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Original Article

Associations between three measures of physical activity and selected influences on physical activity in youth transitioning from elementary to middle school

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ABSTRACT

Measurement of physical activity is challenging, and objective and subjective methods can be used. The purposes of this study were to apply structural equation modeling in: 1) examining the associations between three distinct measures of physical activity and three factors that are often found to be correlated to physical activity in children, and 2) examining the associations of the combination of three measures with the same correlates in a cohort of youth followed from 5th to 7th grade. A total of 409 children (45% boys) had complete physical activity data derived from accelerometers, self-report by youth, and proxy-report by parents. The potential correlates of physical activity included self-efficacy, physical activity support, and facilities for physical activity. Structural equation models were used to assess the relationship between physical activity and the correlates. The structural equation models examining associations between individual measures of physical activity and selected correlates showed that parent-reported and child self-reported physical activity were associated with parental support for physical activity and self-efficacy. Objectively measured physical activity was associated only with facilities for physical activity. A structural equation model showed that a composite expression of physical activity, based on the inclusion of all three individual measures, was associated with all three correlates of physical activity. In conclusion, combining measures of physical activity from different sources may improve the identification of correlates of physical activity. This information could be used to plan more effective physical activity interventions in children and youth.

Introduction

Physical activity is a critical health behavior in children and adolescents, and current federal guidelines call for school-age youth to engage in moderate-to-vigorous intensity physical activity for at least 1 h per day.[1] Most, youth in the United States (U.S.) do not meet that standard,[2,3] and consequently, there is an ongoing need to advance policies and practices that promote higher levels of physical activity in young people. Advancing research and public health practice on physical activity in youth requires valid and practical measures of physical activity. Such measures are needed to support public health surveillance, to evaluate interventions, and to advance understanding of the factors that associate with and influence physical activity in youth.

Numerous methods have been developed for measuring physical activity in children and youth. These include direct observation,[4,5] objective assessment via accelerometry[2,5] and pedometry,[5,6] self-report,[5,7] and surrogate-report by parents and teachers.[5,8] Frequently, the psychometric properties of these measures have been examined by determining the levels of association among the different methods.[9,10] Typically, studies have observed that the shared variance between different types of measures (e.g., self-report vs. accelerometry) does not exceed 25%.[9,10] This finding suggests that different types of measures assess different elements of physical activity behavior. Further, it suggests that a comprehensive assessment of physical activity may require multiple measures that are combined into a composite indicator.

An extensive body of research has identified numerous factors that associate with physical activity behavior in young people.[11–13] This research has utilized many different measures of physical activity and

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multiple approaches to measuring the factors that associate with physical activity. These methods have included self-report by children (e.g., enjoyment of physical activity), reports by parents (e.g., parental support of child physical activity), reports by professionals (e.g., school policies and practices), and objective observations (e.g., community resources and built environment). Hence, studies of associations between children's physical activity and factors that may influence physical activity have used many different measurement combinations. The combinations of measures have ranged from child self-report of both physical activity and correlates of physical activity to the objective measurement of both constructs, with a wide range of combinations in between.

It seems likely that observed associations between children's physical activity and factors that influence physical activity may be affected by the nature of the measurement methodologies used. Because the different types of measures of physical activity differ markedly in psychometric properties,[11,13] the findings of studies on factors hypothesized to associate with children's physical activity may be biased by the types of measures selected. Further, because different types of physical activity measures may complement one another, an understanding of factors that influence physical activity could be advanced by applying composite indices derived from multiple, distinct measures.[14–17]

The Transitions and Activity Changes in Kids (TRACK) study afforded the opportunity to examine relationships between multiple, distinct measures of physical activity and factors associated with physical activity in a cohort of children over time. Therefore, the purposes of this study were to apply structural equation modeling in: 1) examining the associations between three distinct measures of physical activity and three factors that are often found to be correlated physical activity in children (self-efficacy, parent support, and physical activity facilities); and 2) examining the associations of the combination of the three physical activity measures with the same correlates. The study was undertaken in a diverse cohort of youth followed from 5th to 7th grade.

Methods

Study design

TRACK was a longitudinal observational study that followed children from 5th grade into middle school. Parents provided informed consent and children provided assent. Data collection occurred at the school and was administered by a trained measurement team. Students completed surveys and anthropometric measures and received an accelerometer. Parent surveys were sent home for parents to complete and return. For this study, data from children and their parents who completed questionnaires in the 5th and 7th grades, including questions about physical activity and correlates of physical activity, were included. The study also measured child physical activity objectively over one week as well as community-based resources for children to be active. The Institutional Review Board at the University of South Carolina approved the protocols.

Participants

Fifth-grade children ($n = 1080$) from 21 elementary schools in South Carolina were enrolled into the TRACK study and were followed into middle school. Fifty-four percent were girls; self-reported race/ethnicity was 37.4% white, 35.1% black, 11.2% Hispanic and 17.3% other or multi-race/ethnicity; and the average age and body mass index (BMI) of 5th graders was 10.6 (0.6) years and 21.2 (4.9), respectively. Children were excluded from the analysis due to missing accelerometer data ($n = 88$), child self-report of physical activity, parent report of child physical activity ($n = 96$), or data on community-based physical activity facilities ($n = 164$), leaving 732 children in the 5th-grade sample. There were no differences in percent females, parent education, race/ethnicity, or average BMI between those included ($n = 732$) and not included ($n = 348$), but the analytic sample was slightly younger. In 7th grade, 409 of the students in the sample provided complete data; those included ($n = 409$) and not included ($n = 323$) did not differ on sex, race/ethnicity, parent education, age and BMI at 5th grade.

Measurement

Demographic and individual characteristics

Each child was asked to self-identify as Hispanic or Latino (yes/no) and to select all applicable race categories (white, African American/Black, Asian, American Indian/Alaska Native, and other). Research staff measured participants' height and weight after the child removed heavy clothing and shoes. Parents reported their highest level of education and their relationship to the child.

Physical activity

Parent report of child's physical activity was assessed using 2 items: a rating of the child's level of physical activity compared to others of the same age and sex (5-point scale: much less to much more) and a measure of the child's activity during his/her free time (5-point scale: almost always sedentary activities to almost always physical activities).[18] Internal consistency was determined using Cronbach's alpha, and for the two items, the values were 0.68 in 5th grade and 0.58 in 7th grade.

Child's self-reported physical activity was measured using 4 items: a rating of physical activity compared to peers of the same age and gender (5-point scale: much less to much more than others) and 3 items about the child's view of himself/herself regarding exercising regularly, keeping physically fit, and being physically active (4-point scales: not at all true to very true).[19] Cronbach's alpha for the 4 items was 0.69 and 0.80 in 5th and 7th grades, respectively.

Physical activity was measured objectively using accelerometers (ActiGraph GT1M or GT3X models, Pensacola, Florida). Each child wore an accelerometer during waking hours for 7 consecutive days, except while bathing or swimming. Accelerometer data were collected and stored in 60-s epochs. Any period of 60 or more minutes of consecutive zeroes was considered to be non-wear time and was set to missing. Moderate-to-vigorous physical activity (MVPA) was calculated using an age-specific prediction equation[20] generalized to the mean age in the TRACK cohort. The threshold for MVPA was 2200 counts/min, corresponding to 4.0 metabolic equivalents (METs; 1 MET $= 3.5$ mL $O_2 \cdot kg^{-1} \cdot min^{-1}$). Data for Sundays were excluded from the analyses due to shorter wear of time on those days. Missing values for children with at least two days of eight or more hours of wear per day were estimated by multiple imputations using Proc MI in SAS (Version 9.4, SAS Institute). Prior to the imputation, on average, 73% of total possible records from Monday to Saturday were available over the three years. MVPA was expressed as minutes/hour (daily MVPA/daily wear time) and was skewed and square root transformed before it was entered into structural equation models.

Factors potentially associated with physical activity

The study examined three factors that previous studies have found to be associated with physical activity in children – self-efficacy, parent support for physical activity, and access to physical activity places and resources. Efficacy beliefs about overcoming barriers to physical activity (barriers self-efficacy) were measured by child report using 8 items rated on a 4-point scale (disagree a lot to agree a lot). The items were developed for use with 5th-grade boys and girls[21] and re-specified for use with 6th and 8th-grade girls.[22] Cronbach's alpha for the 8 items was 0.77 in 5th grade and 0.80 in 7th grade.

Parents reported support for physical activity using four items[18] that asked them how many days in a typical week they engaged in four types of support. The items were rated on a 5-point scale with the following response categories: 0, 1–2, 3–4, 5–6, and 7 days. Cronbach's alpha of this scale was 0.76 for both 5th and 7th grades.

Facilities that provided physical activity opportunities and resources were identified by searching internet resources and databases for churches, commercial facilities, parks/trails, and schools/colleges.

Trained staff visited the facilities and completed a Physical Activity Resource Assessment (PARA) for each one.[23] The PARA included information on facility features (e.g., baseball fields, sidewalks), amenities (e.g., lighting, drinking fountains) and incivilities (e.g., broken glass, graffiti). The PARA was utilized to determine how many of 18 possible features were available at each facility, and this number was reduced by the number of incivilities present, due to the negative influence of incivilities. Using GIS software (ArcGIS 10.1) and a 2-mile street network buffer around each child's home, four PARA-weighted scores of available places to be active were created for each child.

Statistical analysis

Individual structural equation models

Three structural equation models (SEM) for each grade were tested using maximum likelihood estimation in M-plus (version 8.0).[24] Structural equation modeling is a combination of confirmatory factor analysis (measurement model) and regression (structural model) used to evaluate hypotheses while controlling for error. In this study, the measurement model included three exogenous latent variables: barriers self-efficacy (8 indicators), parent support (4 indicators), and PARA-weighted score for physical activity facilities (4 indicators). Physical activity was modeled as an endogenous variable in three different ways, one for each of the models: child's moderate-to-vigorous physical activity (accelerometer: 6 indicators), parent report of child's physical activity (2 indicators), and child's self-reported physical activity (4 indicators). The SEM included three direct paths: from barriers self-efficacy, parent-reported parent support, and PARA-weighted score for physical facilities to physical activity. All analyses were adjusted for sex, race/ethnicity, and parent education.

Structural equation panel models

Two additional structural models were also tested using panel analysis[25] to examine seventh-grade associations while adjusting for fifth-grade associations. For these models, robust weighted least squares estimation with mean- and variance-adjusted Chi-square test (WLSMV) (because of binary covariates) were used.

For the 1st model, the three measurements of physical activity were entered as correlated latent variables. The SEM included a total of nine direct paths, three for each of the physical activity latent variables, from barriers self-efficacy, parent-reported parent support, and PARA-weighted score to one of the 7th-grade physical activity latent variables.

For the 2nd model, a second- or higher-order confirmatory measurement model was specified by using the twelve physical activity variables (accelerometer: 6 items, parent-report: 2 items, and child-report:4 items). These three latent variables (first order) were then loaded onto a second- or higher-order factor representing the physical activity. The SEM included three direct paths for the 7th grade: from barriers self-efficacy, parent-reported parent support, and PARA-weighted score for physical activity facilities to the second-order physical activity.

Model fit

Model fit was assessed according to multiple fit indices. A Chi-square value that is non-significant is an indicator of fit, but it is too sensitive to a large sample, so other indices are commonly used. The root mean square error of approximation (RMSEA) represents the closeness of fit. Values of < 0.08 [26] correspond to an acceptable fit,[26] ≤ 0.06 represents a close fit, while 0 represents an exact fit.[27] The comparative fit index (CFI) tests the proportionate improvement in the fit of the target model with the null model. CFI values approximating 0.90 indicate a minimally acceptable fit.[28] $p < 0.05$ was considered statistically significant. For the correlated model, regression coefficients between each of the three predictor variables (self-efficacy, parent support, and PARA facility) and each of the three measures of physical activity were compared using the Wald test and by Chi-square difference tests ($p > 0.05$), and change in $CFI > 0.01$ in comparisons of a freely estimated model with a nested model that constrained the coefficients to be equal.[29]

Results

Descriptive statistics

Forty-seven percent of the 409 children were boys (Table 1), and the mean age in 5th grade was 10.6 years. The racial and ethnic composition of the sample was 38% white, 35% black, 11% Hispanic, and 17% other race/ethnicity. About 58% of the parents had higher than high school education, and 87% were mothers.

Both child-reported self-efficacy and parent-reported support for child's physical activity were significantly positively related to child's self-report of physical activity, parent-report of child's physical activity, and accelerometer MVPA (Table 2). However, PARA-weighted score of physical activity facilities was only positively related to accelerometer MVPA in the 5th grade and 7th grade. The inter-correlations between the physical activity variables were all positive and significant.

Individual structural equation models

Results of the six structural equation models after adjustment for gender, parent education, and race/ethnicity are presented in Table 3. The RMSEA of all models was <0.06, indicating close fit, and CFI were all greater than 0.90, indicating acceptable fit. All factor loadings in the measurement models were significant. Standardized parameter estimates (SE) indicate significant relationships in 5th and 7th grade between physical activity variables and barriers self-efficacy and parent support. The only significant paths between PARA-weighted score and physical activity variables were for accelerometer MVPA in 5th grade and 7th grades.

Structural equation panel models

Fig. 1 (Physical activity correlated model) and 2 (higher order panel model) show the panel SEM models after adjusting for 5th grade. All variables loaded significantly on their respective factors, and fit indices indicated that both models had an adequate fit.

For the model with three correlated physical activity measurements (Fig. 1), of the nine direct paths between self-efficacy, parent support, and PARA-weighted score and the three correlated physical activity variables, five paths were positive and significant (solid lines). These included: self-efficacy and child-reported physical activity ($\beta = 0.63$; $p < 0.001$), self-efficacy and parent-reported physical activity ($\beta = 0.19$; $p < 0.001$), PARA-weighted score and MVPA ($\beta = 0.13$; $p < 0.01$), parent support and parent-reported physical activity ($\beta = 0.41$; $p < 0.001$), and parent support and child-reported physical activity ($\beta = 0.23$; $p < 0.001$). The correlations between the three physical activity variables were small to moderate ($r = 0.16$ to $r = 0.48$).

Table 1
5th-grade characteristics.

	Total ($n = 732$)	Cohort ($n = 409$)
	Mean (*SD*) or *Percentage*	*Mean* (*SD*) or *Percentage*
Age (years)	10.6 (0.5)	10.6 (0.5)
Body Mass Index (kg/m^2)	21.1 (5.0)	21.1 (5.2)
Gender	44.9% boys	46.5% boys
Race/ethnicity		
Black	34.4%	34.7%
Hispanic	11.1%	10.5%
Other	17.4%	16.9%
White	37.2%	37.9%
% Parent > High School	56.0%	57.5%
% Mother respondent	86.6%	87.4%

SD = standard deviation.

Table 2
Means (SD) and Spearman correlations by grade (Cohort, $n = 409$).

	Mean (SD)	Child's Physical Activity			*Mean (SD)*	Child's Physical Activity		
	5th Grade	Self-report	Parent report	MVPA min/hr	7th Grade	Self-report	Parent report	MVPA min/hr
Child-reported Self-efficacy	3.3 (0.5)	0.52 ***	0.31***	0.16 **	3.1 (0.5)	0.59***	0.33***	0.23***
Parent-reported Parent support	2.9 (0.8)	0.23***	0.39***	0.31***	2.7 (0.8)	0.35***	0.41***	0.28***
PARA weighted score	29.3 (28.1)	-0.04	0.05	0.16**	29.3 (28.1)	0.02	0.04	0.21***
Self-report PA	3.3 (0.7)	1.00			3.3 (0.7)	1.00		
Parent report of child's PA	3.1 (0.9)	0.42***	1.00		3.2 (1.1)	0.49***	1.00	
MVPA min/hr	1.6 (0.5)	0.32***	0.38***	1.00	1.5 (0.5)	0.40***	0.31***	1.00

SD = standard deviation.
MVPA = moderate-to-vigorous physical activity.
PA = physical activity.
PARA=Physical Activity Resource Assessment.
$*p < 0.05$; $**p < 0.01$; $***p < 0.001$.

Table 3
5th grade and 7th grade ($n = 409$) Standardized parameter estimates (SE) from SEM models[a].

	5th Grade			7th Grade		
			Measurement models[b]			
Physical Activity	Self-report (4 items) 0.54 - 0.78	Parent report (2 items) 0.74 - 0.75	MVPA (6 days) 0.59 - 0.76	Self-report (4 items) 0.60 - 0.80	Parent report (2 items) 0.56 - 0.68	MVPA (6 days) 0.51 - 0.79
Self-Efficacy	0.38–0.62	0.37–0.63	0.37–0.63	0.44–0.71	0.44–0.70	0.44–0.70
Parent Support	0.51–0.82	0.50–0.83	0.51–0.82	0.57–0.82	0.54–0.80	0.54–0.81
PARA-weighted score	0.46–0.92	0.46–0.92	0.46–0.92	0.46–0.92	0.46–0.92	0.46–0.92
			Structural models			
	Self-report	Parent report	MVPA	Self-report	Parent report	MVPA
Self-Efficacy	0.67 (0.05)***	0.32 (0.07)***	0.14 (0.06)*	0.69 (0.04)***	0.32 (0.07)***	0.17 (0.05)**
Parent Support	0.12 (0.06)*	0.48 (0.06)***	0.28 (0.06)***	0.32 (0.05)***	0.58 (0.07)***	0.21 (0.05)**
PARA-weighted score	0.04 (0.05)	-0.04 (0.06)	0.18 (0.05)***	0.01 (0.04)	-0.04 (0.06)	0.21 (0.05)***
			Model fit			
χ^2, df, *P*-value	442.6, 247, $p < 0.001$	410.9, 202, $p < 0.001$	550.2, 296, $p < 0.001$	470.4,47, $p < 0.001$	409.7, 202, $p < 0.001$	547.9, 296, $p < 0.001$
CFI	0.92	0.91	0.91	0.93	0.92	0.93
RMSEA, 90% CI	0.044 (0.037, 0.051)	0.050 (0.043, 0.057)	0.046 (0.040, 0.052)	0.047 (0.041, 0.053)	0.05 (0.043, 0.057)	0.046 (0.040, 0.052)
R^2 for PA	0.50 (0.06)***	0.36 (0.06)***	0.25 (0.04)***	0.64 (0.05)***	0.47 (0.08)***	0.33 (0.04)***
R^2 for Self-efficacy	0.05 (0.02)*	0.05 (0.02)*	0.05 (0.02)*	0.03 (0.02)	0.03 (0.02)	0.03 (0.02)
R^2 for Parent Support	0.02 (0.02)	0.02 (0.02)	0.02 (0.02)	0.03 (0.02)	0.03 (0.02)	0.03 (0.02)
R^2 for PARA-weighted score	0.02 (0.02)	0.02 (0.02)	0.02 (0.02)	0.02 (0.02)	0.02 (0.02)	0.02 (0.02)

SE = standard error.
SEM=Structural Equation Model.
MVPA = moderate-to-vigorous physical activity.
PARA=Physical Activity Resource Assessment.
RMSEA = Root mean square error of approximation.
$*p < 0.05$, $**p < 0.01$, $***p < 0.001$.
[a] Adjusted for Gender, Parent education and Race/ethnicity.
[b] Range of estimates of observed variables for Latent variables.

All three physical activity latent variables: child-reported physical activity ($\beta = 0.88$; $p < 0.001$), MVPA ($\beta = 0.54$; $p < 0.001$), and parent-reported child physical activity ($\beta = 0.86$; $p < 0.001$) loaded significantly on the higher-order physical activity factor (Fig. 2). Self-efficacy ($\beta = 0.53$; $p < 0.001$) and parent support ($\beta = 0.29$; $p < 0.001$) were positively related to the higher order physical activity factor.

Discussion

The use of objective physical activity monitors has grown exponentially in recent years.[5,9,14,15] However subjective, self-report measures continue to be used in large studies and for population surveillance.[8,30] Few studies[15] have combined results of more than one type of measure of physical activity for analysis. The feasibility of combining child self-reports and proxy estimates by parents with an objective measure of physical activity (i.e., pedometer) to form a latent variable using structural equation modeling has been demonstrated.[31] An advantage of this latent variable approach is that it provides simultaneous estimates of all relationships between variables, while adjusting for measurement error. To our knowledge, this is the first study to examine putative determinants of physical activity in a longitudinal study.

The study found some consistent results for the individual structural equation models (self-reported, parent-reported and accelerometer MVPA) and the higher order physical activity factor (Fig. 2) panel model. Significant relationships between physical activity and child-reported barriers self-efficacy and parent-reported parent support were found after adjusting for gender, parent education, and race/ethnicity in the 5th and 7th grade for the individual models and after adjusting for 5th grade in the panel model. These findings are consistent with a previous study by Wang et al. of self-efficacy[16] and a recent metaanalysis of parent

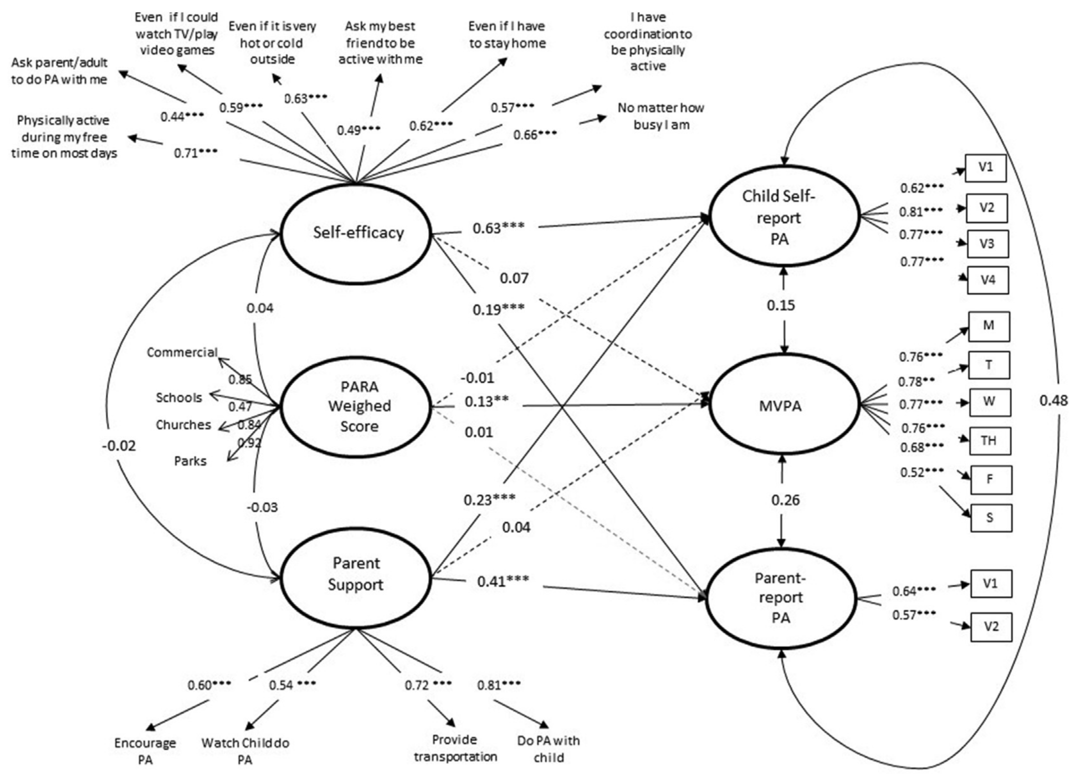

Fig. 1. The model illustrating the relationships (measurement model) for the panel analysis of three correlated reports of physical activity for 7th grade youth and relationship between barriers self-efficacy, parent support, and PARA-weighted score after adjustment for 5th grade. Model also adjusted for sex, and parent education using structural equation modeling with standardized regression coefficients (β). Solid lines represent significant relationships and dashed lines represent non-significant relationships. The root mean square error of approximation of the model was 0.027 (90% Confidence interval was 0.023, 0.031); *comparative fit index* = 0.95; *Chi-square* = 1617.6, *df* = 1248, $p < 0.001$. PARA=Physical Activity Resource Assessment. MVPA = moderate-to-vigorous physical activity. PA = physical activity.

support.[32] The findings emphasize the importance of self-efficacy and parent support for promoting physical activity in elementary and middle school children, regardless of how physical activity is measured.

The findings for the relationship between PARA-weighted score and physical activity were inconsistent. In the individual structural equation models, significant positive relationships were observed for accelerometer MVPA in both 5th and 7th grades, but no relationship was observed between PARA-weighted score and the higher order physical activity factor panel model. However, there was a significant positive relationship between MVPA and PARA-weighted score in the correlated physical activity model (Fig. 1). A recent review of associations of objectively-measured built-environment attributes with MVPA found negative effects on children's physical activity but positive effects on adolescents' physical activity.[33] Similarly, in the present study we found higher correlations between accelerometer MVPA and PARA score in the 7th grade ($r = 0.21$) as compared to the 5th grade ($r = 0.16$). This suggests that older children are more likely to be physically active in places away from their homes, possibly due to greater availability of programs for older children or greater access to transportation.

The present study was unique for several reasons: data from two time points (5th and 7th grade) were included, subjective physical activity was measured in two ways (child self-report and parent proxy-report), and structural equation modeling was used to determine whether relationships existed between physical activity and selected correlates of physical activity. Similar to previous reports, some relationships differed according to the way that physical activity was measured,[16,17,34] and were higher when measures were congruent (e.g., both measured subjectively or both measured objectively), suggesting that the strength of the relationships between physical activity and physical activity correlates may depend on the data sources for both, thus reflecting common method bias.[35] Combining three measures of physical activity with the use of structural equation models may eliminate some of this common method bias. Although the results of the two approaches to panel modeling were not consistent, both provide a way to investigate potential correlates simultaneously with different methods of measuring physical activity.

The generalizability of the study is limited, as children from only one state and a small age range were included. Strengths include using both subjective and objective measures on the same children over the transition from elementary to middle school. Analyses were performed using structural equation modeling rather than multiple regression, allowing us to model physical activity as a latent variable, adjusting for measurement errors. The correlations between the subjective (parent-report, self-report) and objective MVPA were moderate (≥ 0.31). Also, the children were racially diverse and included both boys and girls.

In Conclusion, a unique contribution of this study was that it analyzed physical activity as a latent variable composed of physical activity data from three sources. No single measure of physical activity is optimal; however, combining several measures may help identify physical activity correlates regardless of data source (obtained objectively or subjectively). This is important because physical activity interventions have produced only modest effects,[36–38] due in part to lack of knowledge concerning factors related to physical activity in children.[13] Such information could inform the development of more effective physical activity interventions that increase physical activity and improve the health of youth.[39]

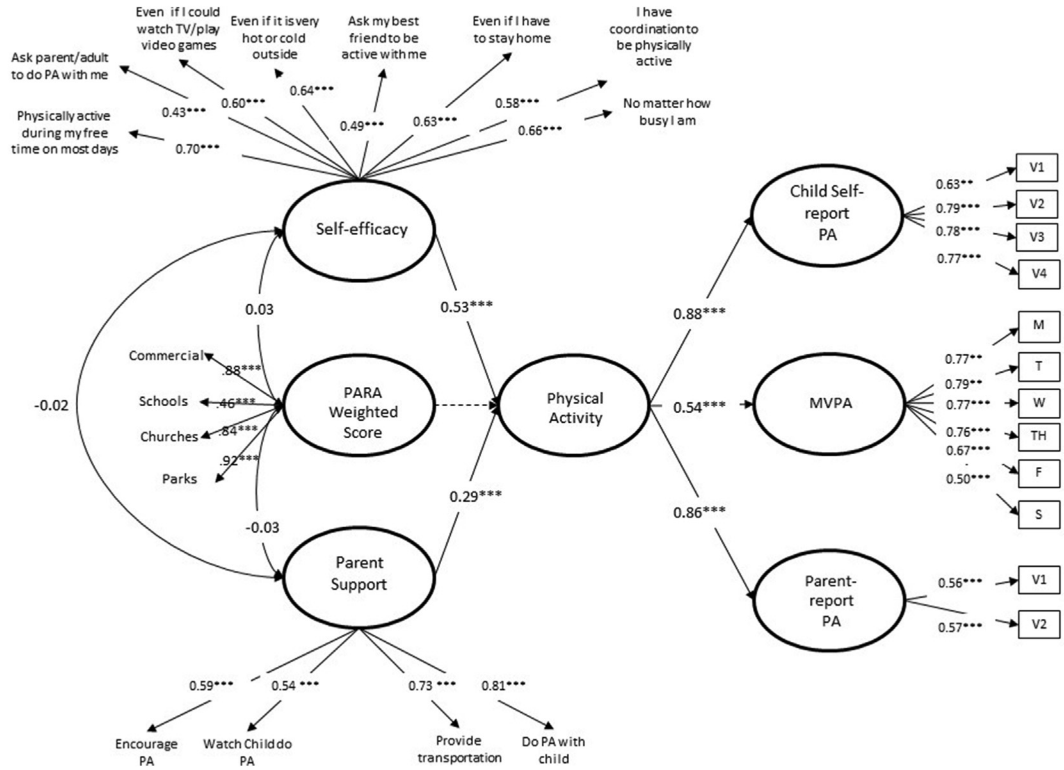

Fig. 2. The model illustrating the relationships the higher order factor model (measurement model) for the three reports of physical activity for 7th grade youth and relationship between barriers self-efficacy, parent support, and PARA-weighted score after adjustment for 5th grade. Model also adjusted for sex, and parent education using structural equation modeling with standardized regression coefficients (β). Solid lines represent significant relationships and dashed lines represent non-significant relationships. The root mean square error of approximation of the model was 0.034 (90% Confidence interval was 0.030, 0.037); *comparative fit index* = 0.92; *Chi-square* = 1645.5, $n = 1122$ $p < 0.001$. PARA=Physical Activity Resource Assessment. MVPA = moderate-to-vigorous physical activity. PA = physical activity.

Submission statement

This manuscript is not currently submitted elsewhere. None of the manuscript's contents have been previously published in any journal. All authors have read and approved the submitted manuscript.

Authors' contributions

Marsha Dowda participated in study design, data analyses, interpretation and drafting of the manuscript. Rod Dishman participated in data analyses, interpretation and drafting of the manuscript. Ruth Saunders helped in interpretation of the data and drafting the manuscript. Russ Pate participated in study design and drafting of the manuscript.

Ethical approval statement

The institutional Review Board at the University of South Carolina approved the protocol. Parents provided informed consent and children provided assent before the collection of any data.

Conflict of interest

The authors report no conflicts of interest.

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