34.5% of adolescents aged 12-19 years were overweight or obese [1]. Obese adolescents are at high risk for many medical complications [2] that were previously found primarily among adults including hypertension [3], hyperlipidemia [4], diabetes [4,5] and sleep apnea [6]. Obesity throughout adolescence may also have detrimental psychosocial consequences such as exposure to teasing or ridicule about weight issues [2,7].

Factors which are associated with the increase of childhood and adolescent obesity include parental weight status, birth weight, poor diet and a lack of physical activity [2,8]. Engaging in physical activity has been associated with health benefits in children and adolescents including improved overall weight control [9-11] and psychological [12] and general well-being [13].

The identification of mechanisms that may attenuate the progression of abnormal weight gain throughout adolescence is needed to move both individual and population based interventions forward [2]. One such mechanism is the association between changes in physical activity and changes in weight status throughout adolescence.

A recent systematic review concluded that physical activity during adolescence is protective against obesity; however, this conclusion was based mainly on cross sectional studies as a very limited number of longitudinal studies have been conducted [14]. Of these, some were able to show significant evidence that declines in physical activity during adolescence were associated with increases in body weight [15-18].

The evidence is not significant



Figure 1: BMI percentile by Study Year.



Figure 2: Change in BMI percentile by Study Year.

Characteristics	Total	Boys		Girls	
		Percentage (%)			
Gender					
Boys	52.8				
Girls	47.2				
Race					
Caucasian	77.9	78.5		77.2	
African American	22.1	21.5		22.8	
SES					
Low	17.7	30.7		26.4	
Middle	53.6	51.8		55.7	
High	28.7	17.5		17.9	
Percent Overweight*	10.3	14.1		18.8	
Percent At Risk for Overweight*	16.3	12.4		7.9	
		Mean (SD)		Mean (SD)	
Age (years)	13.5 (1.0)	13.6 (1.0)		13.5 (1.0)	
Height (cm)	160.7 (8.9)	163.4 (9.7)		157.7 (6.5)	
Weight (kg)	57.5 (13.7)	59.0 (14.7)		55.8 (12.2)	
BMI (kg/m ²)	21.4 (4.2)	21.2 (4.2)		21.6 (4.3)	
BMI percent (%)	61.4 (27.6)	59.5 (29.0)		63.5 (25.9)	
		Median (IQR)		Median (IQR)	
Physical Activity (hrs/wk) *	13.3 (5.3, 27.2)	23.1 (12.1, 37.5)		6.9 (3.1, 13.6)	
Vigorous Physical Activity (hrs/wk) *	7.0 (2.3, 16.4)	12.5 (5.3, 23.6)		3.1 (0.8, 7.8)	

	1989 to 1990			1990 to 1991			1991 to 1992		
	T	B	G	T	B	G	T	B	G
Physical Activity									
Large decrease (10 h/wk)	24.6	35.5	12.7	21.9	27.8	15.2	17.9	D.17.9	

Small increase (2-4.99 h/wk)	0.9	-0.6,2.4	-0.8	-3.5,2.0	1.8	-0.1,3.6	0.7	-1.1,2.6	0.8	-1.9,3.5
Moderate increase (5-9.99 h/wk)	0.5	-1.1,2.0	0.4	-1.8,2.5	0.3	-2.0,2.6	0.2	-1.9,2.3	0.9	-0.9,2.7
Large increase (10h/wk)	3.1**	1.5,4.7	2.6*	0.5,4.7	3.3*	0.7,5.8	3.6**	1.6,5.7	1.4	-0.4,3.3

obs = number of observations, as each individual had one or more observations

Healthy weight defined as 5-85th BMI percentile; Unhealthy weight >85th BMI percentile All analyses adjusted for age, sex, and BMI percentile at baseline year.

*p<0.01; **p<0.001

change in daily caloric consumption. Third, changes in time spent

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