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Evaluating a Model of Youth Physical Activity

Carrie D. Heitzler, PhD, MPH,
University of Minnesota, Division of Epidemiology and Community Health, Minneapolis, MN

Leslie A. Lytle, PhD, RD,
University of Minnesota, Division of Epidemiology and Community Health, Minneapolis, MN

Darin J. Erickson, PhD,
University of Minnesota, Division of Epidemiology and Community Health, Minneapolis, MN

Daheia Barr-Anderson, PhD,
University of Minnesota, School of Kinesiology, Minneapolis, MN

John R. Sirard, PhD, and
University of Minnesota, Division of Epidemiology and Community Health, Minneapolis, MN

Mary Story, PhD, RD
University of Minnesota, Division of Epidemiology and Community Health, Minneapolis, MN

Abstract

Objective—To explore the relationship between social influences, self-efficacy, enjoyment, and barriers and physical activity.

Methods—Structural equation modeling examined relationships between parent and peer support, parent physical activity, individual perceptions, and objectively measured physical activity using accelerometers among a sample of youth aged 10–17 years (N=720).

Results—Peer support, parent physical activity, and perceived barriers were directly related to youth activity. The proposed model accounted for 14.7% of the variance in physical activity.

Conclusions—The results demonstrate a need to further explore additional individual, social, and environmental factors that may influence youth's regular participation in physical activity.

Keywords

physical activity; children; peers; self efficacy; social support

Although childhood is the most physically active time of life for most individuals, few children and adolescents are meeting recommended levels of activity, and these active lifestyles appear to steadily decline as children age.[1,2] This, in part, is contributing to the rise in obesity among both youth and adults.[3] A number of reviews on the correlates of physical activity (PA) have been conducted over the past decade that support the complexity of PA behaviors and suggest that multiple levels of influence should be examined.[4–6] Several theoretical models have been evaluated to identify possible determinants of PA, including the theories of reasoned action and planned behavior,[7] social cognitive theory,[8] and the Youth Physical Activity Promotion Model.[9] However, there are mixed results when employing these theories to predict children's PA participation,[10–14] and it is evident that many of the variables linked to children's PA are not associated with any one theory or

Address correspondence to Dr Heitzler, University of Minnesota, Division of Epidemiology and Community Health, 1300 S Second Street, Suite 300, Minneapolis, MN 55454. heitz022@umn.edu.

model. Thus, calls have been made to develop and test new behavioral models that adopt ecologic approaches and incorporate factors at multiple levels, including social-level factors and individual- or intrapersonal-level factors.[4,15]

The model presented here builds off such previously tested models[12,16–19] and includes important social and individual constructs that have been shown to be related to youth PA.[4,6] Social constructs include the influence of both parents and peers and include (1) direct influences through verbal encouragement and positive reinforcement, watching activities, and doing activities together;[20–24] (2) influence through parents' or peers' own participation in PA (ie, modeling of the behavior);[25,26] and (3) indirect social influence through individual-level cognitions and perceptions related to PA such as self-efficacy, perceived enjoyment, and perceived barriers.[4,5,12,13,17,27] In the Youth Physical Activity Promotion Model, these social influences are referred to as "reinforcing factors" for the role they may play in affecting children's perceived abilities (eg, self-efficacy and barriers) and values (eg, enjoyment related to PA) related to PA.[9]

Self-efficacy refers to the confidence an individual has to change or maintain a certain action or behavior and is the key to several theoretical health behavior models, particularly social cognitive theory.[8] Self-efficacy is one of the most frequently studied constructs in relation to youth PA and has been shown not only to consistently correlate with PA behavior among youth[5,11,28] but also to mediate the relationship between social support by parents or peers and PA.[12,17,29] Additionally, expectancy-value theories[30] and other models of health behavior change, including the health belief model,[31] theory of reasoned action,[7] and social cognitive theory[8] suggest that behavior is more likely to occur if positive outcomes are expected (eg, enjoyment, reinforcement, increased feelings of health or wellness) and if these benefits outweigh barriers. The concept of enjoyment may reflect one's intrinsic motivation toward PA as it relates to positive feelings such as fun and pleasure[32] whereas perceived barriers represent obstacles to engaging in behavior and can reflect internal barriers such as lack of motivation or external barriers such as unfavorable weather or lack of time. Both concepts have also been shown to mediate the relationship between other individual and social variables and PA among youth.[19,33]

Structural equation modeling (SEM) is a powerful analytic tool that allows for the simultaneous estimation and testing of relationships among multiple predictor, mediating, and outcome variables.[34] SEM provides information about the processes through which theoretical constructs influence PA, as it permits calculation of a variable's direct, indirect, and total effects on outcomes.[34] Applications of SEM to assess the factors that influence PA are relatively new,[35] and studies among youth have found varying results related to individual and social influences of PA.[12,17,19,29,36]

The purpose of this study was to evaluate the relationship between social- and individual-level variables and accelerometer-measured moderate-to-vigorous PA (MVPA) among children and adolescents aged 10–17 years. The main hypothesis of the study was that social influences of parents and peers as well as PA-related individual cognitions (ie, self-efficacy, perceived enjoyment, and barriers) would have direct effects on youth's participation in MVPA. A second hypothesis was that social influences would have indirect effects on MVPA through individual-level variables (for example, parent support would influence perceived barriers, which in turn, would influence PA). The model proposed here extends the work of previous studies by including multiple social and individual variables, by considering relevant covariates of PA in the model, and by using objective measurement of PA.

METHODS

Study Design, Participants, and Data Collection Procedures

The sample for this study was composed of 720 youth and parents who were part of baseline measures for the IDEA (Identifying Determinants of Eating and Activity)[37] and ECHO (Etiology of Childhood Obesity) cohort studies. Identical measurement protocols and instruments were used for both studies; differences lie in the timing of the data collection and recruitment protocols. Baseline measures for the IDEA study took place from November 2006 to April 2007 and baseline measures for the ECHO study took place from September 2007 to May 2008. Three recruitment sources were used to recruit youth for the IDEA study: (1) an existing cohort of children and adolescents participating in the Minnesota Adolescent Community Cohort tobacco study, (2) a Minnesota Department of Motor Vehicle list, and (3) a convenience sample drawn from local communities.[37] Youth in the ECHO study were recruited through HealthPartners®, a managed care organization in Minnesota. Recruitment was designed to enroll a sample representing both healthy and overweight youth and adults and higher racial/ethnic diversity than the IDEA study. Both studies were designed to collect data annually on a cohort of youth aged 10–17 years old at baseline and one significant adult (a parent or guardian with whom they spent a significant amount of time). For both cohorts, exclusion criteria for youth included if they planned to move from the area in the next 3 years, had a medical condition that affected their growth, were non-English speaking, and/or had any other physical or emotional condition that would affect their diet or activity levels or make it difficult to complete measurements. Children and parents completed all measurements, including self-administered surveys and anthropometric measurements during a 2-hour clinic visit, supervised by trained and certified data collectors. All study procedures were approved by the University of Minnesota Institutional Review Board, and all participants provided written informed assent and consent.

Measures

The 5 latent scales included in these analyses were parent support, peer support, self-efficacy, perceived enjoyment, and perceived barriers. A description of these scales, including all items and their associated internal consistency (Cronbach's α) is provided in Table 1. Parent and youth MVPA were based on individual indicators.

Parent and peer social support—Perceived parental social support and peer social support were each measured with 4 items on a self-administered student survey. Questions assessing parental support asked how often during a typical week their mother or father provided different types of support whereas peer social support measured how often one of their friends provided support. Both scales were based on the 5-item family and parent support scales used in previous research.[12,38] The original item relating to providing transportation to a place for PA was not used in the current study.

Self-efficacy—Self-efficacy related to PA was measured with 8 items that measured children's confidence in their ability to overcome common barriers related to PA and in seeking support. This 8-item scale was taken directly from the work of Motl, Dishman, and colleagues, who demonstrated factorial validity and invariance across race in samples of adolescent girls.[39,40]

Perceived enjoyment—Enjoyment related to PA was measured using the 7 negatively worded items from the 16-item Physical Activity Enjoyment Scale developed by Motl and colleagues.[41] As Dishman et al report, using the 7 negatively worded items alone reduces participant burden and removes the methodologic effects of combining both positively and

negatively worded items.[18] All items were recoded so that a higher score on this scale indicated more enjoyment.

Perceived barriers—Perceived barriers related to PA were measured by asking children how often potential obstacles keep them from being physically active. The 12 items for this scale were adopted based on the 10-item scale developed by Dishman et al.[18] The 2 items added for this study were "I don't have the right clothes" and "After I exercise I would need to shower, fix my hair, etc."

Parent physical activity—During clinic visits, parents completed the long form of the International Physical Activity Questionnaire (IPAQ). The IPAQ assesses PA in 4 domains: (1) during transportation, (2) at work, (3) during household and gardening tasks, and (4) during leisure time, including exercise and sport participation. In each of the 4 domains the number of days per week and time per day spent in both moderate and vigorous activity are recorded. Using published guidelines for data processing and analysis of the IPAQ,[42] continuous measures of minutes per day were computed for walking, moderate-intensity, and vigorous-intensity PA across all 4 domains. Two indicators, daily minutes of leisure-time moderate PA and daily minutes of leisure-time vigorous PA, were summed to derive a measure of MVPA for parents in these analyses.

Youth physical activity—Children's PA was measured objectively with the use of uniaxial accelerometers, specifically the ActiGraph model 7164 (Actigraph, Pensacola, FL). The ActiGraph accelerometer is a small, electro-mechanical device that is worn on the hip that records acceleration and deceleration of movement, time of day, and counts in user-specified time intervals (here, 30-second periods or "epochs"). During their clinic visits, children were fitted with the accelerometer and were instructed to wear it for a total of 7 days during waking hours, excluding showering, bathing, water sports, or contact sports in which they felt at risk for injury. Participants were given postage-paid envelopes and were asked to mail the monitor directly back to data collection staff, who subsequently downloaded all data.

A number of exclusion and inclusion criteria were specified to reduce the accelerometer data. First, 30 minutes of consecutive counts of "0" was used to indicate that the accelerometer was not being worn, and these data points were excluded. Next, days with fewer than 8 hours of data were excluded from the analysis to account for unrepresentative days of activity. Participants with data from at least 3 out of 5 weekdays and one out of 2 weekend days were considered to have valid accelerometer data for these analyses. Average minutes per day spent in MVPA was calculated based on the age-specific equation of Freedson et al (2005)[43] using the convention of Troiano et al (2008) in which MVPA equals 4 METs (metabolic equivalents) or greater.[1] The ActiGraph accelerometer is considered an objective measure of PA and has high interinstrument reliability and has been previously validated for use with children in laboratory and field settings.[44]

Demographic and anthropometric information—Demographic information of children's gender, date of birth, grade, race/ethnicity, and family living arrangements was self-reported by children on the student survey. Parents reported their highest level of education and whether their child qualified for free or reduced-price lunch. Trained and certified staff members collected height and weight data, in duplicate, during clinic visits. Height was measured to the nearest 1.0 cm with children barefoot, using a direct reading stadiometer (Shorr Productions, Olney, MD); body weight was measured to the nearest 0.1 kg without shoes and wearing light clothing, using an electronic scale/body composition analyzer (Tanita TBF-200A; Tanita Corporation of America, Inc, Arlington Heights, IL). Body mass index (BMI) was calculated by dividing the average of 2 weight values in

kilograms by the average of 2 height values in meters squared (weight (kg) / [height (m)]^2). Children were categorized as healthy weight or overweight (≥ 85th percentile) according to their BMI, age, and gender using the 2000 Centers for Disease Control and Prevention growth charts.[45]

Statistical Analysis

Descriptive statistics

Prior to conducting the SEM analysis, frequencies and means (standard deviations) were calculated for all study variables for the whole sample and for boys and girls separately using SAS version 9.1 (Cary, NC: SAS Institute Inc). All variables were examined for their normality and multicollinearity.[34] Because the measure of children's daily minutes of MVPA had moderate indices of skewness and kurtosis, a logarithmic transformation was performed on this variable. All other study variables were normally distributed.

Structural equation model

Data were analyzed using a SEM approach with maximum likelihood estimation. In order to reduce the number of parameters that would be estimated, item parceling was conducted with the self-efficacy, enjoyment, and barriers items.[46] *Item parceling* involves summing together 2 or more items and using the resulting sum as the basic unit of analysis; it is a common practice in SEM.[46] Here, items were systematically grouped together on the basis of their order within the survey (ie, items 1–2, items 3–4, etc). In addition to producing more stable parameter estimates, item parcels are said to have improved reliability and to have distributions that are more continuous and normally distributed as opposed to individual items. Because the unidimensional factor structures of these latent constructs were established in other studies,[18,39,40] the use of item parceling was deemed appropriate.

A 2-step method was used to test the hypothesized relationships among the variables. First, the overall measurement model was evaluated to confirm the factor structure of the latent variables; and next, SEM was performed to test the proposed structural model. Factor loadings, factor correlations, residual variances, and path coefficients for the measurement and structural models were inspected for sign and/or magnitude. Model fit was evaluated based on the following fit indices: the model chi-square statistic, the root mean square error of approximation (RMSEA) and its 90% confidence interval, the Bentler comparative fit index (CFI), and the standardized root mean square residual (SRMR). These indices reflect current standards and recommendations for reporting in SEM analyses.[34,47] However, all indices are affected by multiple design factors, and the interpretation of what constitutes good fit varies across studies.[48,49] In particular, the chi-square statistic is sensitive to sample size and often prone to type I error and was interpreted in the context of the other model fit measures.

The measurement model is represented in Figure 1 and specifies the relationships between the observed variables (ie, indicators) to their posited underlying constructs or latent variables, with the constructs allowed to correlate freely. The measurement model consisted of 2 single indicators denoted by rectangles—parent MVPA and youth MVPA—and 5 latent variables denoted by circles: parent support (4 indicators: PAR1-PAR4), peer support (4 indicators: PEER1-PEER4), self-efficacy (4 indicators: SE1-SE4), enjoyment (3 indicators: ENJ1-ENJ3), and barriers (4 indicators: BAR1-BAR4). The factor loading for the first item on each latent variable was constrained to 1.0 to establish its metric.

The initial structural model, which served as the baseline model, was a heavily parameterized model that included paths that emanated directly from parent MVPA and each of the 5 latent variables to youth MVPA (ie, direct effects). In addition, parent support

and peer support were hypothesized to directly influence levels of self-efficacy, enjoyment, and barriers and have their effects on MVPA mediated by these variables (ie, indirect effects). Modeling of PA by parents (ie, parent MVPA) was also hypothesized to influence levels of parent support, which in turn would influence MVPA among youth. No specific hypotheses were set about the relationships between parent support and peer support or between each of the individual-level latent variables; instead they were assumed to covary. In addition, the following covariates were included in the model to account for their influence on all of the latent constructs and parent and youth MVPA: gender, grade, race, parental education, qualification for free or reduced-price lunch, and weight status.

To reduce the number of parameters to be estimated, model modifications were performed whereby covariates that had nonsignificant relationships (P>0.05) with individual latent variables were removed. Parental education and qualification for free or reduced-price lunch were not significantly related to any of the individual-or social-level variables and, therefore, were not included in the final model. Thus, the final model, presented in Figure 2, included all of the direct and indirect paths modeled in the baseline model with covariate adjustment for only significant variables. Differences in model fit between the baseline model and the final model were based on a chi-square difference test and comparisons of the additional fit indices. A nonsignificant chi-square value indicated failure to reject the null that the data fit the 2 models equally.

Lastly, the relative contribution of direct and indirect effects in addition to the total effect for each variable was also estimated. The squared multiple correlation (R^2) associated with youth MVPA was used to evaluate the effectiveness of the model in explaining the variance observed in this sample's objectively measured MVPA. All models were estimated using Mplus version 5.2.[50] There were missing/ invalid data on the indicators for the primary constructs, ranging from n=1 missing data on the self-efficacy scale to n=101 missing data on the accelerometers (4 unreturned accelerometers and 97 youth with invalid data per the aforementioned criteria). Youth with missing/invalid data were slightly older than those with valid data (15.1 years versus 14.6 years) and were more likely to have parents with lower education levels than those with valid data. The maximum likelihood estimator was used to retain all participants in the analysis, with missingness assumed to be random conditional on the observed covariates.[50]

RESULTS

Descriptive Statistics

Sample characteristics, including overall means and standard deviations for the latent variables and parent and youth MVPA, are presented in Table 2. Of the 720 youth, 48.9% were boys; their mean age was 14.7 (SD=1.8) years; 84.7% were white; and the majority of youth had at least one parent with a college degree or higher (64.1%). Over a quarter of youth in this sample were classified as overweight (25.7%) (≥ 85th percentile). The 619 youth with valid accelerometer data averaged 27.1 (SD=18.3) minutes of MVPA daily; parents (n=666) reported an average of 34.0 minutes (SD=44.9) of leisure-time MVPA daily.

Confirmatory Factor Analysis

The measurement model resulted in good model fit (χ^2= 683.68, df = 170, P<0.001, RMSEA = 0.065 [90% CI = 0.060, 0.070], CFI = 0.93, SRMR = 0.050). Results showed good convergent validity of the factors as each indicator's factor loading was significant (P<0.05) on its respective latent construct, and the majority of indicators had relatively high standardized loadings on their respective factors. Only 2 indicators, parent support items 1

and 2 ("Encouraged you to do physical activities or play sports" and "Done a physical activity or played sport with you"), were below .60 (PAR1 = .50 and PAR2 = .59). All correlations between the factors were statistically significant (P<0.05), except the correlations between parent MVPA and self-efficacy, barriers, and youth MVPA; and none of the estimated correlations were excessively high (eg, >.85), exhibiting good discriminant validity (Table 3).

Structural Equation Model

Hypothesized paths and standardized parameter estimates are shown in Figure 2. The final model provided excellent fit to the data with all fit indices exceeding standard thresholds (χ^2 = 856.04, df = 246, P<0.001, RMSEA = 0.059 [90% CI = 0.054, 0.063], CFI = 0.92, SRMR = 0.049). There were statistically significant direct effects between (a) parent MVPA and parent support (Beta = 0.06, P=0.10); (b) parent MVPA and youth MVPA (Beta = 0.07, P=0.06); (c) parent support and self-efficacy (Beta = 0.29, P<0.001), enjoyment (Beta = 0.26, P<0.001), and barriers (Beta = −0.27, P<0.001); (d) peer support and self-efficacy (Beta = 0.34, P<0.001), enjoyment (Beta = 0.20, P<0.001), and barriers (Beta = −0.17, P<0.05), and youth MVPA (Beta = 0.15, P<0.01); and (e) barriers and youth MVPA (Beta = −0.12, P=0.07). Notably, the hypotheses suggesting that parent support, self-efficacy, and enjoyment would be significantly, directly related to youth MVPA were not supported. The relationship between peer support and youth MVPA was primarily through direct effects (78.3%). Similarly, 91% of the effects of parent MVPA on youth MVPA were through direct effects. None of the indirect effects of parent or peer influences on MVPA were significant. Overall, the model accounted for 14.7% of the variance in objectively measured MVPA among this sample of youth.

DISCUSSION

This study tested the relationships among social- and individual-level influences and MVPA among a large sample of children and adolescents. The results showed an overall good fit between the proposed model and the data. The findings of this study are congruent with previous research that suggests that support by parents and peers is linked to children's and adolescents' beliefs regarding their ability and enjoyment related to PA. That is, youth with higher levels of perceived support from their parents and friends reported higher levels of self-efficacy and enjoyment related to PA and lower levels of perceived barriers. Similarly, King and colleagues[33] found that adolescents who did not receive parental encouragement were significantly more likely to perceive more barriers to PA than were those who did receive parental encouragement.

Among all variables, peer support was the strongest factor related to MVPA among youth. This is in agreement with previous investigations,[17,27,29] which show perceived peer support to have a strong positive direct effect on PA. For example, in a recent investigation of a sample of rural high school girls, Beets and colleagues[17] showed a direct effect of peer influence on youth PA. The measures of peer support used in the present study referenced both perceived emotional support (ie, encouragement and praise) and instrumental support (ie, companionship during activities) related to PA. Expanding measures to include other means by which friends and peers may be influential is warranted. Examining the number and type of peers (ie, classmate, neighborhood, best friend) who participate in supportive behaviors and their influence on different types of activities, including organized versus free-time activities, could help identify leverage points for future interventions.

In the current study, parents' self-reported participation in leisure-time MVPA was found to be moderately associated with youth PA whereas perceived parental support was not. These results differ from the work of Trost et al,[12] who found the relationship between parental PA

and children's self-reported PA to be nonsignificant. Trost et al hypothesized that parents' participation in PA was influential only through its relationship with parent support. However, the work by Beets and colleagues showed that the support of neither mothers nor fathers was related to girls' PA,[17] which confirms the results of the present study. It appears that within this sample of children and adolescents, role modeling of PA behaviors by parents is more influential than other supportive behaviors. In the current study, parents' participation in PA was limited to leisure-time MVPA. Using this measure, as opposed to including job- and transportation-related PA, likely reflects parents' values and motivations regarding PA as they are dedicating their discretionary time to it. These values may serve as important standards set in the family and may strengthen the beliefs of the importance of PA among children and adolescents. Continuing to explore the relationship between parents' leisure-time MVPA, including examining PA levels of both parents, is suggested.

The strength of the association between perceived barriers to participating in PA and youths' engagement in MVPA found in this study is consistent with the current literature. In the hallmark review of correlates of youth PA by Sallis et al,[4] among children, perceived barriers was the most consistent negative correlate of PA, whereas among adolescents, perceived barriers was concluded to be unrelated to PA given the low percentage of studies (33%) that showed significant associations.

Unlike much of the literature, self-efficacy and perceived enjoyment were not found to have significant positive associations with youth PA in the present study. Despite the significant positive correlation between self-efficacy, enjoyment, and MVPA, the paths from these individual beliefs to MVPA were not significant in model testing. There are a number of possible explanations for the finding of nonsignificant relationships. First, the youth in this sample generally reported a high degree of self-efficacy and enjoyment (ie, mean = 30.6 on a scale ranging between 11 and 40 and mean = 29.7 on a scale of 7–35, respectively). Perhaps such high levels of self-efficacy and enjoyment related to PA do not facilitate PA, but instead, low levels may serve as significant hindrances to regular participation. A second explanation is specific to the measurement challenges associated with assessing these concepts. The wording of the items used in the self-efficacy scale (ie, "I can be physically active during my free time on most days no matter how busy my day is") often elicit comments during data collection such as "Well, I could, if I wanted to." That is, several youth of this age may feel efficacious to participate in activities on a regular basis, but still may not have the intrinsic desire or motivation to do so. It is plausible that these items are tapping a construct that is closer to desire rather than confidence. Additional concepts from expectancy-value models[30] such as physical self-perceptions, perceptions of competence, personal efficacy expectations, perceived behavioral control, and subjective values may better assess the internal beliefs and values related to PA and help to further explain regular participation.

The proposed model represented 14.7% of the variance in youth's participation in PA. This is similar to other models proposed in the literature, which account for 6 to 25% of the variance in moderate and/ or vigorous PA.[10,11,27] Further investigations should continue to explore the direct and indirect influences of multiple individual- and social-level factors on youth PA and should also consider the real and perceived environmental influences on youth PA. Issues of neighborhood safety, equipment accessibility, and availability of facilities and venues for activity should be included as possible determinants of regular participation. It is conceivable that even given positive cognitions, beliefs, and social support regarding activity, factors in the home and neighborhood environments may facilitate or hinder youth participation in PA at moderate to vigorous levels.[5]

Several study limitations should be noted. One limitation is the cross-sectional nature of the data. Even though arrows are drawn in a particular direction, the estimates that are calculated refer only to the association between the 2 variables; they do no imply causality. Another key limitation is the relatively homogeneous sample. The IDEA and ECHO studies were conducted in one metropolitan area within the Midwest. The analytic sample is predominantly white and of higher socioeconomic backgrounds, making it difficult to make comparisons by race, ethnicity, or socioeconomic status. As has been documented, minority youth and youth from lower socioeconomic backgrounds may be at higher risk than other children for low levels of PA and higher levels of obesity. It is important that additional research, including testing models such as the one proposed here, be conducted with more diverse samples including those most at risk for obesity. Also, data collection for the current study took place during months that experience low temperatures and relatively high snowfall, factors that may influence levels of PA. Thus, the findings of this study may not be generalizable to all youth of this age or to youth from other geographical regions.

Additionally, the items and scales available to measure the correlates of PA among youth are somewhat limited. The scales included in this study represent only a small number of potential influences on youth PA. Due to space constraints on the student survey, it was not possible to assess all factors that have been shown to be associated with youth PA in previous studies. Additionally, although all scales have good internal consistency, they may not necessarily measure the construct the best way possible. For example, more items and/or subscales that measure self-efficacy and social support may explain additional relationships. Several subcomponents of self-efficacy have been proposed in the literature including support seeking efficacy, barriers self-efficacy, positive alternatives efficacy, and environmental change efficacy, which may further explain the significance of this concept.

Nevertheless, this study has several major strengths. This study used a relatively large sample that includes an even distribution of boys and girls across the middle-school and high-school age ranges. Few studies have used objective measurement of PA combined with children's individual perceptions and parents' report of their own PA. The IDEA and ECHO studies' novel design in collecting objective measures of PA and the important factors that may influence these behaviors at multiple levels among youth provided an ideal opportunity to expand this body of research.

Though this analysis cannot draw claims of causality, it does provide support for the proposed model of social and individual influences on youth PA. There are interesting implications based on this study. The results support the notion that both parent and peer social support are related to individual-level beliefs and cognitions but that peer versus parent support may be more important in determining adolescent MVPA. A large proportion of the variance in PA among children and adolescents is yet to be described. Models such as the one proposed in the current study help shed light on some of the important factors and relationships among social and psychological influences on youth PA. However, a greater understanding of the direct and mediating mechanisms underlying PA among youth requires that additional theoretical and empirical models be tested that include deeper examinations of the many potential individual, social, and environmental factors that predict regular PA. Such examinations may help to develop and implement more focused and effective PA messages and interventions for youth.

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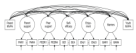

Figure 1. Measurement Model

χ^2 = 683.676, df = 170, P<0.001, RMSEA = 0.065 (90% confidence interval = 0.060, 0.070), CFI = 0.930, SRMR = 0.050

Note.

Model illustrates the relationships among the 2 indicators (parent and youth MVPA denoted in rectangles) and 5 latent variables (denoted in ovals) that were tested using confirmatory factor analysis. Only the first and last indicator items for each latent variable (eg, PAR1-PAR4) and uncorrelated uniquenesses are shown to improve clarity.

χ^2 Chi-square

df Degrees of freedom

RMSEA Root mean square error of approximation

CFI Comparative fit index

SRMR Standardized root mean square residual

MVPA Moderate-to-vigorous physical activity

Figure 2. Final Structural Model with Standardized Beta Coefficients

χ^2 = 856.04, df = 246, P<0.001, RMSEA = 0.059 (90% confidence interval 0.054, 0.063), CFI = 0.920, SRMR = 0.049

Note.

Model illustrates the relationships tested using structural equation modeling. To improve the clarity of the figure, covariates, correlations, items, and disturbances are not included. Solid lines represent statistically significant standardized path coefficients (*0.10>P>0.05; **P<0.05); dashed lines represent nonsignificant standardized path coefficients.

χ^2 chi-square

df degrees of freedom

RMSEA root mean square error of approximation

CFI comparative fit index

SRMR standardized root mean square residual

MVPA moderate-to-vigorous physical activity

Table 1

Scales and Items Used to Measure Hypothesized Social and Individual Influences

Scale	Cronbach's α	Items
Parent support[a] (4 items)	0.80	*During a typical week, how often has your mother or father…*
		…Encouraged you to do physical activities or play sports?
		…Done a physical activity or played sports with you?
		…Watched you participate in physical activities or sports?
		…Told you that you are doing well in physical activities or sports?
Peer support[a] (4 items)	0.86	*During a typical week, how often has one of your friends…*
		…Encouraged you to do physical activities or play sports?
		…Done a physical activity or played sports with you?
		…Watched you participate in physical activities or sports?
		…Told you that you are doing well in physical activities or sports?
Self-efficacy[b] (8 items)	0.83	I can be physically active during my free time on most days.
		I can ask my parents or other adults to do physically active things with me.
		I can be physically active during my free time on most days even if I have the choice to watch TV or play video games instead.
		I can be physically active during my free time on most days even if it is very hot or cold outside.
		I can ask my best friend to be physically active with me during my free time on most days.
		I can be physically active during my free time on most days even if I have to stay at home.
		I have the coordination I need to be physically active during my free time on most days.
		I can be physically active during my free time on most days no matter how busy my day is.
Enjoyment[b,c] (7 items)	0.93	*When I am active…*
		…I feel bored.
		…I dislike it.
		…It's no fun at all.
		…It makes me depressed.
		…It frustrates me.
		…It's not at all interesting.
		…I feel as though I would rather be doing something else.
Barriers[d] (12 items)	0.83	*How often do these things keep you from being physically active?*
		Physical activity is boring.
		The weather is bad.
		I don't know how to do the physical activity that I want to do.
		I don't have time to do physical activity.
		I'm chosen last for teams.
		I don't like to sweat.
		It would take time away from my friends.
		I might get hurt or sore.
		It would make me embarrassed.
		It would make me tired.
		I don't have the right clothes.
		After I exercise I would need to shower, fix my hair, etc.

[a] Response options: 1=Never, 2=Once, 3=Sometimes, 4=Almost every day, 5=Every day

[b] Response options: 1=Strongly disagree, 2=Disagree, 3=Neither disagree nor agree, 4=Agree, 5=Strongly agree

[c] Items were reverse-coded for analysis so that higher scores reflected more enjoyment

[d] Response options: 1=Never, 2=Rarely, 3=Sometimes, 4=Often, 5=Very often

Table 2

Characteristics of Study Participants and Variables of Interest (N=720)

Characteristic	%
Demographic Variables	
Gender, boys	48.9
Grade, 6th–8th	46.5
Age, mean ± SD	14.7 ± 1.8
Race/Ethnicity, % white	84.7
Parental education, % ≥ college degree (n=713)	64.1
Qualifies for free or reduced-price lunch	11.9
Overweight[a]	25.7
Latent Variables	**Mean ± SD**
Parental support (range = 4–20)	11.3 ± 3.8
Peer support (range = 4–20)	11.6 ± 4.1
Self-efficacy (range = 11–40) (n=719)	30.6 ± 4.9
Enjoyment (range = 7–35)	29.7 ± 5.2
Barriers (range = 12–49)	22.6 ± 6.7
Physical Activity	
Parent MVPA[b] (n=666)	34.0 ± 44.9
Youth MVPA[c] (n=619)	27.1 ± 18.3

[a] At or above the 85th percentile according BMI-for-age growth charts

[b] Daily minutes of moderate-to-vigorous leisure-time physical activity as reported by the IPAQ

[c] Daily minutes of moderate-to vigorous physical activity assessed by accelerometry MVPA Moderate-to-vigorous physical activity

Table 3

Correlations Among Variables

Variable	Parent MVPA	Parent Support	Peer Support	Enjoyment	Self-efficacy	Barriers	Youth MVPA
1. Parent MVPA	1.00						
2. Parent Support	0.09*	1.00					
3. Peer Support	0.09*	0.61*	1.00				
4. Enjoyment	0.09*	0.50*	0.53*	1.00			
5. Self-efficacy	−0.001	0.39*	0.37*	0.60*	1.00		
6. Barriers	−0.06	−0.38*	−0.35*	−0.52*	−0.67*	1.00	
7. Youth MVPA[a]	0.07	0.19*	0.22*	0.15*	0.13*	−0.20*	1.00

Note.

*P<0.05

[a]Natural log

MVPA Moderate-to-Vigorous Physical Activity