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Effect of Child Gender and Psychosocial Factors on Physical Activity From Fifth to Sixth Grade

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Background: Gender differences in physical activity (PA) trajectories during adolescence are well documented, yet little research has examined whether the determinants of these trajectories vary by child's gender. This study is one of few prospective examinations of gender differences in the influences of psychosocial and socioenvironmental factors on changes in objectively measured PA. **Methods:** Students and parents from elementary and middle schools located in 2 school districts in South Carolina were enrolled in a prospective cohort study of changes in children's PA from elementary to middle school. Measures included children's and/or parents' ratings of various psychosocial and socioenvironmental factors as well as objectively measured PA, children's anthropometric characteristics, and neighborhood factors at fifth and sixth grades. **Results:** Parents' reports of children's sport and class participation, parent-reported support for PA, and neighborhood resources for PA were protective against declines in PA for both boys and girls. The effects of 2 factors—children's self-efficacy and parents' leisure-time PA—on changes in PA over time were moderated by the child's gender. **Conclusions:** A better understanding of these dynamics may inform the development of interventions.

Keywords: child behavior, exercise, social support, self-efficacy, parent physical activity, longitudinal

Promoting physical activity (PA) in children is a valuable approach for maintenance of healthy weight and prevention of chronic disease risk factors.[1] However, rates of PA among children are low, with only 11% engaging in the recommended 60 minutes per day of moderate to vigorous physical activity (MVPA).[1,2] Low rates of PA are particularly concerning given that levels of PA tend to decline as children progress through adolescence.[2,3–7] Girls tend to have lower levels of PA than boys beginning in elementary school[8] and across ethnic groups.[9] Evidence from longitudinal studies of steeper declines in PA among girls than among boys suggests that early gender differences may intensify during adolescence.[4]

Systematic reviews of factors associated with PA among children have highlighted the influences of psychosocial and socioenvironmental factors on children's PA.[10,11] Associations between PA and children's reports of self-efficacy,[12,13] barriers to PA,[12] parental support for PA, and peer support for PA[12,14] may be moderated by gender. Children's sports participation has been associated with MVPA levels,[15] which may contribute to girls' declines in MVPA during adolescence.[4] To understand the changes in PA among children, we should jointly consider gender differences and psychosocial factors.

Previous studies have provided evidence for gender differences in associations between parental behaviors and MVPA.[13,16] Among boys, parental encouragement was positively associated with PA, but high parental monitoring was negatively associated with PA. Among girls, parental support for PA was also associated with PA, especially for girls who experienced early physical maturation relative to their peers.

Few studies have been able to directly examine gender differences in associations of individual-level psychosocial factors and parental factors with *longitudinal changes in PA* among children. The purpose of this study was to investigate the extent to which child's gender moderated the influences of psychosocial and socioenvironmental factors on children's PA as children transitioned from elementary to middle school.

Methods

Participants and Settings

Students from elementary and middle schools located in 2 school districts in South Carolina were recruited to participate in the Transitions and Activity Changes in Kids study. This study was a prospective study of the influences on changes in children's PA as they transition from elementary to middle school. In total, 14 of 17 elementary schools and all 7 middle schools in one district and all 7 elementary and all 6 middle schools in the other district agreed to participate. Of the 1857 children enrolled in the elementary schools, 1080 [501 boys and 579 girls (58.1%)] agreed to participate in the study, and school-level response rates in fifth grade averaged 64% in one school district and 57% in the other school district. At baseline, 35.1% of participants were black, 11.2% were Hispanic, 36.4% were white, and 17.3% were other races/ethnicities (including multiracial). Mean age (fifth grade) was 10.6 (±0.6) years. Participants were followed into middle school, which began in sixth grade for the children in this cohort. Analyses for this paper are based on data from fifth and sixth grade measurements. Further details regarding recruitment of the schools and children are reported elsewhere.[17]

Original study participants were included in the present analysis (N = 541) if they had complete data at both fifth and sixth grade

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time points for total PA and MVPA and complete data at baseline for control variables and psychosocial covariates, including those obtained from the parent survey. Those excluded due to missing data were more likely to be male (53% among excluded vs 44% among included), black (42% among excluded vs 31% among included), and/or have parents with a high school education or less (48% among excluded vs 39% among included), and they tended to live in neighborhoods with higher poverty levels (17.3% among excluded vs 15.8% among included).

Data Collection Procedures

Active consent and assent forms were sent home with students, and completed forms were returned to the schools. Parents/guardians provided informed consent and students provided assent to participate in the study. The institutional review board at the University of South Carolina approved all protocols.

Data collection procedures were carried out over 2 visits each year at all schools according to a manual of procedures by a trained measurement team. Each year, participants completed a self-administered computer-based questionnaire, had anthropometric measurements taken, and received an accelerometer. During the second visit 7–10 days later, participants returned the accelerometer and completed a PA recall and a dietary screener. Participants entered all self-administered questionnaire responses into a survey software database on laptop computers. Participants completed the measures as part of small groups (≤24 students) at times and locations determined by each school. A questionnaire was sent home to be completed by a parent or a guardian.

PA Measurement. PA was measured using ActiGraph accelerometers (models GT1M and GT3X; ActiGraph, Pensacola, FL). Each child wore an accelerometer during waking hours for 7 consecutive days, except while bathing, swimming, or sleeping. Accelerometer data were collected and stored in 60-second epochs. Any period of ≥60 minutes of consecutive zeroes was considered to be nonwear time and was set to missing. MVPA was defined as ≥2200 counts per minute that corresponded to 4.0 metabolic equivalents.[18] Total PA was defined as activity >100 counts per minute. PA was expressed as mean daily minutes per hour of wear time. Data for Sundays were excluded from analysis because of poor wear rates (approximately 60% of weekday wear rates). At the fifth and sixth grade measurements, respectively, 80% and 75% of the children had accelerometer data for ≥8 hours per day on ≥4 days. For children with ≥2 days of ≥8 hours of wear each day (21% of children), missing values for the remaining times were estimated by multiple imputation using PROC MI in the SAS software program (Cary, NC).[19] There were no significant differences in the sociodemographic characteristics between the participants for whom PA measures were/were not imputed.

Sociodemographic Characteristics. Participants reported their age, gender, and race/ethnicity. For race, they were asked to check as many categories as applied (white, black/African American, Asian, American Indian/Alaskan Native, and other). They were also asked whether they considered themselves Hispanic or Latino. Race/ethnicity responses were recoded as black, white, Hispanic, and other/mixed race. As a proxy for socioeconomic status, parents reported their highest level of education; for analysis purposes, parents' responses were dichotomized based on whether or not they reported more than a high school education. This single-item measure has been shown to be the best measure when limited to using a single item.[20–22]

Child-Reported Variables. A student questionnaire was completed by each participant in the fifth and sixth grades. Self-efficacy beliefs about overcoming barriers to PA were measured using an 8-item scale developed for use with fifth grade boys and girls and adapted slightly for use with sixth and eighth grade girls.[23,24] Example items on the self-efficacy measure follow: "I can be physically active during my free time on most days no matter how busy my day is" and "I can ask my parent or other adult to do physically active things with me." The items were rated on a 5-point scale ranging from 1 (disagree a lot) to 5 (agree a lot). The test–retest stability has been estimated at 0.84 across 2 weeks[25] and 0.40 across 2 years.[26]

Perceived barriers to PA were measured using a 5-item scale modified from the 9-item version developed for the Trial of Activity in Adolescent Girls.[26,27] Items included statements such as "I don't have a place to do physical activity," which were rated on a 5-point scale ranging from 1 (never) to 5 (very often). Motives for PA consisted of the mean of 3 items for the "social" construct[27] (eg, "because I want to be with my friends") measured on a 4-point scale ranging from "not at all true for me" to "very true for me."

Eight items (4 for each of 2 parents) from the student survey of the Amherst Health and Activity Study,[28] previously validated for use in the Trial of Activity in Adolescent Girls study,[29] were used to assess children's perception of how frequently parents or guardians provided support for PA[26] (eg, "did physical activity with me") on a 5-point scale ranging from "none" to "daily." Parent support in the form of encouragement (eg, "encouraged me") was measured with the mean of 2 items.[26] Frequency of peer support for PA was measured on the same scale with the mean of 3 items[27,30] (eg, "During a normal week, how often do your friends do physical activities or play sports with you?").

Parent-Reported Variables. A parent or a guardian completed a questionnaire about his or her child and the family (91% of respondents were mothers). Parents were asked about their child's participation in sports/PA classes during the past year (1 item). Other questions addressed sedentary equipment in the child's bedroom (3 items) and rules about the use of electronic media (3 items). Parents also reported their perception of how many days in a typical week they engaged in 4 types of support for their child's PA on a 5-point scale with anchors of 0 and 7 days, whether it was important that their child participates in sports/PA,[28] and whether parents believed it was safe for their child to play outdoors in their neighborhood.[28] Parents also reported their own enjoyment of PA (1 item) and their own leisure-time PA and sports participation.[31]

Neighborhood Variables. Potential places at which children might be active were identified from a variety of sources (eg, Internet yellow pages) and included addresses of churches, commercial facilities, trails, parks, and schools (public, private, charter, and colleges) in the 2 counties where the participants lived. Trained data assistants visited the identified places (after the sixth grade) and completed a physical activity resource assessment (PARA)[32] to capture features (eg, baseball field), amenities (eg, drinking fountains), and incivilities (eg, graffiti). For this study, we calculated a PARA index for each facility by counting features and amenities (range: 0–18) minus the average number of incivilities (range: 0–7). A PARA-weighted PA resources score was created for each child using GIS software (ArcGIS 10.1, Redlands, CA), using 2.0-mile street network buffer around his or her home. A score for neighborhood-level socioeconomic status was represented by the proportion of the population living below the federal poverty level in the census tract in which the child's primary residence was located.

Statistical Analyses

Descriptive statistics were calculated for the total sample and separately for males and females at baseline (fifth grade). Chi-square and *t* test analyses were used to determine if there were differences in any of the support variables between males and females. Changes in total PA and MVPA over time were assessed by calculating means for each time point separately for boys and girls. Study participants were included in the analysis (N = 541) if they had complete data at both fifth and sixth grade time points for total PA and MVPA and complete data at baseline for control variables and psychosocial covariates, including those obtained from the parent survey. Those excluded due to missing data were more likely to be male (53% among excluded vs 44% among included), black (42% among excluded vs 31% among included), and/or to have parents who had high school or lower levels of educational attainment (48% among excluded vs 39% among included), and they tended to live in neighborhoods with higher poverty levels (17.3% among excluded vs 15.8% among included).

We conducted a series of nested mixed model repeated measures analyses to examine the associations of child-reported variables, parent-reported variables, and neighborhood resources with total PA, with adjustment for school clustering, race/ethnicity, parent education, and the proportion of the census tract living below the federal poverty level. All continuous variables were centered. We employed a 2-stage process to minimize our experimentwise error rate while also exercising caution about prematurely excluding variables with substantive importance for one but not both gender subgroups. In the first stage, we estimated main effects in models stratified by child's gender that included all potential variables of interest. Any variable with a *P*-value for a gender-specific main effect below .20 was included in subsequent models that pooled boys and girls. In the second stage, pooled models tested the following: (1) main effects for variables retained from stage 1, (2) interactions between time and variables of interest, and (3) interactions between child's gender and variables of interest. In the stage 2 models, variables with nonsignificant associations were trimmed from subsequent models. Finally, where statistically significant moderating effects of child's gender were observed, we calculated least squares means to estimate simple main effects.[33,34] For ease of interpretation, these simple main effect models collapsed continuous main effects into 2 categories using the median as a cut point.

Results

Descriptive characteristics of the children at baseline (fifth grade) are presented in Table 1, for the total sample and separately for boys and girls. The mean age was 10.6 (SD = 0.5) years. With respect to race/ethnicity, 42% were white, 31% were black, 9% were Hispanic, and 18% were of other/mixed races. Approximately, one-third of the sample (39%) had parents who had a high school diploma or less. On average, the children lived in census tracts in which 16% of the population lived below the federal poverty level. Overall, children averaged 28.10 minutes per hour of total PA (SD = 4.64). Only 11% of children met the daily PA guideline of 60 minutes per day of MVPA.

Table 2 presents the results of stage 1 mixed model repeated measures analyses to estimate the associations of child-reported variables, parent-reported variables, and neighborhood resources with changes in total PA, separately for boys and girls and controlling for school-level clustering, race/ethnicity, parent education, and neighborhood poverty levels. Only variables with *P*-values below .20 in stage 1 analyses were retained for stage 2 analyses; thus, child reports of barriers to PA, parent support, and peer support, along with parents' reports of neighborhood safety, sedentary equipment in the child's bedroom, and electronic media rules were dropped from subsequent analyses. Because total PA declined among both males and females from the fifth grade to the sixth grade (ie, a negative slope for changes in total PA), positive

Table 1 Sample Demographics at Baseline (Fifth Grade)

Personal variables	Total (n = 541)	Boys (n = 236)	Girls (n = 305)
Age, mean (SD)	10.6 (0.53)	10.6 (0.53)	10.6 (0.53)
Race/ethnicity, n (%)			
White	228 (42.14)	99 (41.95)	129 (42.30)
Black	169 (31.24)	76 (32.20)	93 (30.49)
Hispanic	49 (9.06)	21 (8.90)	28 (9.18)
Other	95 (17.56)	40 (16.95)	55 (18.03)
Parental education, n (%)			
High school or less	210 (38.82)	86 (36.44)	124 (40.66)
More than high school	331 (61.18)	150 (63.56)	181 (59.34)
Neighborhood poverty, %	15.86	15.67	16.01
Physical activity			
Total physical activity, mean (SD), min/h	28.10 (4.64)	29.17 (4.82)	27.28 (4.33)

Table 2 Multivariate Gender-Stratified Models to Estimate Associations Between Selected Time-Varying Covariates and Fifth to Sixth Grade Change in PA, Controlling for School Clustering, Race, Parental Education, and Neighborhood Poverty

Variables	Boys β (SE)	Girls β (SE)
Personal variables		
Self-efficacy (mean of 8 items)	0.04 (0.38)	**1.08 (0.28)**
Motives—social (mean of 3 items)	0.12 (0.24)	0.22 (0.21)
Parent variables		
Sport/class participation (1 item)	**1.14 (0.40)**	0.44 (0.32)
Parent-reported support (mean of 4 items)	0.29 (0.26)	**0.62 (0.22)**
Parent leisure-time PA (mean of 4 items)	**–0.85 (0.33)**	0.23 (0.27)
Parent sport participation (mean of 4 items)	0.30 (0.26)	0.21 (0.23)
Important child active (1 item)	0.32 (0.37)	0.43 (0.29)
You enjoy PA (1 item)	–0.08 (0.23)	–0.32 (0.23)
Neighborhood		
PARA_Index sum 2 mile	**0.02 (0.01)**	0.00 (0.01)

Note. Parameters with $P < .20$ are included; bold parameter estimates were significant with $P < .05$.

Abbreviations: PA, physical activity; PARA, Physical Activity Resource Assessment.

associations represent effects that were protective against declines in total PA, whereas negative associations represent effects that contributed to the declines in total PA. Among boys, parents' reports of their child's sport/class participation (β = 1.14, SE = 0.40, $P < .05$) and neighborhood resources (PARA; β = 0.02, SE = 0.01, $P < .05$) were protective against declines in total PA, whereas parent accounts of their own leisure-time PA (β = –0.85, SE = 0.33, $P < .05$) may have contributed to declines in total PA. Among girls, self-efficacy (β = 1.08, SE = 0.28, $P < .05$) and parent-reported support for PA (β = 0.62, SE = 0.22, $P < .05$) were protective against declines in total PA.

Table 3 shows the results of stage 2 mixed model repeated measures analyses for the pooled analysis sample that included both boys and girls. The Model 1 column provides estimates for the main effects of child-reported variables, parent-reported variables, and neighborhood resources retained from stage 1 stratified models on changes in total PA while controlling for school clustering, race/ethnicity, parent education, and neighborhood poverty levels. A statistically significant association between child's gender and the slope of changes in total PA (β = 2.24, SE = 0.33, $P < .05$) was observed. In these pooled analyses, self-efficacy (β = 0.78, SE = 0.25, $P < .05$), parents' reports of children's sport/class participation (β = 0.55, SE = 0.28, $P < .05$), parents' reports of support for PA (β = 0.56, SE = 0.18, $P < .05$), and the PARA index (β = 0.01, SE = 0.01, $P < .05$) were all protective against declines in total PA over time.

Next, interaction terms for moderating effects of time on the statistically significant main effects ($P < .05$) were added to model 1 for separate models testing individual moderating effects (see Table 3, Model 2 column). Time was a statistically significant moderator of the effects of parental enjoyment of PA and the PARA index only; the results of a model containing statistically significant main effects and the 2 significant time–by–main effect interactions terms are shown in the Model 2 column.

Finally, interactions between child's gender and statistically significant main effects were added to model 2 (see Table 3, Model 3 column). The effects of self-efficacy (β = –1.47, SE = 0.48, $P < .05$) and parent leisure-time PA (β = –1.14, SE = 0.41, $P < .05$) on children's total PA were significantly moderated by child's gender. The parameter estimates for the gender–by–self-efficacy and gender–by–parent leisure-time PA interactions, after controlling for main effects and the 2 significant interaction effects from model 2, are provided in the Model 3 column.

To illustrate how these moderating effects of child's gender operated in our data, we calculated least squares means for simple main effects with continuous main effect variables collapsed into 2 categories using the median as a cut point (results not shown). For self-efficacy, among boys, there was no difference in total PA between those with higher versus lower self-efficacy; however, among girls, total PA was higher among those with self-efficacy above the median. Thus, consistent with the results of gender-stratified analyses presented in Table 2, self-efficacy was protective against declines in total PA among girls but appeared to have little effect on total PA among boys. For parent leisure-time PA, among boys those with parent leisure-time PA above the median averaged about 1 fewer minute per hour of total PA than those below the median, whereas there were no such differences among girls. Thus, parent leisure-time PA may contribute to declines in total PA among boys but not among girls.

Discussion

Numerous studies have identified correlates of PA in children and adolescents. However, few studies have considered *longitudinal*

Table 3 Gender × Variable Interaction Effects With Selected Time-Varying Covariates and Fifth to Sixth Grade Change in PA, Controlling for School Clustering, Race, Parental Education, and Neighborhood Poverty

	Model 1	Model 2	Model 3
	Main effects	Time × Variable interactions	Gender × Variable interactions
Variables	β (SE)	β (SE)	β (SE)
Gender [males = 1 (reference group); females = 2]	**2.24 (0.33)**		
Personal variables			
Self-efficacy (mean of 8 items)	**0.78 (0.25)**		
Motives—social (mean of 3 items)	0.17 (0.17)		
Parent variables			
Sport/class participation (1 item)	**0.55 (0.28)**		
Parent-reported support (mean of 4 items)	**0.56 (0.18)**		
Parent leisure-time PA (mean of 4 items)	–0.31 (0.22)		
Important child active (1 item)	0.47 (0.25)		
Parent enjoys PA (1 item)	–0.18 (0.17)		
Neighborhood			
PARA_Index sum 2 mile	**0.01 (0.01)**		
Interaction effects			
Time × parent enjoys PA		**0.66 (0.25)**	
Time × PARA_Index		**0.02 (0.01)**	
Gender × self-efficacy			**–1.47 (0.48)**
Gender × parent leisure-time PA			**–1.14 (0.41)**

Note. Bold parameter estimates were significant with $P < .05$.
Abbreviations: PA, physical activity; PARA, Physical Activity Resource Assessment.

trajectories of PA, and investigations of gender differences in those trajectories are even rarer. Indeed, this may be the first study to examine the effects of gender and psychosocial factors on changes in PA over time, with a representative sample of children and objectively measured PA. This analysis used data from a prospective cohort study of changes in PA with objective measurement of PA to consider gender differences in changes in PA in a diverse sample during the transition from elementary to middle school.

Consistent with previous studies,[2,3–5] we observed steeper declines in PA among girls than among boys as they progressed from childhood into adolescence. Overall, our findings provide evidence that most of the influences of psychosocial and socio-environmental factors on changes in PA during the transition from elementary school to middle school operate similarly for boys and girls. Nonetheless those gender differences that were observed appeared to be quite impactful. We found that parents' reports of children's sport and PA-related class participation, parent-reported support for PA, and neighborhood resources for PA were protective against declines in PA for both boys and girls. Nonetheless, the effects of 2 factors—children's self-efficacy and parent's leisure-time PA—on changes in PA over time were moderated by the child's gender.

We found that self-efficacy was protective against declines in PA among girls but not among boys. Similarly, we found that parents' leisure-time PA was associated with declines in boys' PA but not associated with girls' PA. Our results contradict those of 2 previous studies,[13,35] both of which relied upon less rigorous cross-sectional study designs and smaller samples with more limited generalizability than our sample. Future research should consider the possibility of gender differences in experiences of the transition from elementary to middle school and the dynamics of parent–child relationships in relation to parent activity levels.

To the extent that we did observe gender differences in the influences on changes in PA, these results lend support for gender-specific tailoring of interventions for girls to promote PA and/or reduce declines in PA over time. For girls, intervention strategies should consider variability in self-efficacy and strategies for bolstering self-efficacy for PA that are appropriate to their developmental stage.[36–38] Indeed, gender-related norms may become stronger as girls enter adolescence, and strategies that help girls navigate these shifting expectations while remaining active have the potential to halt or reduce declines in PA.

Among boys, the finding that higher parent leisure-time PA was associated with greater declines in PA over time was counter-intuitive. Our data did not allow us to assess the extent to which parents and their children engaged separately or together in PA. Nonetheless, this result suggests that parents may engage in their own leisure-time PA while their sons are engaging in alternative sedentary activities. Certainly, it may be important for parents to be active, not only for their own health and well-being but also as role models. Intervention efforts to promote PA or reduce declines in PA among boys might consider employing strategies that emphasize opportunities for parents and their sons to be active together and addressing ways that families can effectively navigate the need for all members to be physically active. Furthermore, as boys enter adolescence and attain greater independence, interventions might help parents identify ways that parents can be impactful in encouraging boys' activity behaviors.

This study was not without limitations. We note that we found evidence that child and family characteristics were at least mildly associated with having missing data. Compared with previous studies, our study was based on a larger, more representative sample and a prospective design, all of which contribute to greater generalizability of our findings than those of the previous studies. Nonetheless, the fact that missing data in our study do not appear to have been missing at random suggests that generalizability may have been slightly limited by these patterns.

Our study's strengths include a focus on changes in PA over time rather than on levels of PA at a single point in time as was the case with most previous research on this topic. The temporal ordering of independent and dependent variables in our study allows for stronger inferences regarding mechanisms for declines in children's PA. Collectively, the methodological advantages offered by our study underscore the importance of reconsidering the results of previous research.

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