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The Relationship between Psychosocial Correlates and Physical Activity in Underserved Adolescent Boys and Girls in the ACT Trial

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Abstract

Background—Previous research suggests motivation, enjoyment, and self-efficacy may be important psychosocial factors for understanding physical activity (PA) in youth. While previous studies have shown mixed results, emerging evidence indicates relationships between psychosocial factors and PA may be stronger in boys than girls. This study expands on previous research by examining the effects of motivation, enjoyment and self-efficacy on PA in underserved adolescent (low income, ethnic minorities) boys and girls. Based on previous literature, it was hypothesized the effects of motivation, enjoyment and self-efficacy on moderate-to-vigorous PA (MVPA) would be stronger in boys than in girls.

Methods—Baseline cross-sectional data were obtained from a randomized, school-based trial (Active by Choice Today; ACT) in underserved 6th graders (N=771 girls, 651 boys). Intrapersonal variables for PA were assessed via self-report and confirmatory factor analyses were conducted for each predictor. MVPA was assessed with 7-day accelerometry estimates.

Results—Multivariate regression analyses stratified by sex demonstrated a significant positive main effect of self-efficacy and motivation on MVPA for girls. Boys also showed a positive trend for the effect of motivation on MVPA.

Conclusions—The results from this study suggest motivation and self-efficacy should be better integrated to facilitate the development of more effective interventions for increasing PA in underserved adolescents.

Keywords

psychosocial correlates; adolescents; African Americans; sex differences; motivation; self-efficacy

Physical activity (PA) has been shown to decline rapidly during childhood and adolescence 1, 2. While national recommendations and experts call for at least 60 minutes per day of moderate-to-vigorous PA (MVPA) 3, 4, previous research has shown less than 10% of US adolescents are meeting this recommendation 5. Furthermore, underserved adolescents (ethnic minorities, low-income) have been shown to be less likely to meet PA recommendations than non-minorities and adolescents from higher income backgrounds 6. Understanding factors that may lead to increasing MVPA is important as obesity trends continue to be a public health concern 7. It is especially important to increase our understanding of psychosocial factors for PA in underserved adolescents who are typically less physically active than their higher income and non-minority peers 8, 9.

Self-Determination Theory (SDT) 10 and Social Cognitive Theory (SCT) 11 provide two theoretical frameworks for understanding how psychosocial factors may relate to PA in underserved youth. A novel aspect of this study is the examination of these complimentary theoretical perspectives (e.g. motivation and self-efficacy) on understanding factors related to PA behavior specifically in underserved adolescents 12- 13. According to SDT, behaviors that are motivated by intrinsic factors, such as autonomy, belongingness, and competence are more likely to be sustained than behaviors that are extrinsically motivated 10. Furthermore, a variety of factors (e.g., autonomy, competence, belongingness) influence the degree of intrinsic motivation for engaging in a given behavior. Enjoyment of an activity, such as engaging in PA, is important in the development of intrinsic motivation and has been described as a specific regulatory process of intrinsic motivation 10. Experiencing enjoyment and personal satisfaction from engaging in PA leads to increased intrinsic motivation and sustained PA behavior 14. SCT integrates individual-cognitive factors and social-environmental factors to predict behavior 11. SCT emphasizes the importance of development of individual behavioral competence or self-efficacy beliefs related to engaging in behaviors such as PA 15. In the present study both SDT and SCT provide a framework for examining relationships between motivation, enjoyment, self-efficacy and PA in underserved adolescents and, specifically, how those relationships may vary for boys and girls.

Previous studies that have investigated sex differences in motivation, enjoyment and self-efficacy related to PA have shown somewhat inconsistent findings. However, in general, previous studies suggest a stronger relationship between psychosocial factors and PA for boys than girls 16. Little previous research has directly compared boys versus girls across psychosocial factors such as motivation, enjoyment and self-efficacy for PA. Research directly comparing intrinsic motivational differences in boys' and girls' PA has been explored primarily in the context of competition 16 or physical education 17, 18, 19-21. Deci and Ryan 16 reviewed four studies examining sex differences in competitive settings and the effects on intrinsic motivation and concluded that boys seem to find competition more compelling, engaging and prefer it over no competition. In contrast, girls found competition aversive, and it undermined intrinsic motivation 16. In a physical education context, Ferrer-Caja & Weiss 17 found the relationship between intrinsic motivation and motivated behaviors for girls and boys in physical education classes worked similarly and thus, did not find support for sex-specific models.

Other investigators have found mixed support for sex differences in motivation and PA. Tappe and colleagues 22 found that predictors of PA behavior (including both leisure-time and competitive activities) varied as a function of sex such that intrinsic motivation positively predicted PA level for girls but not for boys. However, Gillison and colleagues' 13 demonstrated the effects of motivation on leisure-time PA were largely similar across sex though boys reported significantly higher levels of motivation. Furthermore, intrinsic motivational factors for engaging in PA have been shown to differ in boys and girls such that girls report enjoyment, health benefits (i.e., appearance and weight concerns), choice, variety, and stress management as motivators while boys report enjoyment, choice, competition, strength, and skills as motivators 22- 23. In summary, although some investigators have shown that intrinsic motivation was more strongly related to PA in boys (vs. girls) in competitive settings, these effects are inconsistent and have not been shown when evaluating leisure-time PA.

Enjoyment has been conceptualized as a necessary component of intrinsic motivation 24. Previous research has examined the effects of enjoyment on PA, and several studies have found strong, consistent associations 25- 26. Some investigators have observed sex differences. For example, in a three-year longitudinal study, DiLorenzo et al 25 found

enjoyment to be an important predictor of PA (including leisure-time and competitive activities) and the only consistent finding among boys and girls. The Diloranzo et al. study determined that enjoyment appeared particularly important among girls in that social components (e.g., modeling, social support) predicting girls' PA got stronger over time while intrapersonal components (e.g., self-efficacy) became stronger for boys.²⁵ Similarly, Sallis and colleagues²⁷ found enjoyment to be one of three variables showing strong, consistent relationships with PA with girls showing slightly stronger correlations. However, in the Trial for Activity for Adolescent Girls (TAAG), enjoyment of PA was not associated with participation in structured PA,²⁸ and qualitative work has shown that boys reported participation in PA because of having fun more often than girls²³. In general, previous research suggests enjoyment may be an important factor influencing PA and that sex differences, though inconsistently shown, may characterize these effects. In particular, whether types of PA activities are structured versus leisure-time may differentially influence enjoyment level for PA in girls.

SCT suggests self-efficacy is a primary factor influencing behavior and interacts with social and environmental variables to change behavior¹⁵. While self-efficacy has been shown to be a consistent, important factor effecting PA^{15, 29, 30}, the available research on sex differences in self-efficacy for PA in youth is still somewhat inconsistent. Past research has found that boys generally report higher levels of self-efficacy for PA than girls^{31–33}. However, few studies have directly examined differential effects of boys' and girls' self-efficacy levels as they relate to PA. A longitudinal study of 111 children showed self-efficacy was more strongly related to PA in boys than in girls²⁵. Though the importance of different determinants of PA was highly variable, the authors concluded that personal interest in PA (e.g., self-efficacy for PA) became more significant for boys over time as compared to girls. These results are consistent with those of Cardon and colleagues³⁴ who found that boys engaged in significantly more PA and had significantly higher levels of self-efficacy than girls in a sample of 1124 10- to 11-year-olds.

In summary, the studies reviewed above suggest that motivation, enjoyment and self-efficacy for PA may be differentially associated with PA for boys versus girls. The inconsistency in previous literature surrounding sex differences in psychosocial constructs may be related to a failure to achieve measurement invariance, when two or more groups (e.g., boys and girls) have the same underlying levels of a measured construct and receive the same observed score on that measure. That is, boys and girls may be responding to psychosocial measures differently, which would cause more inconsistency in the literature on psychosocial sex differences. However, some studies have not tested for measurement invariance^{18, 20, 25, 34}. Given the relative paucity of research on underserved adolescents and sex differences in understanding psychosocial factors related to PA, further investigation is warranted. In addition, few investigators have evaluated these relationships using accelerometry data in large samples of youth. Thus, research is needed utilizing accelerometry data as relationships with self-reported PA differ from those of accelerometry estimates of PA with the latter tending to show weaker relationships given self-report measures may be bias³⁵. Examining sex differences are particularly important as PA interventions have been shown to be less effective in girls³⁶ and rates of PA are lower in girls as compared to boys, especially from underserved backgrounds. This study builds on previous research by exploring the relationship between motivation, enjoyment, self-efficacy, and PA in underserved adolescent boys and girls. Understanding these psychosocial constructs related to PA could inform future development of more efficacious sex specific interventions that promote long-term lifestyle changes in boys and girls. While previous research is inconsistent, it seems the relationships between motivation, enjoyment, self-efficacy, and PA are generally stronger in boys than girls. In the present study, it was hypothesized that motivation, enjoyment and self-efficacy would display significant

relationships with MVPA for boys and girls, and that the magnitude of these relationships would be stronger for boys.

Methods

Participants

Participants were part of a larger, ongoing, randomized-control trial, “Active by Choice Today” (ACT), examining a motivational plus behavioral skills intervention to increase PA in underserved adolescents. A detailed description of the ACT trial has previously been published³⁷. Students were ineligible to participate if they 1) had a medical condition that prevented participation in MVPA, 2) were developmentally delayed such that the intervention materials were not cognitively appropriate or, 3) were currently in treatment for a psychiatric disorder. This study examined the baseline measures of 1422 (771 girls and 651 boys) adolescent participants from the ACT trial (see Table 1 for demographics). The ACT trial was a four-year group-randomized cohort design involving 24 middle schools (73% minority, 71% free/reduced lunch).

Procedure

Adolescents were invited to participate in the study through recruitment at 24 middle schools throughout South Carolina. Staff members were present at school orientations and conducted homeroom visits to recruit participants. All parents/guardians completed an IRB approved parental consent form, and all adolescent participants completed an IRB approved assent form. After recruitment and before randomization to treatment condition, trained measurement staff collected baseline measures for all students. Baseline measures were collected over a two-week time period during the school days in groups and included a survey (demographics and psychosocial measures), objectively collected height, weight, and waist circumference, and 7-day accelerometer estimates of PA. During week 1, activity monitors were distributed, anthropometrics were collected, and surveys were administered. During week 2, activity monitors were returned. Survey measures were modified for a 3rd grade reading level and through expert input from international consultants. Specifically, all measure response options were modified to be answered on a three-point scale ranging from 1 = Not like me, 2 = A little like me to 3 = A lot like me. This was done to increase the likelihood that youth would be able to meaningfully discriminate between response options. Furthermore, some wording changes were made to specific items to ensure comprehension by underserved adolescents. Body mass index (BMI) was calculated from objective height and weight data. Participants received a \$5 gift-card incentive for completing baseline assessments.

Measures

Motivation for PA—Motivation for PA was measured using a 10 item questionnaire from previous work^{38, 39}. Example items included “It is important to be active everyday” and “I am excited about being active most days”. Correlations with enjoyment ($r = .70$) and with an additional intrinsic motivation measure ($r = .63$) suggest aspects of both enjoyment and intrinsic motivation are being measured with the motivational measure used in this study. The 10 items were standardized and averaged to create an overall measure of motivation. To test whether the factor structure was the same as previous work using this scale, a confirmatory factor analysis (CFA) using WLSMV estimation¹ was conducted in Mplus. Fit indices revealed the model fit was inadequate ($\chi^2(29) = 485.5$; $p < .001$; CFI = .93; TLI = .

¹WLSMV estimation is a strong approach to dealing with non-normal ordinal data (Flora 2008), however, because df and chi-square values are both estimated chi-square difference tests and other comparisons of fit between nested models must be estimated and cannot be made directly. Df and differences in df do not necessarily match the number of parameters.

97; RMSEA = .10) when all 10 items were included in the model. A second CFA dropping two negatively worded items improved the model and demonstrated acceptable fit (χ^2 (18) = 146.2; $p < .001$; CFI = .98; TLI = .99; RMSEA = .07)², standardized residuals were all under .08, and there was good reliability in the present study ($\alpha = .88$ for boys, $\alpha = .88$ for girls). These results are consistent with past research using other psychosocial measures in underserved girls, which found support for a methodologic effect for positively worded items⁴⁰. Measurement invariance was tested by comparing two models. One model constrained factor loadings, thresholds, and item residuals to be equal across sex and was compared to a second model where these parameters were freely estimated for boys and girls. Fit indices were acceptable (χ^2 (34) = 145.7; $p < .001$; CFI = .98; TLI = .99; RMSEA = .07) for the unconstrained model, and also adequate (χ^2 (42) = 127.8; $p < .001$; CFI = .99; TLI = .995; RMSEA = .05) for the constrained model. However, the chi-square difference test showed the unconstrained fit the data significantly better than the constrained model (χ^2 (16) = 29.43; $p < .05$), providing some evidence against measurement invariance. Construct validity is supported in the current study by significant, positive relationships with self-efficacy ($r = .62$, $p < .01$), enjoyment ($r = .70$, $p < .01$) and MVPA ($r = .18$, $p < .01$).

Enjoyment for PA—Enjoyment for PA was measured using a modified version of the Physical Activity Enjoyment Scale (PACES)^{40 41}. Examples of scale items include, “When I am active it feels good,” and “When I am active I find it fun.” Fifteen items were standardized and averaged to create a measure of enjoyment. Based on previous research utilizing this scale in a sample of slightly older adolescent girls⁴⁰, a CFA using WLSMV estimation was run in Mplus to test whether items loaded onto a single enjoyment factor. Fit indices showed inadequate fit (χ^2 (33) = 760.3; $p < .001$; CFI = .90; TLI = .96; RMSEA = .12) when all 15 items were included in the model.³ A second CFA using the nine positively worded items (similar with previous studies)³⁷ improved the model and demonstrated acceptable fit (χ^2 (24) = 145.1; $p < .001$; CFI = .98; TLI = .99; RMSEA = .06) and showed good reliability in the present study ($\alpha = .90$ for boys, $\alpha = .90$ for girls). These results are consistent with past research using the PACES which found support for a methodologic effect for positively worded items⁴⁰. Therefore, the current study utilizes the positive enjoyment factor consisting of 9 items. Measurement invariance between boys and girls was tested in comparing a model with factor loadings, thresholds, and item residuals constrained to be equal across sex with a second model where these parameters were freely estimated for boys and girls. Fit indices showed acceptable fit for the constrained model (χ^2 (44) = 118.6; $p < .001$; CFI = .99; TLI = .997; RMSEA = .05). However, a chi-square difference test showed the unconstrained model fit the data significantly better than the constrained model (χ^2 (17) = 28.56; $p < .05$), and fit indices were acceptable (χ^2 (44) = 169.4; $p < .001$; CFI = .98; TLI = .994; RMSEA = .06). Construct validity was supported in the theoretically supported relationships with motivation ($r = .70$, $p < .01$), self-efficacy ($r = .55$), and MVPA ($r = .13$, $p < .01$).

Self-efficacy for PA—Self-efficacy for PA was measured with a modified version of the Self-Efficacy scale developed by Saunders and colleagues^{42–44}. Examples of scale items include, “I can be active in my free time on most days,” and “I can ask my best friend to be active with me in my free time on most days.” Ten items were standardized and averaged to create a measure of self-efficacy. A CFA using WLSMV estimation was run to examine whether items loaded onto one factor of self-efficacy. Fit indices showed modest model fit (χ^2 (32) = 217.9; $p < .001$; CFI = .90; TLI = .93; RMSEA = .06), standardized residuals were all less than .06. This scale demonstrated adequate reliability ($\alpha = .73$ for girls, $\alpha = .70$ for

²Analysis of the items and item residuals suggested the two negatively worded items were causing poor fit.

³Analysis of the items and of the residual item variances suggested a second factor (6 items) associated with negatively worded and/or reverse scored items, which we did not use for the purposes of this study as the items were not theoretically relevant.

boys) in the present study. Measurement invariance, tested in the same manner as described above for other measures showed inadequate fit ($\chi^2(78) = 331.7$; $p < .001$; CFI = .87; TLI = .92; RMSEA = .07) for the constrained model, and better fit for the unconstrained model ($\chi^2(61) = 238.1$; $p < .001$; CFI = .91; TLI = .93; RMSEA = .06). The chi-square difference test comparing the two models rejected the hypothesis of no differences in measurement between boys and girls ($\chi^2(23) = 111.4$; $p < .05$). Construct validity was supported with theoretically supported positive relationships with motivation ($r = .62$, $p < .01$), enjoyment ($r = .55$, $p < .01$), and MVPA ($r = .16$, $p < .01$).

In sum, with some modification reasonable factor structures were found for the three predictors, motivation, enjoyment, and self-efficacy. However, there was evidence of some sex differences in the measurement of each of these constructs, thus limiting the ability to compare boys and girls on any of these measures directly⁴⁵.

Physical activity measure (accelerometers)—Assessments of PA behavior were obtained with omni-directional accelerometers as the primary PA outcome in this study using the Actical accelerometer (Mini-Mitter, Bend, OR). Previous studies have demonstrated moderate to high correlations between Actical estimates and activity counts and energy expenditure of individuals measured concurrently by other empirically tested accelerometers (e.g., MTI Actigraph, Caltrac, Tritrac) in several studies⁴⁶. Participants wore an accelerometer over seven consecutive days (Tuesday through Monday) to calculate MVPA at baseline. Each day of Actical data were divided into five intervals: 6–9 am, 9–2 pm, 2–5 pm, 5–8 pm, and 8 pm to midnight. Data were recorded in 1-minute epochs⁴⁷, and raw activity data were converted into time spent in moderate PA (3 to <6 METS), vigorous PA (6 to <9 METS), and MVPA (3 to <9 METS) based on Actical-specific activity count thresholds identified by Puyau et al.⁴⁶ where MVPA = 1,500 to <6,500 and VPA = $\geq 6,500$. Following a previous national multi-site trial's procedures, a student's data were considered missing for a given time period if they wore the accelerometer less than 80% of the time that 70% of the students wore their accelerometers⁴⁸. Missing data were dealt with using single imputation. Following data imputation, minutes of PA are summed for each interval to produce daily counts of PA. All seven days are then averaged to provide one measure of average daily MVPA.

Data Analysis

A hierarchical regression procedure was conducted to evaluate the effects of motivation, enjoyment and self-efficacy on MVPA. A multivariate analysis including all predictors was run stratified by sex given that the psychosocial measures showed sex non-invariance. Therefore, stratified models are presented. It is important to note that a full model with interactions with sex was also conducted and showed only a significant main effect for motivation⁴. As the data contain a nested structure (students clustered within schools), intraclass correlations and design effects (the multiplier by which standard errors are increased due to clustering) were calculated to examine the degree to which individual level variation was explainable by school level variation. Intraclass correlations ranged between .01 and .02 and individual level design effects, calculated using the formula from Neuhaus and Segal⁴⁹, ranged between 1.006 and 1.012 for this study, supporting the use of individual level analyses. Cohort was included as a covariate to account for cohort effects.

⁴The overall model was significant ($F(8, 1412) = 23.37$, $p < 0.05$). Results showed a significant main effect for motivation ($\beta = .478$, $se = 2.19$, $T(1420) = 2.18$, $p < .05$) but not for self-efficacy ($\beta = 3.67$, $se = 2.60$, $T(1420) = 1.41$, $p > .05$) or enjoyment ($\beta = 1.34$, $se = 2.02$, $T(1420) = 0.66$, $p > .05$). The sex interactions with motivation ($\beta = -1.80$, $se = 2.84$, $T(1420) = -0.63$, $p > .05$), self-efficacy ($\beta = -0.17$, $se = 3.35$, $T(1420) = -0.05$, $p > .05$), and enjoyment ($\beta = 2.94$, $se = 2.63$, $T(1420) = -1.12$, $p > .05$) were not statistically significant.

The original sample size was 1422. One outlier with an extreme value on MVPA was excluded from the analyses resulting in a final sample size of 1421.

Results

Participant Characteristics

Demographic and baseline characteristics by sex are presented in Table 1. T-tests demonstrated that boys showed significantly higher levels of MVPA than girls ($p < .01$) and were significantly older ($p < .01$). Means and standard deviations for motivation, enjoyment, and self-efficacy are presented in Table 1 stratified by sex. No other differences were significant.

Psychosocial Construct Correlation Analyses

Correlation analyses were performed to determine the relationships between motivation, enjoyment, self-efficacy, and MVPA. Correlations for the sample as a whole (not shown) were examined ($p < .05$ for all). Correlations showed MVPA was significantly correlated with motivation ($r = .18$), self-efficacy ($r = .16$), and enjoyment ($r = .13$). Thus, construct validity for the measures was supported via theoretically supported positive relationships between theoretical constructs and in their relationships to MVPA. Higher levels of motivation, self-efficacy, and enjoyment were associated with higher levels of MVPA. Interestingly, the relationship between motivation and MVPA was stronger than those of enjoyment and self-efficacy and MVPA.

Additional correlation analyses for the variables of interest were examined stratified by sex (shown in Table 2). Motivation, self-efficacy, and enjoyment were related to MVPA for boys (r ranged from .15 – .18) and girls (r ranged from .07 – .13).

Multivariate Regression Predicting MVPA for Girls

A hierarchical regression procedure was used for this analysis with cohort entered as a covariate on the first step. Motivation, enjoyment and self-efficacy were entered on the second step. The model for step one was not significant ($F(1,769) = .17, p > .05$). The overall model for step two was significant, and results are presented in Table 3 ($F(4, 766) = 4.37, p < 0.05$). Significant effects for self-efficacy and motivation were found such that girls who reported higher levels of motivation and self-efficacy showed greater MVPA than adolescents who reported lower levels of motivation and self-efficacy.

Multivariate Regression Predicting MVPA for Boys

A hierarchical regression procedure was used for this analysis with cohort entered as a covariate on the first step. Motivation, enjoyment and self-efficacy were entered on the second step. The model for step one was not significant ($F(1,648) = .27, p > .05$). The overall model for step two was significant, and results are presented in Table 3 ($F(4, 645) = 6.00, p < 0.01$). A marginally significant trend was observed for the effect of motivation on MVPA.

Discussion

This study is among the first to provide support for the importance of psychosocial variables in understanding PA in an underserved adolescent population using accelerometry estimates. Consistent with previous literature, this study demonstrated boys engaged in significantly more MVPA than girls^{5, 50}. Importantly, both motivation and self-efficacy were shown to have significant effects as individual predictors of MVPA for girls holding constant the effects of the other psychosocial variables in the model. Analyses for boys, however, only indicated a marginally significant trend for motivation while holding self-efficacy and

enjoyment constant. This study is consistent with previous studies^{25, 29, 51–54} that have shown that self-efficacy had an effect on MVPA in adolescents but is one of the first large trials to show this effect in underserved girls using accelerometry data.

This study examined PA in a broad context by capturing PA levels during and after the school day, on weekdays and weekends, and in a variety of social interactions typical in a student's everyday life. This broad context is more reflective of general PA behavior (including leisure time PA) than that of PA in competitive or physical education settings¹⁶. Importantly, this study expanded on previous research by utilizing accelerometer estimates of PA. Research has shown that self-reported estimates of PA are more strongly related to other self-reported measures as compared to accelerometer estimates of PA, which may be inflating effects due to social desirability response bias³⁵. However, our study provides support that even with accelerometer estimates of PA the associations between MVPA and intrapersonal factors were significant and of modest magnitude. Furthermore, few studies have examined motivation, enjoyment and self-efficacy, which appear to be unique and important constructs in understanding PA. Specifically, motivation and self-efficacy were significant predictors for girls while only motivation was a significant predictor for boys. Both SDT and SCT show contextual factors (e.g., psychological needs fulfillment and social support) play an important role in the development of motivation and self-efficacy^{10, 11, 15}. Future research should continue to explore whether sex differences in MVPA may be related to contextual factors (e.g., structured vs leisure-time). That is, the relationship between psychosocial factors, sex, and PA may be different in structured and leisure-time contexts²⁸.

The differences in the correlations between enjoyment and motivation, and MVPA provide support for SDT. Enjoyment was more strongly related to motivation than self-efficacy, as would be expected from a SDT perspective¹⁰. Further, the unique associations of SDT and SCT variables (e.g., motivation and self-efficacy) provide some evidence that these theories offer complementary perspectives in understanding MVPA. Indeed, perceived competence, which is conceptually similar to self-efficacy, is described as a fundamental psychological need, vital to the promotion of intrinsic motivation¹⁰.

This study expands on previous work by examining the relationship of psychosocial factors related to PA in low income and minority adolescents. Our study showed that psychosocial constructs such as motivation was important for underserved boys and girls, and self-efficacy were also important for girls. Few previous studies have specifically focused on underserved youth, though it has been shown that underserved youth engage in less PA and more sedentary behavior^{8, 9} as compared to youth from higher income families and who are non-minorities. In the present study PA was measured with accelerometry data which may explain why motivation and self-efficacy was significantly related to MVPA for girls in the present study. Given that accelerometry estimates are continuous for 7 days, PA is measured throughout the course of the day including evenings and weekends and could include more leisure time activities. Thus, further research is needed to more adequately test whether psychosocial constructs may be more predictive of leisure time PA (vs. structure PA) in underserved girls. Relationships between motivational variables and PA are important in understanding underserved adolescent PA in both boys and girls and should continue to be explored in future research by comparing leisure time versus structured PA.

Interestingly, the results of the present study showed enjoyment did not predict PA individually when holding self-efficacy and motivation constant for boys or girls and draw attention to the question of why. Past research has shown that enjoyment is important in MVPA^{12, 19, 29, 55}. Indeed, in reviews of correlates of PA, enjoyment has often been shown to be an important predictor for both boys and girls^{23, 25, 37, 38, 51}. In the present study our

motivational measure was strongly correlated with enjoyment and intrinsic motivation. Given the overlap in the enjoyment construct and our motivational measure it may have decreased the likelihood of demonstrating an independent effect of enjoyment in the present study. Few studies have investigated underserved youth and some evidence suggests that enjoyment may operate differently in this population. For example, previous research has also shown that African American girls report less enjoyment for PA than do Caucasian girls⁵⁶. Therefore, it may be important to provide more opportunities for PA consistent with girls' preferences in order to achieve stronger enjoyment effects on PA. DiLorenzo et al²⁵ found enjoyment to be an important predictor of PA (including leisure-time and competitive activities) and the only consistent finding among boys and girls, however, this study did not focus on minority or underserved youth specifically. Further research is also needed to explore whether the effects of enjoyment are largely mediated by motivation in underserved youth.

It is also interesting to consider why self-efficacy was not a significant individual predictor of PA holding constant enjoyment and motivation for boys. As boys have consistently been shown to engage in more PA, it may be that self-efficacy surrounding engaging in PA is less important in boys. Boys may generally feel competent in engaging in PA but lack motivation to do so, and some research has shown that boys exhibit higher levels of self-efficacy than girls³⁴. It may be that motivation and self-efficacy have a stronger combined effect with girls while boys are more sensitive to motivational changes given a background with more PA exposure and PA behavior. Research has shown that boys demonstrate higher levels of motor proficiency in PA than girls⁵⁷. It may be that competence in the physical performance aspect of PA differs for boys and girls and may explain why self-efficacy was significantly related to MVPA for girls in the present study in which activity was measured throughout the course of the day and not just during structured PA time.

The current study is limited in that only cross-sectional data were used for analyses. Additionally, the magnitudes of the relationships were modest and only account for a relatively small portion of the variance in PA. However, objective measures of PA have been shown to exhibit weaker relationships as compared to self-reported estimates, and the effect sizes in the current study are consistent with other studies utilizing objective measure of PA³⁵. Additionally, some research examines modified bouts of 10 minutes of MVPA, and in such cases the MVPA changes seen in the current study would be a meaningful step toward that criterion⁵. As confirmatory factor analyses demonstrated in the present study, it is likely that existing psychosocial measurement scales could be improved to measure these concepts in underserved adolescents. Given results of the current study showed some evidence of sex non-invariance, an important implication is that future research is needed to develop psychosocial measures of PA that function similarly across underserved boys and girls..

The strengths of the current study included a large sample size, a large percentage of African-American students, and accelerometer estimates of PA. Future studies are needed to examine causality and directionality of the relationship between motivation, enjoyment, self-efficacy, and PA in longitudinal prospective studies. Little research thus far has examined all of these concepts as they relate to PA, and temporal precedence in this relationship has yet to be established. Understanding sex differences in MVPA is important in developing effective interventions and replication of these effects using a longitudinal design is a next step. Furthermore and importantly, too few studies test for the effects of psychosocial variables and PA in boys and girls^{19–21}. This study has implications for future researchers in that potential sex differences should not be ignored and that type of activity (structure versus leisure time) should be a focus of future investigations.

In summary, this research provides evidence that psychosocial variables are not only important in PA, but that the pattern differs for underserved boys and girls. Girls' PA was significantly predicted by motivation and self-efficacy while boys' PA exhibited a marginal trend with motivation. Importantly, researchers should test the assumption that results apply equally across sex. Furthermore, the results for motivation showed this construct an important factor in PA behavior of underserved adolescents. Psychosocial constructs such as motivation and self-efficacy appear to be important for understanding PA behavior and should be targeted in future PA interventions.

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Table 1

Demographic, Baseline, and Psychosocial Characteristics by Sex

Variable	Boys	Girls	Total
Sample Size, No (%)	650 (45.74)	771 (54.26)	1421
African American, No (%)	474 (72.92)	567 (73.54)	72.9% (1041)
Age (yrs) **	11.43 (0.64)	11.27 (0.53)	11.34 (0.59)
Free/Reduced Cost Lunch, No (%)	452 (69.54)	563 (73.02)	1015 (71.43)
BMI (kg/m ²) **	22.23 (5.91)	23.29 (6.09)	22.80 (6.03)
Waist Circumference (cm)	70.75 (12.49)	71.20 (12.32)	71.01 (12.38)
MVPA [†] (min/day) **	51.49 (30.28)	34.45 (20.55)	42.81 (26.67)
Motivation	2.39 (0.50)	2.28 (0.51)	2.33 (0.51)
Self-Efficacy	2.35 (0.34)	2.27 (0.37)	2.30 (0.36)
Enjoyment	2.60 (0.45)	2.53 (0.47)	2.56 (0.46)

Values are expressed as means (standard deviations)

**
p <0.01

[†] Moderate to vigorous physical activity

Table 2

Correlations Between Psychosocial Variables and MVPA Stratified by Sex

Variable	MVPA	Motivation	Self-Efficacy	Enjoyment
MVPA ^a	--	0.12**	.13**	.07 [†]
Motivation	.18**	--	.60**	.68**
Self-Efficacy	.15**	.65**	--	.54**
Enjoyment	.15**	.73**	.56**	--

**
p < .01 ;

[†]
p < .10

^a Moderate to vigorous physical activity (min/day)

Note: Correlations on top are for girls, and correlations on bottom are for boys.

Table 3
Summary of Multivariate Regression Analyses for Variables Predicting MVPA.

	Step	Variable	Unstandardized Coefficients		Standardized Coefficients		t	R ²
			B	SE	Beta			
1	Overall Model F = 4.37 (4, 766), p<0.01 for Girls							
	Intercept		34.46	1.86		.28	18.52**	<.01
	Cohort		0.54	0.68		.02	0.79	
	Motivation		2.93	1.47		.11	2.00*	
2	Self-Efficacy		3.73	1.72		.14	2.16*	.02
	Enjoyment		-1.64	1.37		-.06	-1.20	
1	Overall Model F = 6.00 (4, 645), p<0.01 for Boys							
	Intercept		52.71	2.92		.30	18.03**	<.01
	Cohort		-0.76	1.03		-.03	-0.73	
	Motivation		4.90	2.60		.18	-1.88 [†]	
2	Self-Efficacy		3.64	3.08		.14	3.18	.04
	Enjoyment		1.27	2.40		.05	0.53	

* p < .05;
 ** p < .01;
[†] p < .10