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Physical Inactivity, but not Sedentary Behavior or Energy Intake, Is Associated with Higher Fat Mass in Latina and African American Girls

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Abstract

Background—Minority girls are disproportionately affected by overweight and obesity. The independent effects of physical activity (PA), sedentary behavior (SB), and diet are not well understood.

Objective—This study examined the individual influences of PA, SB and diet on fat mass in Latina and African American (AA) girls, aged 8–11.

Methods—Baseline data from a longitudinal cohort study in minority girls is presented. Multiple linear regression analysis assessed the effects of PA, SB, and energy intake on fat mass, adjusting for lean mass, age, Tanner stage and ethnicity.

Results—Participants were 53 Latina and AA girls (77% Latina; M_{age}=9.8 ± .9; $M_{BMI\%}$=80.8 ± 23.1). Moderate-to-vigorous physical activity (MVPA) by accelerometry (β= −.13, *P*<.01) and lean mass(β=.69, *P*<.001) were associated with fat mass (Model R^2=.63; *P*<.0001). MVPA by 3-day-physical-activity-recall (β=−.04, *P*=.01) and lean mass (β=.75, *P*<.001) were associated with fat mass (Model R^2=.61; *P*<.0001). SB and energy intake were not associated with fat mass in any model.

Conclusion—Using both objective and subjective measures of PA, MVPA, but not SB or diet, was associated with higher fat mass in Latina and AA girls, independent of lean mass, age, Tanner stage, and ethnicity. Prospective studies are needed to clarify the differential impact of diet and activity levels on adiposity in this population. (*Ethn Dis.* 2011;21(4):458–461)

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Keywords

Physical Activity; Overweight; Obesity; Latina; African American; Girls

Introduction

Latino and African American girls are disproportionately affected by overweight and obesity.[1] In 2007–2008, 40.5% of Latino and 43.3% of African American girls aged 2–19 years were overweight (BMI percentile ≥85th percentile for age and sex), compared to 31.6% of non-Hispanic White girls.[1] The increasing rates of overweight closely parallel increasing rates of type 2 diabetes and other metabolic risk factors among Latinos[2] and African Americans.[3]

Lifestyles characterized by physical inactivity and an abundant availability of energy dense foods are related to obesity.[4] However, findings examining associations of dietary intake and physical activity patterns with obesity in children have been inconsistent.[5–7] This may indicate that most studies have not investigated diet and physical activity simultaneously. Additionally, the majority of studies have not measured both physical activity and sedentary behavior, which have been shown to have independent effects on weight status.[8] Lastly, most studies have relied on less precise and subjective measures of diet, activity levels, and/or adiposity. Therefore, this study examined the independent influences of physical activity, sedentary behavior, and diet on fat mass, using state-of-the-art measures, in an understudied population of Latina and African American girls.

Methods

Participants

Baseline data from the Transitions Study, a longitudinal cohort study investigating the pubertal decline in physical activity, were employed for the current study. Participants were 74 Latina and African American females, ages 8–11 years, in Tanner stage 1 or 2. Of the 74 participants, 53 had complete data on all variables of interest; only these participants make up the study sample. There were no significant differences in age, Tanner, ethnicity, or body fat between participants with complete and incomplete data. Informed written consent from parents and assent from the children were obtained. This study was approved by the Institutional Review Board of the University of Southern California.

Measures

Ethnicity, Tanner Stage and Weight Status—Ethnicity was based on self-identification of participant, both parents and all four grandparents as either Latino (Mexican and Central American) or African American. Pubertal Tanner stage was based on breast stage following physical examination by a licensed physician assistant during a clinical screening visit.[9] Fat mass and lean mass were measured by air displacement plethysmography (BodPod™; Life Measurement Instruments, Concord, CA).

Physical Activity and Sedentary Behavior—Physical activity and sedentary behavior were assessed objectively (uniaxial Actigraph GT1M accelerometer) and subjectively (3-Day Physical Activity Recall; 3DPAR). Only participants who wore the accelerometer for at least four 10-hour days were included in these analyses. The monitor collected data in 15-second epochs. Data were then summed into 60-second epochs for use with the current publicly-available NHANES processing code. This study used mean minutes per day of moderate (4 METs) and vigorous (7 METs) physical activity (MVPA) and sedentary behavior. The MVPA thresholds were age-adjusted[10] and the sedentary threshold was set at 100 counts per minute.[11]

A modified 3PDAR assessed subjective physical activity and sedentary behavior.[12,13] Participants identified different activities to describe their daily activity in half-hour intervals from 0700h to 2400h for two weekdays and one weekend day. They rated the intensity level for each activity as light, moderate, hard, or very hard. Activity types were converted into half-hour blocks of either light, moderate, or vigorous physical activity using a combination of the intensity ratings and the compendium of physical activities.[14] Minutes per day spent in MVPA (at an intensity of ≥4 METs) was created to complement the variable extracted from the accelerometer measure. Leisure-time sedentary behaviors were coded as the half-hour blocks spent watching television/movies, playing video games/ surfing the internet, and talking on phone. Daily total time spent in MVPA and sedentary behaviors were obtained by summing the half-hour blocks over each day. Mean minutes per day spent in MVPA and leisure-time sedentary behavior were obtained by averaging total minutes in either activity level across three days.

Dietary Intake—Participants were provided three-day diet records to complete for two weekdays and one weekend day.[15] Participants were trained on how to estimate portion sizes and given measuring cups and rulers to aid in accurate reporting. Research staff, trained and supervised by a registered dietitian, clarified all dietary records. Nutrition data were analyzed using the Nutrition Data System for Research (NDS-R version 5.0_35), a software program developed by the University of Minnesota.

Statistical Analysis

Means and frequencies were used to present the descriptive statistics of the sample. Baseline characteristics were compared between Tanner stage groups using independent *t* tests. Multiple linear regression models were specified to examine the independent effects of physical activity, sedentary behavior, and diet on fat mass, controlling for ethnicity, age, and Tanner stage. All statistical analyses were performed with SAS v.9.2 software (Cary, NC). Statistical significance was set at .05.

Results

Table 1 provides demographic characteristics of the participants included in the study. Participants were 53 Latina and African American girls (77.4% Latina; mean age= 9.4 ± .9; mean BMI percentile =80.8 ± 23.1). Approximately half (49%) of the sample was in Tanner stage 1. Participants in Tanner stage 2 were more likely to have higher percent body fat, fat mass, lean mass, and spend more time in sedentary behavior (based on accelerometry data) than those in Tanner stage 1.

Table 2 shows the results of the multiple linear regression analyses using objective (accelerometry) and subjective (3DPAR) measures of physical activity and sedentary behavior. Tanner stage, age, ethnicity, total energy intake, and sedentary behavior were not associated with fat mass in either model. Higher levels of lean tissue were predictive of higher fat mass in both models. Lower levels of MVPA measured by accelerometry and 3DPAR were associated with higher fat mass in both models. The strength of the relationship indicates that for every one-minute increase of MVPA, body fat is reduced by .13 kg as measured by accelerometry and .04 kg as measured by 3DPAR.

Discussion and Conclusion

This study investigated the independent influences of physical activity, sedentary behavior, and diet on fat mass in peri-pubertal Latino and African American girls. This study found that lean mass and MVPA were the only correlates of adiposity in Latino and African American girls, after accounting for Tanner stage, age, ethnicity, total energy intake, and sedentary behavior. The strong inverse physiological relationship between fat and lean mass is mirrored in these findings. A closer look at these findings shows that a 30-minute increase in MVPA, measured objectively, would be related to a 3.9 kg decrease in fat mass, or a 1.2 kg decrease in fat mass measured subjectively. These findings replicate those of previous research, however in a novel population. In a predominately White sample, aged 10–18 years, MVPA was inversely associated with fat mass, independent of energy intake and sedentary behavior.[16] Lower levels of vigorous physical activity were the only risk factors for boys being overweight, regardless of energy intake and time spent in sedentary behavior[17] in a multi-ethnic sample of adolescents aged 11–15. These findings support the hypothesis that increasing MVPA is beneficial in decreasing adiposity in children.

This study also found that girls in Tanner stage 2 had higher levels of body fat and spent more time in sedentary behavior. Previous research demonstrates a pubertal decline in physical activity, particularly among African American and Latina girls.[18,19] To our knowledge, this is the first study to document higher levels of sedentary behavior in early-pubertal versus pre-pubertal minority girls.

A limitation of this study is that it is cross-sectional, therefore the true direction of the associations could not be determined. It is possible that higher fat mass may lead to inactivity.[20] Second, the relatively small sample size of the study population might have missed potentially important relationships between Tanner stages. Third, the predominantly Latino sample may prevent generalizing the findings to other children who belong to different sex, age, or ethnic groups. However, the fact that these findings have been illustrated in samples of males and other ethnicities, suggests that these findings may be generalizable to other US pediatric populations. A major strength of this study is the use of extremely strong measurement technologies. Body composition was objectively measured, rather than relying on body mass index as an indicator of adiposity. Additionally, physical activity and sedentary behavior were measured using both objective and subjective measures, and dietary intake was assessed with 3-day dietary records rather than food frequency questionnaires.

The findings from this study add to the current literature by extending previous findings to a novel population at highest risk for obesity and related disorders. It also highlights the important role that activity levels may play in the development of adiposity, regardless of energy intake. This may have implications for future interventions, and suggests that minority children may benefit more from strategies that target increasing physical activity, rather than decreasing sedentary behavior or changing diet.

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References

1. Ogden CL, Carroll MD, Curtin LR, Lamb MM, Flegal KM. Prevalence of high body mass index in US children and adolescents, 2007–2008. JAMA. Jan 20; 2010 303(3):242–249. [PubMed: 20071470]

2. Goran MI, Lane C, Toledo-Corral C, Weigensberg MJ. Persistence of pre-diabetes in overweight and obese Hispanic children: association with progressive insulin resistance, poor beta-cell function, and increasing visceral fat. Diabetes. Nov; 2008 57(11):3007–3012. [PubMed: 18678615]
3. Nwobu CO, Johnson CC. Targeting obesity to reduce the risk for type 2 diabetes and other co-morbidities in African American youth: a review of the literature and recommendations for prevention. Diab Vasc Dis Res. Dec; 2007 4(4):311–319. [PubMed: 18158701]
4. Weinsier RL, Hunter GR, Heini AF, Goran MI, Sell SM. The etiology of obesity: relative contribution of metabolic factors, diet, and physical activity. Am J Med. 1998; 105(2):145–150. [PubMed: 9727822]
5. Goran MI. Measurement issues related to studies of childhood obesity: assessment of body composition, body fat distribution, physical activity, and food intake. Pediatrics. 1998; 101(3 Pt 2): 505–518. [PubMed: 12224657]
6. Lichtenstein AH, Kennedy E, Barrier P, et al. Dietary fat consumption and health. Nutr Rev. 1998; 56(5 Pt 2):S3–19. discussion S19–28. [PubMed: 9624878]
7. Wareham NJ, van Sluijs EM, Ekelund U. Physical activity and obesity prevention: a review of the current evidence. Proc Nutr Soc. 2005; 64(2):229–247. [PubMed: 15960868]
8. te Velde SJ, De Bourdeaudhuij I, Thorsdottir I, et al. Patterns in sedentary and exercise behaviors and associations with overweight in 9–14-year-old boys and girls–a cross-sectional study. BMC Public Health. 2007; 7:16. [PubMed: 17266745]
9. Marshall WA, Tanner JM. Variations in pattern of pubertal changes in girls. Arch Dis Child. 1969; 44(235):291–303. [PubMed: 5785179]
10. Trost SG, Pate RR, Sallis JF, et al. Age and gender differences in objectively measured physical activity in youth. Med Sci Sports Exerc. 2002; 34(2):350–355. [PubMed: 11828247]
11. Matthews CE, Chen KY, Freedson PS, et al. Amount of time spent in sedentary behaviors in the United States, 2003–2004. Am J Epidemiol. 2008; 167(7):875–881. [PubMed: 18303006]
12. Weston AT, Petosa R, Pate RR. Validation of an instrument for measurement of physical activity in youth. Med Sci Sports Exerc. 1997; 29(1):138–143. [PubMed: 9000167]
13. Pate RR, Ross R, Dowda M, Trost SG, Saland JM. Validation of a 3-Day Physical Activity Recall Instrument in Female Youth. Pediatr Exerc Sci. 2003; 15:257–265.
14. Ainsworth BE, Haskell WL, Whitt MC, et al. Compendium of physical activities: an update of activity codes and MET intensities. Med Sci Sports Exerc. 2000; 32(9 Suppl):S498–504. [PubMed: 10993420]
15. Johnson RK, Driscoll P, Goran MI. Comparison of multiple-pass 24-hour recall estimates of energy intake with total energy expenditure determined by the doubly labeled water method in young children. J Am Diet Assoc. Nov; 1996 96(11):1140–1144. [PubMed: 8906138]
16. Fulton JE, Dai S, Steffen LM, Grunbaum JA, Shah SM, Labarthe DR. Physical activity, energy intake, sedentary behavior, and adiposity in youth. Am J Prev Med. 2009; 37(1 Suppl):S40–49. [PubMed: 19524155]
17. Patrick K, Norman GJ, Calfas KJ, et al. Diet, physical activity, and sedentary behaviors as risk factors for overweight in adolescence. Arch Pediatr Adolesc Med. 2004; 158(4):385–390. [PubMed: 15066880]
18. Gordon-Larsen P, Adair LS, Popkin BM. Ethnic differences in physical activity and inactivity patterns and overweight status. Obes Res. 2002; 10(3):141–149. [PubMed: 11886936]
19. Kimm SY, Glynn NW, Kriska AM, et al. Decline in physical activity in black girls and white girls during adolescence. N Engl J Med. 2002; 347(10):709–715. [PubMed: 12213941]
20. Metcalf BS, Hosking J, Jeffery AN, Voss LD, Henley W, Wilkin TJ. Fatness leads to inactivity, but inactivity does not lead to fatness: a longitudinal study in children (Early Bird 45). Arch Dis Child. 2010 Jun 23. [Epub ahead of print].

Table 1

Demographics of participants included in study

Variable	All*	Tanner 1	Tanner 2	*t* test (Pr)
Total sample	53	26 (49%)	27 (51%)	
Ethnicity				.22
Latina	41 (77.4%)	22 (84.6%)	19 (70.4%)	
African American	12 (22.6%)	4 (15.4%)	8 (29.6%)	
Age (years)	9.4 (0.9)	9.2 (1.0)	9.6 (0.8)	.06
BMI percentile	80.8 (23.1)	75.1 (26.3)	86.3 (18.5)	.08
Normal (<85%)	21 (39.6%)	12 (46.1%)	9 (33.3%)	
Overweight (≥85%)	13 (24.5%)	8 (30.8%)	5 (18.5%)	
Obese (≥ 95%)	19 (35.9%)	6 (23.1%)	13 (48.2%)	
% Body fat	26.3 (10.6)	23.2 (9.9)	29.4 (10.6)	.03
% Lean fat	73.7 (10.6)	76.8 (9.9)	70.6 (10.6)	.03
Fat mass (kg)	12.7 (8.2)	9.0 (5.3)	16.2 (9.0)	<.001
Lean mass (kg)	31.2 (6.9)	27.1 (4.5)	35.2 (6.4)	<.0001
Energy (kcals)	1747.7 (432.5)	1715.7 (374.1)	1775.8 (484.1)	.65
Accelerometry				
MVPA (minutes)	46.8 (27.3)	50.4 (27.7)	43.4 (27.0)	.36
SB (minutes)	421.4 (69.9)	390.7 (62.4)	451.0 (64.6)	.001
3DPAR				
MVPA (minutes)	77.8 (59.4)	71.7 (50.9)	83.7 (67.1)	.47
SB (minutes)	127.5 (92.3)	129.4 (92.7)	125.6 (93.7)	.88

*Ethnicity and BMI represent frequency (percent); other variables note mean (standard deviation). MVPA, Moderate to vigorous physical activity; SB, sedentary behavior; 3DPAR, three day physical activity recall.

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Table 2

Regression analysis on body fat mass (*N*=53)

IV	Accelerometry			3DPAR		
	Beta	***P***	**R^2 (change)**	**Beta**	***P***	**R^2 (change)**
Intercept	7.46	.51		−3.04	.76	
Tanner stage	3.21	.13	.20	3.09	.15	.20
Age	−1.24	.23	.22 (.02)	−1.02	.33	.22 (.02)
Ethnicity	−.30	.89	.23 (.01)	−1.80	.43	.23 (.01)
Lean mass	.69	<.0001	.50 (.27)	.75	<.0001	.50 (.27)
Total energy intake	.002	.31	.52 (.02)	.001	.57	.52 (.02)
Sedentary behavior	−.02	.26	.53 (.01)	.01	.40	.54 (.02)
Moderate-vigorous physical activity	−.13	<.01	.63 (.10)	−.04	.01	.61 (.07)
Model			.63			.61