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A Dyadic Analysis on Source Discrepancy and a Mediation Analysis via Self-Efficacy in the Parental Support and Physical Activity Relationship among Black Girls

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Abstract

Background: Physical activity (PA) declines in adolescence among black girls. This study assesses how moderate/vigorous physical activity (MVPA) relates to caregiver- vs. adolescent-reported parental support and whether the relationship is mediated by self-efficacy.

Methods: MVPA was assessed through accelerometry. Parental support and encouragement on adolescents' PA were reported by caregivers and adolescents with a 10-item Social Support and Exercise Survey. Adolescent-reported self-efficacy related to PA was assessed with an 8-item scale. Structural equation modeling assessed source variation (caregiver vs. adolescent report) in the relationship between parental support and MVPA and mediation through adolescent self-efficacy.

Results: The sample includes black adolescent girls ($n = 272$), with mean age of 11.6 years (standard deviation = 0.7), and average MVPA/day of 40.6 minutes. Caregiver/adolescent agreement on parental support was low (weighted Kappa <0.20). There was significant source variation in the parental support-MVPA relationship (Wald $\chi^2 = 4.18$, df = 1, $p = 0.041$); adolescent-reported support was related to MVPA ($b = 0.40$, standard error = 0.14, $p = 0.003$) and mediated through self-efficacy (95% bootstrapped confidence interval: 0.05–0.29). Caregiver-reported support or BMI z-score was not related to MVPA.

Conclusions: The association between MVPA and adolescent-reported parental support among black adolescent girls is explained by positive self-efficacy. Findings suggest that effective adolescent/caregiver communication around parental support on PA relates to high adolescent self-efficacy and supports objectively measured PA. Additional research is merited to examine longitudinal patterns. Furthermore, although 51.5% of girls in the sample were overweight or obese, the lack of association between MVPA and body composition minimizes its implication for mitigating obesity among overweight/obese black adolescent girls.

Keywords: adolescent girls; dyadic analysis; mediation; physical activity; self-efficacy

Introduction

Adolescent obesity is a national concern, with 33.8% of adolescent girls and 35.1% of adolescent boys overweight or obese (overweight/obese).[1] Insufficient physical activity (PA) is a contributing factor.[2] PA declines between childhood and adolescence.[3] Based on the National Health and Nutrition Examination Survey, only 8% of adolescents 12–19 years of age obtain the recommended 60 minutes/day of PA.[4–6] Compared with white adolescent girls, black adolescent girls are less likely to participate in PA,[7] have a greater decline in PA during adolescence,[6,8] and a higher prevalence of overweight/obesity (42.5% vs. 31.0%),emphasizing the importance of identifying factors that encourage PA among black adolescent girls.

Based on social cognitive theory (SCT),[9] familial and personal factors are associated with engagement in PA. Parental social support may facilitate children's engagement in PA through role modeling, encouragement, and logistical arrangements.[10] However, the impact of parental support often wanes during adolescence with inconsistent findings between parental support and PA among black adolescent girls.[5,11–14] Adolescence is a period of increasing, yet vacillating autonomy, often with differing perspectives and miscommunication between caregivers and adolescents.[15,16] At

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times, black adolescent girls perceive their caregivers' behavior toward PA as controlling and forceful.[17–19] Based on relational regulation theory,[20] adolescents' perception of parental psychological control over their PA may not only erode the parent/adolescent relationship but also contributes to adolescents' resistance to comply.[17,18]

Many prior studies of parental support for PA have relied on caregiver- or adolescent-reported measures of PA, rather than direct measures, and few have examined how differences in caregiver-reported vs. adolescent-reported perceptions of parental support for PA relate to black adolescent girls' PA. One study among preadolescent black girls reported that the girls' perception of parental support was not related to their PA, with a nonsignificant trend for a positive relationship between caregiver-reported parental support and the girls' PA.[11] Another study reported agreement between caregiver-reported and child-reported parental support among a sample of predominantly black elementary school children of both genders, with child report more strongly associated with child PA than caregiver report.[21] Investigation on the agreement between caregivers and adolescents in their perception of parental support and relationships with the girls' objectively measured PA may provide insights into the decline in PA among black adolescent girls.

Based on SCT, personal factors such as self-efficacy (adolescent girls' belief in their ability to engage in PA) may relate to PA. One study among primarily white adolescents found that self-efficacy mediated the association between parental support and adolescents' self-reported PA.[22] Several studies have found that black girls report lower self-efficacy for PA than white girls[23,24] and that self-efficacy has limited utility in predicting PA among black adolescent girls.[14,24] The current study extends prior research among black adolescent girls in three ways: (1) including objectively measured PA, (2) comparing associations between caregiver- and adolescent-reported parental support and girls' PA, and (3) evaluating whether self-efficacy mediates the relationship between parental support and PA.

This study tests three hypotheses. The first is that parental support varies by report source, reflecting differing perspectives commonly described between caregivers and adolescents. The second is that adolescent-reported parental support is more closely aligned with PA than caregiver-reported parental support, and is based on adolescents' sensitivity to controlling strategies and desire for autonomy.[18,19] The third is that adolescent girls' self-efficacy mediates the relationship between parental support and PA.

Methods

Study Sample

This cross-sectional study used baseline data from a school-based obesity prevention trial. Adolescent girls (sixth–seventh grade, $n = 789$) from 22 low-income and predominantly black (>70% students) schools and their primary caregivers were recruited during 2009–2013. Students were eligible if they were able to participate in physical education class activities. Parents and girls provided written informed consent and assent, respectively. This study was approved by institutional review boards (IRB) at the university and public school system.

Due to a limited number of accelerometers, PA assessment was limited to a random subset ($n = 654$, 82.6%); 560 (85.6%) with valid accelerometry data. Caregivers received paper-based surveys, returned by mail. A total of 301 girls (53.8% of 560) had both valid accelerometry and caregiver data: 272 (90% of 301) were black and 29 (10%) were of other race/ethnicities, including Asian (0.3%), Hispanic (3%), white (4%), and American Indian (3%). Included girls were younger than excluded girls (11.6 vs. 11.8 years, $p = 0.001$), with no differences in race, poverty, caregiver's education, BMI z-score, PA, adolescent-reported parental support, or self-efficacy for PA. The analytic samples were restricted to the 272 black girls, considering that decline in PA applies particularly to black girls and 90% of samples were black.

Measures

Moderate/Vigorous Physical Activity

An Actical accelerometer (Phillips, Respironics, Minimitter, Bend, OR) placed superior to the lateral malleolus of the nondominant ankle was worn for ≥7 consecutive days. Activity counts were collected in 1-minute intervals and reduced using Actiware 9.0. First and last days, and days with incomplete 24-hour data were removed. Validated Actical ankle accelerometry thresholds for moderate/vigorous physical activity (MVPA)[25] were applied, yielding MVPA (minutes/day).

Parental Support for PA

Caregiver-reported parental support and adolescent-reported parental support for PA were collected from the caregiver and adolescent surveys, separately. The Social Support and Exercise Survey[26] assessed logistic support and encouragement of PA using 10 items for both surveys. The girls and their caregivers responded to similar questions with minor modification reflecting support in the past 3 months (*e.g.*, my family was physically active with me/I have been physically active with my daughter), using a 5-point Likert scale: "1 = none," "2 = rarely," "3 = a few times," "4 = often," and "5 = very often." Cronbach's alpha, 0.90 for adolescent-report and 0.92 for caregiver-report, was consistent with prior reports of 0.90 for a sample of middle school students (10-item version)[27] and 0.91 for a sample of female white young adults (12-item version).[26] Responses were summed, with possible scores ranging within 10–50.

Self-Efficacy

Self-efficacy for PA was measured by an 8-item scale that addresses confidence in being physically activity,

using a Likert scale (1 = disagree a lot to 5 = agree a lot).[24] For example, girls were asked "I can be physically active during my free time on most days." Cronbach's alpha in this sample (0.81) was similar as a sample of sixth–eighth grade girls (0.79).[28] Self-efficacy was skewed by the girls' tendency to choose 4 = "agree" or 5 = "agree a lot." To identify the girls who strongly endorsed self-efficacy, we grouped the girls into high confidence (responses of "agree a lot" to 3 or more items, ~25%) and low confidence (responses of "agree a lot" to 2 or fewer items, ~75%).

Other Variables

Demographics. Girls self-reported their age (years). Caregivers reported their own education, which was categorized as attended high school, high school graduate/General Educational Development (GED) certification, attended college/vocational school, and college graduate.

Poverty ratio. Poverty ratio was calculated based on caregiver-reported family size, number of dependents, and total family income, using the ratio of family income to the 2010 US poverty threshold. High scores indicate higher income.[29]

BMI z-score. Trained research assistants measured weight/height using a portable stadiometer and electronic scale, following standard procedures. BMI-for-age z-score and percentiles were based on gender-specific CDC 2000 standards. Girls were categorized into normal weight (BMI-for-age <85th percentile), overweight (BMI-for-age ≥85th and <95th percentile), or obese (BMI-for-age ≥95th).[30] Overweight and obese were combined into overweight/obese in descriptive analyses.

Statistical Analysis

Means/standard deviations were calculated for continuous variables and frequencies for categorical variables. Correlation coefficients were assessed.

Hypotheses were tested in three stages. First, source discrepancy (caregiver vs. adolescent report) of parental support was assessed with Spearman correlation coefficients, weighted kappa (1.0 perfect agreement between caregiver and adolescent reports, 0.8 adjacent categories, and 0 separation by >2 categories),[31] and paired *t*-tests (hypothesis 1), similar to a published study.[21] Second, to assess whether adolescent-reported parental support is more closely aligned with MVPA than caregiver-reported parental support (hypothesis 2), we conducted a dyadic model using structural equation modeling (SEM), allowing a statistical test of source difference (caregiver-report vs. adolescent-report) by including two correlated independent variables (adolescent-reported and caregiver-reported parental support) simultaneously in one model and comparing the strength in their relationships with MVPA. Robust maximum likelihood used as the distribution of MVPA is slightly skewed (skewness = 1.99). We used Wald test for parameter constraints to assess whether the parental support-MVPA relationship differs between caregiver report and adolescent report. Third, mediation analysis assessed whether self-efficacy mediates the relationship between parental support and MVPA. Since the mediator self-efficacy is dichotomous, we used weighted least square means and variance adjusted estimation method based on probit regression. The indirect effect was estimated with the product of regression coefficients.[32] Bootstrapped confidence interval was used since the Sobel test is usually underpowered.

Although model fitness in SEM is usually estimated, for example, chi-square test, root mean square error of approximation, comparative fit index, and the Tucker–Lewis index,[33] this dyadic model and the mediation model with one mediator are just identified; the model fitness criteria are not meaningful and not reported. Full-information maximum likelihood accounted for missingness. STATA 12[34] and Mplus 8.0 statistical software[35] were used, with $p < 0.05$ as significant.

Results

Sample Description

Among the 272 caregiver/adolescent dyads, girls' mean age was 11.6 years [standard deviation (SD) = 0.7, Table 1]. Half were at/below the poverty threshold. The mean BMI z-score was 1.1 (SD = 1.0). Half were overweight/obese (17.6% overweight and 33.8% obese). Most caregivers were mothers (86.3%); others were fathers (4.1%), grandparents (7.3%), and step-parents or partners (0.7%). Caregiver education varied: 15.9% attended high school, 34.8% high school/GED graduates, 35.2% attended college/vocational school, and 14.1% college graduates.

Average MVPA was 40.6 minutes/day (SD = 28.4, range 2.6–224.2) and 18.8% met the PA guideline of 60 minutes/day in MVPA. MVPA was significantly related to age, self-efficacy, adolescent-reported parental support (positive), poverty ratio, and caregiver education (negative), but not to caregiver-reported parental support (Table 2). Caregiver- and adolescent-reported parental supports were significantly correlated ($r = 0.19$, $p < 0.01$). No variables were related to BMI z-score.

Source Discrepancy in Parental Support for PA

The mean adolescent-reported parental support score was 27.1 (SD = 11.0, range 10–50), indicating most adolescent girls reported "2 = rarely" or "3 = a few times." Caregiver report was significantly higher (mean 30.5, SD = 9.3, range 10–50) than adolescent report (mean difference = 3.52, paired *t*-test $p < 0.01$), with poor agreement between caregiver report and adolescent report based on quintiles (weighted Kappa = 0.11). At item level, caregiver report was consistently higher than adolescent report (paired *t*-tests $ps < 0.05$ for 9 of 10 items); there were weak correlations ($r = 0.02$–0.24) and poor agreement between caregivers and girls for each item (weighted Kappa <0.20).

Table 1. Selected Sample Characteristics of Adolescent Girls in the Overall Sample ($n = 272$)

Variables	Mean (SD) or *n* (%)
Age (years), mean (SD)	11.6 (0.7)
Poverty ratio	1.1 (0.8)
Under poverty threshold	
No	118 (50)
Yes	117 (50)
Caregiver's education	
Attended high school	43 (15.9)
High school graduate or GED	94 (34.8)
Attended college or vocational school	95 (35.2)
College graduate	38 (14.1)
Adolescent BMI z-score	1.1 (1.0)
Adolescent overweight/obesity	
No	132 (48.5)
Yes	140 (51.5)
MVPA (minutes/day), mean (SD)	40.6 (28.4)
Meeting physical activity recommendation (MVPA ≥60 minutes/day)	
No	221 (81)
Yes	51 (19)
Adolescent-reported parental support	27.1 (11.0)
Caregiver-reported parental support	30.5 (9.3)

GED, General Educational Development certification; MVPA, moderate/vigorous physical activity; SD, standard deviation.

Source Variation

As shown in Figure 1, the Wald test of equal regression coefficients of caregiver-reported vs. adolescent-reported parental support in relation to MVPA ($\chi^2 = 4.18$, df = 1, $p = 0.041$) suggests that the parental support-MVPA relationship significantly differs by source report. Adolescent girls reporting higher parental support engaged in more MVPA than girls reporting lower support [unstandardized regression coefficient $b = 0.40$, standard error (SE) = 0.14, $p = 0.003$], indicating that MVPA would be increased by 20% (8 minutes) per day if an average response to the questions related to parental support by the adolescents girls changed from ''rarely''/''a few times'' to ''often''/''very often'' in the past 3 months. In contrast, caregiver-reported parental support was not related to MVPA ($b = -0.04$, SE = 0.16, $p = 0.801$). Poverty ratio was significantly related to MVPA ($b = -10.56$, SE = 2.75, $p < 0.001$). Age or BMI z-score was not related to MVPA.

Mediating Effect of Self-Efficacy

The mediation model assessed whether self-efficacy mediated the relationship between adolescent-reported parental support and MVPA. The intraclass correlation of MVPA within schools was 0.07; therefore, a robust sandwich estimator was used to account for clustering. Figure 2 shows that adolescent-reported parental support was positively related to self-efficacy ($b = 0.03$, SE = 0.004, $p < 0.001$) and self-efficacy was positively related to MVPA, after adjusting for adolescent-reported parental support ($b = 4.11$, SE = 0.63, $p < 0.001$). There was a significant indirect effect between adolescent-reported parental support and MVPA via self-efficacy (95% bootstrapped confidence interval = 0.05–0.29). The direct effect was also significant ($b = 0.17$, SE = 0.06, $p = 0.003$), indicating that self-efficacy partially accounted for the relationship between parental support and MVPA. Collectively, the model accounted for 17% of the variance in MVPA.

Table 2. Correlation Coefficients among the Variables ($n = 272$)

Variables	1	2	3	4	5	6	7	8
1. MVPA	1							
2. Self-efficacy	0.12*	1						
3. Caregiver-reported parental support	–0.03	0.01	1					
4. Adolescent-reported parental support	0.16*	0.24**	0.19**	1				
5. Age (years)	0.14*	–0.14*	–0.12	–0.06	1			
6. Poverty ratio	–0.32**	0.06	0.02	–0.09	–0.01	1		
7. BMI z-score	–0.10	–0.08	0.05	–0.01	0.01	0.11	1	
8. Caregiver education	–0.23**	0.04	0.13*	–0.01	–0.13*	0.44**	0.08	1

Spearman's correlation coefficients were estimated for caregiver education and other variables. Pearson correlation coefficients were estimated for all other pairs.

*$0.01 \le ps < 0.05$ **$ps < 0.01$.

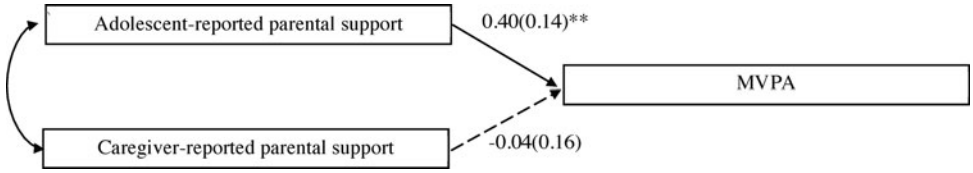

Figure 1. Dyadic model linking caregiver-reported and adolescent-reported parental support to the adolescent girls' physical activity. Wald test shows difference in the relationship between adolescent-reported and caregiver-reported parental support in relation to MVPA ($\chi^2 = 4.18$, df: 1, $p = 0.041$). Path coefficients and covariance were estimated based on robust maximum likelihood. The covariance between adolescent-reported parental support and caregiver-reported parental support is 20.10 (SE = 6.82, $p < 0.01$). Model adjusted for age in years, poverty ratio, caregiver's education, and BMI z-score. **$ps < 0.01$. MVPA, moderate/vigorous physical activity; SE, standard error.

Discussion

This study of parental support and PA among black adolescent girls yielded three primary findings. First, caregivers reported higher parental support for PA than adolescent girls. This finding may be explained either by caregivers' overestimate of their support based on their investment of time and effort[36] or by poor caregiver/adolescent communication regarding PA and low affective social interaction.[16,20] In addition, parental support may be perceived by adolescents as nagging, pressuring, or forceful,[18,19,37] and therefore discounted. In other contexts, for example, family satisfaction and parental knowledge, investigators have found that adolescents rate environmental factors more negatively than caregivers, suggesting that this pattern is not limited to PA and may characterize multiple aspects of caregiver/adolescent communication.[38,39]

Second, adolescent-reported, not caregiver-reported, parental support relates positively to girls' objectively measured PA. This finding extends similar findings among predominantly black elementary school students by measuring PA through objective measures, rather than relying on child-reported PA.[21]

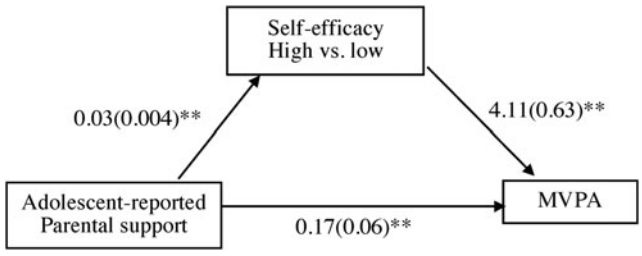

Figure 2. Mediation model on adolescent-reported parental support and MVPA via self-efficacy. All path coefficients are unstandardized estimates, accounting for clustering within schools. Probit model was conducted for self-efficacy in relation to parental support. **$ps < 0.01$. This model accounts for 17% of the variance of MVPA and 17% for self-efficacy. Covariates (age in years, poverty ratio, caregiver's education, and adolescent BMI z-score) were included. The indirect effect via self-efficacy is estimated as 0.17 (SE = 0.06, $p < 0.001$). Ninety-five percent bootstrapped confidence interval for the indirect effect (0.05, 0.29). The mediation model accounts for clustering within schools.

Third, adolescent self-efficacy mediates the relationship between adolescent-reported parental support and MVPA. This study extends findings that self-efficacy mediates the positive relationship between parental support and adolescents' self-reported PA reported in a sample of mainly white high school students of mixed genders,[22] by studying a sample of black girls in early adolescence, and using objectively measured MVPA. It is possible that adolescent-perceived parental support, for example, parental modeling, encouragement, or logistic support, helped the girls strengthen their confidence for overcoming barriers to PA,[40] or increased their motivation[41] to participate in PA.

The black adolescent girls in this sample illustrate the current obesity epidemic. The prevalence of overweight/obesity approached 50%, higher than the national prevalence of black girls of 42.5%,[1] and fewer than one-fifth of the girls met the national recommendation of 60 minutes/day of MVPA. This study provides novel information about the correlates of PA among low-income black girls in early adolescence, at risk of overweight/obesity and low PA. Interventions may address effective communications between parents and daughters on PA support, for example, building trustful and respectful relationships and avoiding forceful communications, and encouraging girls' self-efficacy for PA. However, the modest percent of variance in MVPA explained by parental support and self-efficacy indicates that the influence of parent support might decrease in adolescence and other personal or environmental factors need to be considered in future studies on black girls in early adolescence.

There have been inconsistent findings regarding whether PA is related to body composition among children/adolescents in literature, especially among girls.[42–47] This study found that neither BMI nor overweight/obesity was related to MPVA in the black girls, after controlling for poverty ratio, which is consistent with several other studies.[45–47] Furthermore, poverty ratio was inversely related to MVPA, suggesting that within a low-income sample, adolescent girls from lower income families were more physically active compared with adolescent girls from higher income families. Other studies have shown that children/adolescents in low-income households (*e.g.*, <$20,000 per year) are more likely to engage in active transportation, for example, walking and bicycling to/from schools, than those

in higher income households.[48,49] Additional research is warranted to investigate active transportation.

Strengths

This study has several strengths. First, the investigation used dyadic data on parental support on PA from both caregivers and adolescent girls. A novel dyadic data analysis assessed source discrepancy in parental support-PA relationship among black adolescent girls. Second, MVPA was objectively measured using accelerometry, reducing the bias in self-report. Third, this study targeted a subpopulation of black girls in early adolescence from low-income families at high risk for inactivity and obesity. Fourth, this study examined the potential pathway underlying parental support and MVPA via self-efficacy.

Limitations

There were several limitations. First, the lack of caregivers' reports at follow-up prevented us from conducting longitudinal studies. As a cross-sectional study, interpretations are limited to associations and not direction of effect. Although these findings are consistent with SCT, they should be interpreted with caution because relationships among adolescents' perceived parental support, self-efficacy, and PA may be bidirectional. It is possible that girls' participation in PA may enhance their self-efficacy and drive caregivers to provide support. Future studies need to assess the associations in longitudinal studies. Regardless of the direction of effect, the positive relationship between parental support and MVPA has implications for interventions to promote PA among black adolescent girls.

Second, this study was conducted among low-income black adolescent girls with 84% caregivers being overweight/obese. The high prevalence of overweight/obesity among caregivers reduces their likelihood of engaging in PA alone or with their daughters. Results may not be generalizable to adolescent girls of other sociodemographic characteristics.

Third, the specificity for the measure of parental support varied by respondents. The adolescent girls reported support for PA from family members and caregivers reported on their own support. About half of the caregivers reported additional adults living in the household (50.6%). We excluded these girls and repeated the analyses with similar findings; adolescent-reported, but not caregiver-reported, parental support was related to MVPA. Siblings might also provide support for the girls' PA. However, most adolescent girls (81%) had at least one sibling, preventing the repetition of analyses to examine girls without siblings.

Fourth, the dyadic model cannot account for clustering within schools since the model cannot handle the case of more parameters than clusters. However, we assessed the linear relationship between caregiver- and adolescent-reported parental support and MVPA, accounting for clustering within schools, separately. Results supported that adolescent-reported parental support is more closely related to MVPA than caregiver-reported parental support.

Finally, although overweight/obese children were amply represented in the sample (51.5%), the lack of a significant relationship between MVPA and body composition minimizes the implication of findings for mitigating obesity among overweight/obese black adolescent girls.

Conclusions

This study has significant implications for interventions to increase PA among low-income black adolescent girls. First, the low rate of meeting PA recommendations (<20%) illustrates the urgency of developing effective intervention programs to promote PA. Second, observational methods are feasible to assess girls' PA, removing potential inaccuracies of self-report. Third, parental support might promote the girls' MPVA via increasing girls' self-efficacy in PA. Interventions are needed to target improvement of self-efficacy related to parental support. Finally, the finding that the girls' perception on parental support is more closely aligned with objectively measured PA than caregivers' perception highlights the importance of strategies to enhance caregiver/adolescent communication related to parental support for PA.

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Author Disclosure Statement

No competing financial interests exist.

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