Associations Between Parenting Factors, Motivation, and Physical Activity in Overweight African American Adolescents

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Abstract

Background Positive parenting practices and environmental supports have been linked to physical activity (PA) levels in youth, yet factors associated with positive parenting styles have been understudied in African American adolescents.

Purpose This study expands on previous literature by examining associations between motivation, parenting factors associated with Self-Determination Theory's psychological needs (competence, autonomy, and relatedness) including authoritative parenting, autonomy support and emotional and tangible support, and adolescent moderate-to-vigorous PA (MVPA) and light PA (LPA).

Methods Participants were African American adolescents ($N = 148$; $M_{\text{age}} = 13.6$ years; $M_{\text{BMI}\%} = 96.6$) and their caregivers ($M_{\text{age}} = 43.4$ years; $M_{\text{BMI}} = 37.4$) enrolled in the Families Improving Together for Weight Loss trial. Parenting factors were measured using self-report surveys, and PA minutes were measured using 7-day accelerometry estimates.

Results Regression analyses indicated that overall models for MVPA ($F(11,134) = 4.35$; $R^2 = 0.26$) and LPA ($F(11,134) = 5.84$, $R^2 = 0.32$) were significant. Adolescent motivation for PA ($B = 0.58$, $SE = 0.16$) was positively associated with MVPA minutes. Authoritative parenting ($B = 15.71$,

$SE = 4.38$) and tangible support ($B = 8.53$, $SE = 4.02$) were positively associated with adolescent LPA minutes. Unexpectedly, emotional support was negatively associated with both MVPA ($B = -0.47$, $SE = 0.17$) and LPA ($B = -11.22$, $SE = 4.79$), with follow-up analyses showing this relationship stronger in males.

Conclusion Findings highlight the importance of adolescent motivation for PA on MVPA and positive parenting styles and tangible supports on adolescent LPA in overweight African American youth. Recommendations for integrating these factors within the context of intervention studies are discussed.

Keywords Moderate-to-vigorous physical activity · Light physical activity · Parenting styles · Motivation · African American · Adolescents · Overweight · Self-Determination Theory

Physical activity (PA) has been identified as an important factor for improving both physical and mental health outcomes as well as healthy weight in youth [1–3]. However, adolescents who are overweight engage in fewer daily minutes of PA [4] and are more likely to show a decline in PA in adolescence compared to healthy-weight peers [5]. Based on national averages, only 11.4% (measured by accelerometry data) to 29.4% (measured by self-report data) of African American adolescents meet national PA recommendations [6, 7]. Moderate-to-vigorous PA (MVPA) has been linked to numerous health outcomes including cardiorespiratory fitness, metabolic health, mental health, and longevity [8] and is linked to national PA recommendations. However, overweight and obese youth may be less likely to engage in higher intensity PA because of a lack of social support, increased bullying, physical discomfort, and self-consciousness during activities [9]. Light PA (LPA) may also confer benefits around

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weight-related outcomes and other health outcomes including improved blood pressure, cholesterol, bone mass, atherosclerosis markers, and insulin resistance [10–17]. However, the majority of previous studies among youth have not considered LPA as a potential mechanism for improving weight status and health outcomes in this population [18, 19] that may be more achievable.

This study is a secondary data analysis of the Family Improving Together (FIT) for Weight Loss trial [20, 21]. The FIT trial integrates constructs from Social Cognitive Theory [22, 23], Self-Determination Theory [24], and Family Systems Theory [25] into a culturally tailored-weight loss program for underserved African American families. Specifically, FIT targets behavioral skill building (e.g., self-monitoring, goal setting, skill mastery) and positive parenting strategies (e.g., shared decision making, positive communication, social support, parental monitoring) in the context of a positive social climate intervention. In this trial, a positive social climate is defined as one that promotes autonomy and belongingness based on Self-Determination Theory and, as a result, builds intrinsic motivation for lifestyle change in youth. Self-Determination Theory has been increasingly used as a framework to understand adolescent PA behaviors [26]. Self-Determination Theory proposes that autonomous motivation where the behavior is seen as enjoyable, related to important positive outcomes, or is aligned with personal values, is most conducive to long-term maintenance of health behaviors. Autonomous motivation for PA has been associated with youth PA outcomes in numerous cross-sectional and prospective studies [27] and specifically has been shown to be associated with self-reported PA in adolescents who are overweight [28, 29]. Motivation for PA has also been associated with accelerometry measured MVPA in underserved adolescent populations [30].

For the purpose of the present study, Self-Determination Theory suggests that factors contributing to competence, autonomy, and relatedness may increase adolescents' motivation for engaging in PA. The FIT trial is an innovative intervention program targeting weight-related behaviors by integrating Self-Determination Theory with Social Cognitive Theory and Family Systems Theory to influence parenting behaviors that may be positively associated PA outcomes in youth [20, 21]. Consistent with Family Systems Theory, parenting style and the family home environment may provide a social context within which psychological needs are fulfilled and, in turn, influence adolescent PA behavior [31]. Social Cognitive Theory highlights the importance of social learning, providing support for associations between parental modeling and PA, while Self-Determination Theory and Family Systems Theory emphasize the importance of autonomy supportive parenting on behavioral outcomes. Supportive behaviors, including tangible and emotional support for PA from parents, have also been shown to be beneficial for health

behavior outcomes in youth [32, 33]. While extensive research has shown that parent behaviors are associated with adolescent PA [34–36], few studies have examined the relationship between a wide range of parenting variables associated with psychological needs (competency, autonomy, and relatedness) identified by Self-Determination Theory and Family Systems Theory such as authoritative and autonomy supportive parenting and MVPA and LPA behavior in African American adolescents.

Parenting styles have been defined as the relationship and emotional environment parents provide through interactions with their child [37, 38]. An authoritative parenting style, which balances control over behaviors with high levels of warmth, is generally considered most conducive to positive health outcomes in youth (in comparison to authoritarian, permissive or neglectful parenting). This parenting style supports the psychological needs of autonomy (moderate parent control of behaviors) and relatedness (high levels of engagement, support), and previous research has demonstrated that these parenting behaviors have been an effective strategy for improving adolescent weight-related outcomes [39, 40]. However, parenting styles differ culturally, and there is some evidence that authoritarian parenting is associated with positive outcomes within the African American community [41]. Some parenting literature has found protective effects for authoritarian parenting for African American youth [42, 43], while others have supported the benefits of authoritative parenting [44, 45]. This suggests that the relationship between parenting style and adolescent outcomes may be culturally dependent, but more research is needed.

Warm and supportive family environments have been positively associated with youth health behaviors [40], but previous research has shown that there is little agreement on whether general parenting style or parenting practices specific to PA are more likely to be associated with youth PA outcomes [37]. Few studies have specifically evaluated the associations of positive authoritative parenting styles and specific parenting practices on youth PA [46], and results have been inconsistent. Studies in primarily White youth have shown positive associations between authoritative parenting and self-reported PA [47, 48] and demonstrated positive associations between autonomy-support for PA and adolescent PA behaviors [49–51]. Some studies have shown that parenting practices specific to health behaviors are more strongly associated with those behaviors than general parenting [52, 53], yet limited research has included both general and specific parenting practices in evaluating adolescent PA. The present study expands on past research by evaluating the association between general authoritative parenting style and parenting practices with PA in African American adolescents and aims to clarify these relationships.

Extensive literature has examined the relationship between parent-provided emotional support, tangible support, and adolescent PA and found generally positive associations [34, 54].

Emotional and tangible support map onto competence (through encouragement, provision of resources) and relatedness (through perceived provision of support). In predominantly minority samples, tangible support has been associated with accelerometry-measured and self-reported MVPA as well as changes in MVPA over time [32, 33, 55]. Research on emotional support has shown more mixed results in this population. Parental emotional support for PA has been associated with accelerometry-measured MVPA [33], and recent research has suggested that it is an important factor for youth LPA as well [56]. However, some investigators have reported no association between emotional support and PA [32]. Other investigators have shown sex differences in the associations between emotional support and health behaviors [57–59], with boys showing more negative associations than girls perhaps due to differences in gender socialization patterns [60, 61]. Consistent with Social Cognitive Theory, role modeling of PA by parents may be associated with adolescent PA through social learning [23, 62]. However, previous research on parent supports and role modeling of healthy behaviors has shown mixed results on adolescent PA [63]. Further research is needed to examine these relationships in African American adolescents as parenting practices of health behaviors have been shown to vary by race [64], and adolescents in families with overweight parents may not be exposed to parental modeling of PA.

Informed by Self-Determination Theory, Social Cognitive Theory, and Family Systems Theory, the current study expands on past research by examining associations between adolescent motivation for PA, perceptions of authoritative parenting style, and parenting practices specific to PA (autonomy support, emotional support, and tangible support), with MVPA and LPA in African American adolescents who are overweight. While many past studies have relied on self-report data, the current study is unique in that accelerometry estimates of PA were used which are less susceptible to social desirability response bias. Similarly, the current study utilizes predominantly adolescent-report measures rather than parent-reported measures given that past research has shown that adolescents can accurately report psychosocial measures at this development stage [65]. Based on past research, it was hypothesized that parenting factors, along with adolescent motivation for PA, would be positively associated with adolescent MVPA and LPA. However, because limited research has examined the association of these factors and LPA, we sought to explore whether associations differed based on PA intensity in African American adolescents who are overweight.

Methods

Participants

Baseline data from 148 African American families participating in the on-going FIT for Weight Loss randomized-controlled trial

[20, 21] were included in the present study. Sociocultural mediums including community partnerships, community events, and culturally relevant ads were used as recruitment strategies to identify eligible families [66]. Families were eligible to participate if they had an African American adolescent between the ages of 11–16 years old who was overweight or obese (BMI ≥ 85 th percentile for age and sex), a caregiver that was willing to participate, and internet access. Exclusion criteria include a condition or medication that would interfere with changing PA or diet or concurrent participation in a weight loss program.

Procedures

Each adolescent and their caregiver attended a 2-week run-in phase prior to randomization to group program condition. The run-in phase provided information about the intervention, assessed any barriers to and interest in participation of the full trial, and allowed time for baseline measures. Only participants who attended the run-in phase were randomized into the study trial. During baseline assessments, height and weight were measured by trained staff, and PA levels were measured using 7-day Actical accelerometry assessments (Mini-mitter, Bend, OR) for both parents and adolescents. Parent-report of tangible support (measured as availability of PA supports in the home) and adolescent perception of parenting style, parent autonomy support, parent emotional social support, and their own motivation for PA were assessed using self-report survey measures. All participants signed informed consent and were compensated \$20 for participation. The study was approved by the University of South Carolina Institutional Review Board prior to enrolling families in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Demographic Measures

Demographics were obtained for each participating family and included adolescent age, adolescent sex, parent education, and socioeconomic status.

Adolescent Measures

Parenting Style

Parenting style was assessed using six items from the Authoritative Parenting Index, a youth self-report measure [67] based on Baumrind's [38] parenting styles (authoritative (high warmth, moderate control), authoritarian (low warmth, high control), indulgent (high warmth, low control), and uninvolved (low warmth, low control). This measure was validated in a large sample of elementary and high school students

($\alpha = 0.77\text{--}0.85$). Authoritative parenting, as indicated by past research, has shown positive associations between the Authoritative Parenting Index and PA for non-minority adolescent girls [48] and with child attitudes towards healthy activity [68]. This study used three items from each subscale (responsiveness and demandingness) as used in previous literature to predict youth health outcomes [48, 69, 70] scored on a 4-point Likert scale. Items were chosen based on factor loadings ($\mu_{\text{responsiveness}} = 0.65$; $\mu_{\text{demandingness}} = 0.66$) and included items such as “My parents want to hear about my problems” and “My parents have rules that I must follow.” Items were summed with higher values indicating higher levels of authoritative parenting style and lower values reflecting more neglectful parenting styles. The 6-item-abbreviated measure used in this study was shown to be reliable ($\alpha = 0.79$) and comparable to the full scale [67].

Autonomy Supportive Parenting for PA

Autonomy supportive parenting for PA was measured using a 3-item adolescent-report scale which measured shared decision making around PA behaviors. Items were scored on a 4-point Likert scale ranging from strongly disagree to strongly agree. Items included “My parents allow me to choose what types of exercise activities I do,” “My parents ask me for ideas on which exercise activities we do together,” and “My parents encourage me to help in making decisions about how long I am active.” The full survey which includes items around diet and sedentary behavior in addition to PA has been previously used in African American adolescents participating in a health promotion program and has demonstrated adequate reliability ($\alpha = 0.75$; [71]). In the current study, the measure was found to be moderately reliable ($\alpha = 0.64$) and correlated with positive parenting measures such as authoritative parenting style ($r = 0.38$) and parent emotional support for PA ($r = 0.46$).

Emotional Support for PA

Parent emotional support for PA was measured using a modified version of a measure that assesses social support from family and friends for exercise behaviors as self-reported by adolescents [52]. Six items were scored on a 3-point Likert scale (ranging from “none” to “many times”) and averaged. Sample items included “In the past month, how often has your parent encouraged you to stick with being active?” This abbreviated version has previously been used in predominantly African American adolescent samples [33, 72, 73] and has been shown to have adequate internal consistency ($\alpha = 0.80\text{--}0.89$). Family social support for PA, as measured by this scale, has been associated with adolescent PA in previous studies [73–75] demonstrating predictive validity. In the current study, this scale was found have adequate reliability ($r = 0.86$).

To aid in adjusting for peer support, emotional support from peers for PA was used as a covariate. The six items were identical to the parent-support measure [52], but asked about friend behaviors (i.e., “In the past month how often has a friend reminded you to be active”). In previous studies, this measure has demonstrated reliability ranging from $\alpha = 0.79\text{--}0.88$ and shown concurrent validity for adolescent PA behaviors [76, 77]. Responses were recorded on the same 3-point Likert scale. This measure showed high reliability in the current sample ($\alpha = 0.91$).

Motivation for PA

Adolescent motivation for PA was measured using an 8-item scale that has been previously used with African American adolescents [78, 79]. Items were scored on a 3-point Likert scale (not like me to a lot like me) and included statements such as “being active is important to me” and “I am excited about being active on most days.” Previous measurement work [30] has found that this measure is correlated with enjoyment of activity ($r = 0.70$) and other measures of intrinsic motivation ($r = 0.63$), demonstrating construct validity and predictive validity for MVPA. This measure was found to be reliable in the current sample ($r = 0.87$).

Physical Activity

Objective measurement of PA duration and intensity was obtained using Actical omni-directional accelerometer estimates (Mini Mitter, Bend, OR). For adolescent PA, 60-s epochs and cut points developed for use in youth populations [80] were used to classify activity as LPA (counts between 100 and 1500; 1.6–2.9 metabolic equivalents) and MVPA (counts above 1500; >3 metabolic equivalents). Twenty consecutive zero counts were coded as time of non-wear as used in previous literature [81]. Actical accelerometers have been shown to account for 81% of variability in activity energy expenditure in youth ages 7–18 years and has been shown to be correlated with energy expenditure ($r = 0.83$; (80)).

Parent Measures

Tangible Support for Home PA

PA equipment availability in the home was used as a measure of tangible support for PA and was assessed using a parent-reported checklist of PA resources in the home environment [82]. The scale consists of 15 items (e.g., bike, basketball hoop, jump rope, sports equipment, swimming pool, roller skates/skateboard/scooter, fixed play equipment, home aerobic equipment, weight lifting equipment, water or snow equipment, yoga/exercise mats, exercise, play or rec room, trampoline, stairs, yard) and elicits responses on 5-point

Likert scale ranging from “not available” to ‘uses once a week or more.’ Responses were summed with higher scores indicating greater ability/use of tangible supports in the home. PA supports in the home as measured by this scale (both parent-report and adolescent-report) have been shown to be positively associated with self-report adolescent PA and sedentary behavior [82]. In the current study, this scale achieved a Cronbach’s alpha of 0.73.

Parent PA

Parent daily PA minutes were used as a covariate and were measured using Actical accelerometry estimates using previously validated cut points (LPA 110–1534, MVPA ≥ 1535 ; [83]). Sixty consecutive zero counts were coded as time of non-wear as used in previous studies [84]. LPA and MVPA were summed for total daily PA.

Statistical Analysis

Parent and adolescent accelerometry data was reduced in SAS and coded for missingness based on a commonly used-wear criteria which defined a valid day of wear as 10 h (600 total minutes of wear time) and required a minimum of three valid days for PA data to be included [85, 86]. Adolescents with PA data had an average of 7.0 days of accelerometry estimates, while parents had an average of 8.1 valid days of accelerometry estimates. Approximately, 8% of parents and 22% of adolescent participants’ activity data was coded as missing and dealt with using a single imputation using the R package Amelia which included all demographic, psychosocial, and PA variables. Because the MVPA data was skewed, a square-root transformation was used to achieve a more normal distribution. Influential cases in each model were examined by comparing leverage, Cook’s distance, and DFFITS values to proposed cut-off values [87]. One case was removed for LPA and two cases were removed for MVPA. Scores for each measure were calculated by norming each item before summation to allow each item to contribute equally to the overall scale score. Summed scale scores were transformed to *z* scores to aid in analysis and interpretation of statistical models.

Separate hierarchical regression analyses were used to examine the associations between whether authoritative parenting style, emotional support for PA, tangible support for PA, and autonomy support for PA, parent modeling of PA, and adolescent motivation with MVPA and LPA. Total PA was not examined as an outcome as it was highly correlated with LPA ($r = 0.97$). Because of the known relationships with adolescent PA behaviors, adolescent age, adolescent sex, parent education, and emotional support from peers were included as covariates

in each model. A dummy variable for cohort was included to account for seasonal changes on PA behavior. The final model for the regression predicting MVPA is displayed below. An identical model was also analyzed for LPA as the outcome.

$$\begin{aligned} \text{MVPA} = & \beta_0 + \beta_1 \text{Cohort} + \beta_2 \text{Age} + \beta_3 \text{Male} \\ & + \beta_4 \text{ParentEducation} + \beta_5 \text{FriendSupport} \\ & + \beta_6 \text{ParentingStyle} + \beta_7 \text{EmotionalSupport} \\ & + \beta_8 \text{TangibleSupport} + \beta_9 \text{AutonomySupport} \\ & + \beta_{10} \text{Parent PA} + \beta_{10} \text{Motivation} + \varepsilon \end{aligned}$$

Results

Demographic Data

Demographic data are presented in Table 1. Participants were predominantly female (66%) with female caregivers (94%). The majority of caregivers were obese ($M_{\text{BMI}} = 37.4$ (8.31)) with at least some college education. Adolescents engaged in an average of 217.96 min of LPA and 22.18 min of MVPA per day.

Table 1 Descriptive data for the total sample ($N = 148$)

Variable	Value
Adolescent age $M(SD)$	13.56 (1.74)
Adolescent BMI % $M(SD)$	96.54 (4.14)
Adolescent sex (female), (%)	66%
Parent age $M(SD)$	43.36 (8.21)
Parent BMI $M(SD)$	37.41 (8.26)
Parent sex (female) (%)	94%
Parent education, N (%)	
≤ 12 years	23 (15.54%)
Some college	55 (37.16%)
4-year college	33 (22.30%)
Professional degree	37 (25.00%)
Parent income, N (%)	
<\$10K	23 (15.54%)
\$10–24K	32 (21.62%)
\$25–39K	32 (21.62%)
\$40–54K	17 (11.49%)
\$55K+	44 (29.73%)
Adolescent LPA $M(SD)$	217.96 (54.53)
Adolescent MVPA $M(SD)$	22.18 (16.40)
Parent LPA $M(SD)$	192.89 (68.16)
Parent MVPA $M(SD)$	9.16 (10.98)

Correlation Analyses

Several parenting factors were significantly correlated (Table 2). Authoritative parenting style and parent emotional support for PA were positively correlated ($r = 0.29$), authoritative parenting style and autonomy support for PA were positively correlated ($r = 0.38$), and parent emotional support for PA and autonomy support for PA were positively correlated ($r = 0.46$). Several parenting variables were significantly correlated with adolescent PA outcomes. Authoritative parenting style ($r = 0.26$) and tangible support for PA ($r = 0.22$) were positively correlated with LPA. Parenting variables were not associated with MVPA. Motivation was correlated with several PA parenting variables including parenting style ($r = 0.24$), emotional support for PA ($r = 0.36$), tangible support for PA ($r = 0.21$), and autonomy support for PA ($r = 0.34$) and both PA outcomes (LPA $r = 0.32$; MVPA $r = 0.35$).

Parenting Factors and MVPA

A hierarchical regression model was used to examine whether authoritative parenting style, emotional support for PA, tangible support for PA, autonomy support for PA, parenting modeling of PA, and adolescent motivation were significant predictors of MVPA after controlling for covariates (Table 3). The overall model was significant ($F(11,134) = 4.35$, $p < 0.05$). The model accounted for 26% of the variance in adolescent MVPA and parenting variables, and motivation accounted for additional variance beyond covariates ($\Delta R = 0.14$, $p < 0.05$). Adolescent motivation for PA ($B = 0.58$, $SE = 0.16$) was positively associated with MVPA minutes. Unexpectedly, higher levels of emotional support for PA was associated with lower MVPA minutes ($B = -0.47$, $SE = 0.17$). No other parenting variables significantly predicted MVPA.

Parenting Factors and LPA

The model predicting LPA (Table 4) which included authoritative parenting style, emotional support for PA, tangible support for PA, autonomy support for PA, parent modeling of PA, and adolescent motivation accounted for additional variance above and beyond the covariates ($F(11,134) = 5.84$, $R^2 = 0.32$; $\Delta R = 0.14$, $p < 0.05$). The model accounted for 32% of the variance in adolescent LPA. Authoritative parenting style ($B = 15.71$, $S = 4.38$) and tangible home support for PA ($B = 8.53$, $SE = 4.02$) predicted adolescent LPA minutes such that higher levels of these variables were associated with a greater average minutes of daily LPA. Emotional support for PA was negatively associated with LPA minutes ($B = -11.22$, $SE = 4.79$) such that higher levels of emotional support was associated with lower average daily LPA minutes. Motivation was not a significant predictor of LPA minutes.

Follow-up analyses were conducted to examine whether authoritative parenting style also showed an indirect effect on LPA through specific PA parenting practices (emotional, tangible, and autonomy support for PA). None of the mediation models were significant. However, authoritative parenting was positively associated with both autonomy supportive parenting ($B = 0.33$, $SE = 0.08$) and emotional support for PA ($B = 0.30$, $SE = 0.08$; $p < 0.05$).

Follow-up Emotional Support Analysis

Given that past research has shown sex differences in the effects of emotional support on health outcomes [57–59], the relationship between parent emotional support and PA was further explored through post hoc analyses. First, an interaction between sex and parent emotional support was included in the model. The interaction term was nonsignificant for both LPA ($B = -10.30$, $SE = 8.92$, $p > 0.05$) and MVPA ($B = -0.24$,

Table 2 Correlations among demographic characteristics, parenting factors, and physical activity

	Age	Male	BMI	ED	FS	PS	ES	TS	AS	P.PA	Mot	LPA
Male	0.02	–										
BMI	–0.15	0.08	–									
Parent Education	0.06	–0.21	0.01	–								
Friend Support	0.04	0.12	0.18	–0.13	–							
Parenting Style	0.03	–0.07	–0.07	0.01	0.16	–						
Emotional Support	–0.04	–0.02	0.14	0.07	0.46	0.29	–					
Tangible Support	–0.16	0.02	0.05	–0.04	0.05	0.05	0.05	–				
Autonomy Support	0.05	–0.04	0.12	0.11	0.46	0.38	0.46	0.01	–			
Parent PA	0.01	–0.09	–0.01	–0.04	–0.03	0.15	–0.10	–0.04	0.14	–		
Motivation	–0.23	0.12	0.06	–0.16	0.38	0.24	0.36	0.21	0.34	–0.03	–	
LPA	–0.29	0.18	0.11	–0.22	0.16	0.26	0.02	0.22	0.14	–0.01	0.32	–
MVPA	–0.14	0.24	–0.01	–0.24	0.08	0.05	–0.07	0.13	0.11	0.10	0.35	0.38

Italic values indicate correlations significant with alpha criteria of 0.05. Column headings correspond to row names

Table 3 Regression analyses predicting adolescent MVPA

	<i>B</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>r</i>	<i>R</i> ²	ΔR^2
Model 1: $F(5140) = 3.90, p < 0.05$						0.12	
β_0	7.13	1.37	5.21	<0.01*			
β_1 , cohort	0.13	0.07	−1.73	0.07	0.14		
β_2 , adolescent age	−0.14	0.08	−1.73	0.09	−0.14		
β_3 , adolescent male	0.67	0.31	2.19	0.03*	0.17		
β_4 , parent education	−0.30	0.13	2.24	0.03*	−0.18		
β_5 , friend emotional support	0.06	0.14	0.42	0.68	0.03		
Model 2: $F(11,134) = 4.35, p < 0.05$						0.26	0.14*
β_0	5.75	1.44	4.00	<0.01*			
β_1 , cohort	0.10	0.07	1.45	0.15	0.11		
β_2 , adolescent age	−0.07	0.08	−0.92	0.36	−0.07		
β_3 , adolescent male	0.58	0.29	1.98	0.05*	0.15		
β_4 , parent education	−0.23	0.13	−1.89	0.08	−0.13		
β_5 , friend emotional support	−0.07	0.16	−0.40	0.69	−0.03		
β_6 , parenting style	0.04	0.15	0.30	0.77	0.02		
β_7 , emotional support	−0.47	0.17	−2.85	<0.01*	−0.21		
β_8 , tangible support	0.14	0.14	1.00	0.32	0.07		
β_9 , autonomy support	0.25	0.18	1.40	0.16	0.10		
β_{10} , parent PA	0.00	0.00	0.62	0.53	0.05		
β_{11} , motivation	0.58	0.16	3.66	<0.01*	0.27		

$N = 147$, r = semipartial correlation

*Indicates significance with alpha criteria of 0.05. One influential case was removed

Table 4 Regression analyses predicting adolescent LPA

	<i>B</i>	<i>SE</i>	<i>t</i>	<i>p</i>	<i>r</i>	<i>R</i> ²	ΔR^2
Model 1: $F(5141) = 6.07, p < 0.05$						0.18	
β_0	355.34	40.24	8.80	<0.01*			
β_1 , cohort	3.89	2.20	1.77	0.08	0.14		
β_2 , adolescent age	−8.39	2.41	−3.49	<0.01*	−0.27		
β_3 , adolescent male	15.51	9.07	1.71	0.09	0.13		
β_4 , parent education	−8.03	3.89	−2.06	0.04*	−0.16		
β_5 , friend emotional support	7.71	4.16	1.85	0.07	0.14		
Model 2: $F(11,135) = 5.84, p < 0.05$						0.32	0.14*
β_0	356.98	41.73	8.56	<0.01*			
β_1 , cohort	2.10	2.08	1.01	0.31	0.07		
β_2 , adolescent age	−7.13	2.33	−3.05	<0.01*	−0.22		
β_3 , adolescent male	14.07	8.50	1.67	0.10	0.12		
β_4 , parent education	−8.02	3.77	−2.13	0.04*	−0.15		
β_5 , friend emotional support	3.74	4.81	0.78	0.44	0.06		
β_6 , parenting style	15.71	4.38	3.59	<0.01*	0.25		
β_7 , emotional support	−11.22	4.79	−2.35	0.02*	−0.17		
β_8 , tangible support	8.53	4.02	2.12	0.04*	0.15		
β_9 , autonomy support	7.35	5.12	1.44	0.15	0.10		
β_{10} , parent PA	−0.06	0.06	−1.00	0.32	−0.07		
β_{11} , motivation	6.48	4.60	1.41	0.16	0.10		

$N = 146$, r = semipartial correlation

*Indicates significance with alpha criteria of 0.05. Two influential cases were removed

$SE = 0.31$, $p > 0.05$). The relationship was further explored using models stratified by gender. In the full model predicting LPA, parental emotional support for PA was a significant negative predictor for males ($B = -29.33$, $SE = 11.72$, $p < 0.05$), but not females ($B = -7.21$, $SE = 5.20$, $p > 0.05$). In the full model predicting MVPA, parental emotional support for PA approached significance for males ($B = -0.72$, $SE = 0.38$, $p = 0.07$), but not females ($B = -0.27$, $SE = 0.18$, $p = 0.15$).

Discussion

The current study examined the relationship between authoritative parenting style, autonomy support for PA, parental emotional and tangible support for PA, and adolescent motivation for PA on accelerometry-measured MVPA and LPA in African American youth who are overweight. Models predicting MVPA and LPA were significant and explained 26% and 32% of the variance, respectively. Factors associated with Self-Determination Theory, Social Cognitive Theory, and Family Systems Theory explained 14% of the total variance in adolescent daily MVPA with motivation being the largest positive predictor. These factors also explained 14% of the total variance in adolescent daily LPA with authoritative parenting style and tangible support positively predicting LPA minutes. Unexpected results were found for emotional support such that emotional support for PA from parents was negatively associated with both MVPA and LPA in this sample. However, follow up analyses showed the pattern more specifically for males. In contrast to previous literature showing associations between parenting factors and MVPA, other parenting variables did not predict MVPA minutes. Adolescent motivation for PA was not associated with daily minutes of LPA in youth.

Findings of the current study suggest that the relationship between motivation for PA and adolescent PA behaviors differs based on the intensity, with motivation for PA being more strongly associated with MVPA. Similar to the current findings, motivation for PA has been linked to MVPA in overweight/obese youth [28, 29] and other adolescent populations [27]. While previous studies examining this relationship in adolescents who are overweight have relied on self-reported measures [23, 24], studies utilizing objective measures of MVPA in healthy-weight samples have also shown positive relationships [22]. The current study expands on this previous research by demonstrating the relationship between motivation for PA and MVPA as measured by accelerometry in African American adolescents who are overweight and obese. While motivation for PA was associated with MVPA, the results also suggest that it may not be related to lower intensities of PA (LPA) in comparison to family factors in this population.

Current findings also suggest that parenting factors relate differently to varying intensities of PA. Previous research that has often found positive associations between parenting practices and MVPA has not focused on overweight samples of underserved ethnic minorities who engage in lower levels of PA [88]. Authoritative parenting and parenting practices specific to PA were not found to be significantly associated with MVPA levels in the current sample, which suggests that parenting-related predictors of PA may function differently in samples with high numbers of barriers to PA and lower overall engagement in PA compared to healthy-weight, active youth. Studies have demonstrated that youth who are overweight or obese have less positive attitudes about engaging in MVPA, such as not enjoying it or being insecure about skill or appearance [89]. Further, youth who are overweight report higher levels of body, social, and support-related barriers to MVPA [90]. Focusing on family correlates that are associated with rates of LPA may allow for improvements in overall energy expenditure and health benefits [10–17] while working within these barriers.

This study demonstrated support for the association between general authoritative parenting style and LPA. Limited research is available describing the relationship between parenting style and PA, and no studies have focused on evaluating the relationship with LPA or in an overweight, African American adolescent population. Schmitz et al. [48] found that having an authoritative mother was more likely to be associated with self-reported total PA a year later in a primarily White sample (weight-status not reported). Similar to the current results, studies that have focused on MVPA have not found positive relationships. Two cross-sectional studies using accelerometry-measured MVPA found no associations with authoritative parenting [91, 92], while Berge and colleagues [93] found no relationship between authoritative parenting and self-reported MVPA. The current study fills a gap in the literature by describing a positive relationship between authoritative parenting style and accelerometry-measured LPA in an overweight, African American population. Further, associations with LPA were larger for parenting style than for parenting practices specific to PA. General parenting style, such as authoritative parenting, may provide a context in which specific parenting practices occur, and there is recent evidence that family functioning (communication and affective involvement) are associated with positive adolescent PA outcomes [94]. These results suggest that for adolescents who are overweight or obese, parenting style may be critical and more influential than the parenting practices specific to PA, although further research is needed to replicate these findings given the modest reliability of the scale in the present study.

In the present study, tangible environmental support was also shown to have a positive association with adolescent LPA, but not MVPA. This is consistent with a previous study which found a trend approaching significance for the

association between tangible environmental support and accelerometry-measured LPA in youth who are overweight [56]. In a sample similar to the current study (adolescents who are minimally active), variety of home PA equipment was significantly correlated with self-reported active lifestyle activities which map onto LPA such as taking the stairs or walking [95]. However, a number of previous studies have shown a positive relationship between home environmental support and MVPA which is inconsistent with current findings. Tangible supports, as measured by provision of home PA resources, have been shown to be associated with accelerometry-measured MVPA [96] and self-reported MVPA [82], but these studies did not focus on overweight samples. Some evidence has emerged that tangible environmental support is associated with accelerometry-measured MVPA only for healthy weight youth and not youth who are overweight [97]. Previous literature examining relationships between tangible environmental support and PA, coupled with the current findings, suggest that associations may differ based on weight status with home environmental support being associated with LPA, but not MVPA for adolescents who are overweight.

Emotional support from parents was negatively associated with MVPA and LPA in the full models, and follow-up analysis demonstrated that this effect was more strongly shown for adolescent males. This is in contrast to several previous studies that found positive associations [33, 55, 75, 98–100] or no association [32, 101] between PA and emotional support. However, previous investigators who examined the relationship between emotional support and PA in predominantly African American sample have found positive associations for LPA, but no relationship between emotional support and MVPA [56]. Past studies have shown negative effects of emotional support for boys as compared to girls on health behavior compliance [59] and cardiovascular reactivity responses [102, 103] in African American adolescents. Consistent with these studies, the results suggest that emotional support may function differently across sex, with males reacting less positively or even negatively to this type of social support. It is also possible that encouragement for PA was perceived negatively in the current sample as the measure used did not capture tone of communication.

Autonomy supportive parenting specific to PA did not emerge as a positive predictor of adolescent PA minutes in this sample. This finding is consistent with studies that have evaluated the relationship between parent autonomy-support for PA and step-counts in minority samples that are at-risk for overweight [104]. Some research examining the relationship between parent autonomy-support for PA and step-counts in healthy-weight samples did find a positive relationship, however [51]. Studies that have focused on MVPA have found significant relationships between parent autonomy-support for PA and MVPA as measured by self-report [49, 50] in

contrast to the current findings. However, limited previous research has examined autonomy supportive parenting for PA and PA using accelerometry estimates, and future studies are needed to clarify the relationship using these measures.

Limitations of the current study should be considered in the interpretation of the results. The sample displayed a restricted range of MVPA minutes that may have limited ability to find effects. This cross-sectional study does not allow for causal inferences or definitive conclusions about the directions of effects. While it is likely that authoritative parenting styles positively influence youth LPA levels, it is also possible that parents exhibit more nurturance and monitoring in response to higher levels of adolescent PA engagement. Future studies should consider implementing longitudinal study designs to clarify the direction of effects and explore potential mechanisms for the relationship between parenting style and LPA. This study also used abbreviated versions of some parenting measures (authoritative parenting, emotional support for PA) to reduce participant burden and did not capture other parenting styles. While the abbreviated versions have been used in previous studies, this should be considered in comparison to other studies utilizing these scales. There may also be generalizability limitations to the present study. The study included a sample of overweight African American youth in the Southern USA, and it is unclear how cultural factors including family structure, social norms, or level of collectivism may have influenced the results. The models explained limited amounts of variance in PA outcomes and other individual level factors such as temperament, self-efficacy, enjoyment, or peer social environment should be considered in future studies.

Despite limitations, the study makes important contributions to the literature by including MVPA and LPA to examine potential parenting-related and motivational predictors of PA in youth. Parenting factors including both general authoritative parenting style and parenting practices specific to PA were included in the model, which allowed for differentiation and comparison of associations between parenting behaviors and PA. Objective accelerometry estimates were used for adolescent PA and parent modeling variables, which are less susceptible to social desirability or recall bias, providing more reliable estimates of minutes of PA. A lack of research focusing on youth's perception of their parent's parenting style and parenting practices has been noted as an important gap in the current literature on child obesity [37]. Parenting practices in this study were primarily youth-reported which is influenced less by their parent's intention. Finally, the majority of research regarding youth health behaviors has been conducted in healthy-weight, White samples. This study fills a gap in the literature by examining the associations between parenting factors, motivation, and PA in an overweight/obese African American adolescent sample.

Factors associated with Self-Determination Theory, Social Cognitive Theory, and Family Systems Theory were associated with adolescent PA, yet predictors were inconsistent across PA intensities. Adolescent motivation was most closely associated with MVPA suggesting that this variable may be an important target for increasing more intense forms of exercise for adolescents who are overweight. In contrast, parenting factors that map onto the general home climate, specifically an authoritative parenting style and tangible environmental support, were positively related to youth LPA. Consistent with Family Systems Theory, these results support previous research identifying parents as change-agents for improving obesogenic home environments [39, 105] and finding support for the inclusion of parents in health promotion interventions [40, 106] for lower intensities of PA. Authoritative parenting that provides a positive, warm environment and monitoring of health behaviors, coupled with providing resources which make engaging in PA safe and enjoyable may facilitate higher levels of activity in at-risk adolescents. The results also underscore the importance of examining predictors of PA across the PA intensity spectrum in samples that are less likely to engage in MVPA. Future research should consider examining these variables in longitudinal and intervention studies to determine if targeting motivational factors for MVPA and parenting factors for LPA may be effective strategies for improving PA levels in African American youth who are overweight or obese.

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Compliance with ethical standards

Conflict of interest The authors declare no conflicts of interest.

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