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Physical Self-Concept and Self-Esteem Mediate Cross-Sectional Relations of Physical Activity and Sport Participation With Depression Symptoms Among Adolescent Girls

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The authors tested whether physical self-concept and self-esteem would mediate cross-sectional relations of physical activity and sport participation with depression symptoms among 1,250 girls in 12th grade. There was a strong positive relation between global physical self-concept and self-esteem and a moderate inverse relation between self-esteem and depression symptoms. Physical activity and sport participation each had an indirect, positive relation with global physical self-concept that was independent of objective measures of cardiorespiratory fitness and body fatness. These correlational findings provide initial evidence suggesting that physical activity and sport participation might reduce depression risk among adolescent girls by unique, positive influences on physical self-concept that operate independently of fitness, body mass index, and perceptions of sports competence, body fat, and appearance.

Keywords: African American, psychological adjustment, psychometrics, structural equation modeling

Symptoms of depression among adolescents have been inversely related to physical activity (Brown, Welsh, Labbe, Vitulli, & Kulkarni, 1992; Hilyer et al., 1982; Koniak-Griffin, 1994; MacMahon & Gross, 1988; McDermott et al., 1990; Motl, Birnbaum, Kubik, & Dishman, 2004; Murray, Kelder, Meyers, & McReynolds, 1998; Norris, Carroll, & Cochrane, 1992) and sport participation (Gore, Farrell, & Gordon, 2001; Sanders, Field, Diego, & Kaplan, 2000; Vilhjalmsson & Thorlindsson, 1992). The annual rate of depression among teenagers and young adults in the United States is nearly twice that of adults 25–44 years old (Kessler et al., 1994), and it is estimated that 15%–30% of adolescents will experience an episode of depression (Birmaher et al., 1996; Kessler & Walters, 1998; Lewinsohn, Rohde, & Seeley, 1998). Hence, understanding more about physical activity and depression among adolescents has public health importance.

Mechanisms whereby a salutary effect of physical activity on depression risk might be explained have not, as yet, been elucidated. Limited evidence derived by using animal models of depression has supported favorable biological adaptations during adolescence in brain monoamines (e.g., Dishman et al., 1997; Greenwood et al., 2003; Yoo, Tackett, Bunnell, Crabbe, & Dishman, 2000) and neurotrophins (e.g., Russo-Neustadt, Alejandre, Garcia, Ivy, & Chen, 2004; Van Hoomissen, Chambliss, Holmes, & Dishman, 2003) after chronic physical activity. Another putative, but unstudied, mechanism is increased self-esteem. Self-esteem is a core feature of psychological adjustment during adolescence (Rosenberg, 1985), and low self-esteem is predictive of depression risk during adolescence (Goodman & Whitaker, 2002), especially among girls (Park, 2003; Räty, Larsson, Söderfeldt, & Larsson, 2005). Because increases in physical activity have been associated with enhanced self-esteem in several randomized trials (Ekeland, Heian, & Hagen, 2005; Fox, 2000), it is plausible that self-esteem might explain the association previously reported between physical activity and depression symptoms. In the present article, we report initial correlational results from a cross-sectional study of girls in late adolescence that suggest that physical self-concept mediates the associations of physical activity and sport participation with self-esteem, which is inversely related to depression symptoms. Although the cumulative evidence has not supported a direct influence of self-esteem on several behaviors (e.g., school performance, alcohol and drug use, sexual activity, and social behavior; Baumeister, Campbell, Krueger, & Vohs, 2003; Marsh, Byrne, & Yeung, 1999; Valentine, DuBois, & Cooper, 2004), the evidence that low self-esteem is associated with increased risk of depression is more compelling (Baumeister et al., 2003). However, physical activity or sport participation, and their associations with physical self-concept, have not been considered

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as effect modifiers in the extant literature on self-esteem and depression risk.

Factor analysis of the physical self-concept domain (Fox & Corbin, 1989; Marsh & O'Neil, 1984) initially distinguished the distinct, but related, dimensions of physical self-concept to include sport competence, strength, endurance, and appearance. Further conceptual and psychometric refinements of these ideas led to the contemporary view that physical self-concept can be described as a hierarchical construct comprised of related subcomponents such as strength, body fat, endurance/fitness, sports competence, coordination, health, appearance, and flexibility (Hagger, Biddle, & Wang, 2005; Marsh & Redmayne, 1994; Sonstroem, 1998).

Unlike the evidence on school performance (e.g., Guay, Marsh, & Boivin, 2003), the causal directionality of the putative reciprocal relations between physical activity or sport participation and physical self-concept has not been tested by prospective studies. Nonetheless, physical activity and physical fitness have been consistently related to physical self-concept among adolescents (Blackman, Hunter, Hilyer, & Harrison, 1988; Hagger, Ashford, & Stambulova, 1998; Marsh & Peart, 1988; Marsh & Redmayne, 1994; Sonstroem, 1976). Sport participation, which is a major portion of girls' physical activity during adolescence (Dowda et al., 2004; Grunbaum et al., 2004), has also been positively related to self-esteem (Delaney & Lee, 1995; Tiggemann, 2001; Yin & Moore, 2004).

Thus, the cumulative evidence is consistent with a possible functional network linking physical activity and sport participation with enhanced self-esteem through a mediated effect of increased physical self-concept (Sonstroem, 1998). Although prospective controlled cohort studies or randomized controlled trials are needed for directional or causal tests of effect mediation (Kraemer, Stice, Kazdin, Offord, & Kupfer, 2001; Kraemer, Wilson, Fairburn, & Agras, 2002), cross-sectional studies can provide the empirical justification for such studies. Thus, the purpose of the current correlational, cross-sectional study is to provide the initial test of potential mediating effects of global physical self-concept (GPSC) and its subdomains on the relations of physical activity and sport participation with self-esteem and depression symptoms.

We hypothesized that the inverse relations of physical activity and sport participation with depression symptoms reported by other investigators would be completely or partially mediated by physical self-concept and self-esteem. Because physical fitness and body fatness have been related to both physical activity (Baquet, Van Praagh, & Berthoin, 2003; Levin, Lowry, Brown, & Dietz, 2003) and physical self-concept (Guérin, Marsh, & Famose, 2004; Marsh, 1996a, 1996b; Marsh & Redmayne, 1994) among adolescents, we also examined their potential influence as confounders of the relations among physical activity, sport participation, and physical self-concept.

We sampled 12th-grade girls because adolescent girls are twice as likely as boys to develop depression (Birmaher et al., 1996), and their participation in physical activity is highly variable; less than half of 12th-grade girls are estimated to get sufficient amounts of vigorous physical activity (Grunbaum et al., 2004). African American girls are less physically active than White girls by late adolescence (Kimm et al., 2002), and their risk of depression symptoms seems less influenced by physical self-concept (Franko & Striegel-Moore, 2002), so we also compared the hypothesized relations between Black and White girls.

Method

Participants

Participants ($N = 1250$) were 12th-grade girls from 22 public high schools in South Carolina who had a mean age of 17.66 ($SD = 0.61$) years and a racial distribution of 39.0% White ($n = 487$), 54.6% Black ($n = 682$), and 3.9% other ($n = 49$); 2.6% ($n = 32$) of the girls did not report race. The Black girls had higher body mass index (BMI), $t(1148) = 6.70$, $p < .01$; had lower cardiorespiratory fitness (Physical Work Capacity 170; PWC_{170}), $t(944) = 6.30$, $p < .01$; and were slightly ($M = 0.145$ years) older, $t(1167) = 4.05$, $p < .01$, than the White girls.

Measures

Depression symptoms. The Center for Epidemiological Studies—Depression Scale (CES–D; Radloff, 1977) was used to measure depressive symptoms during the previous week. The scale consists of 20 items rated on a 4-point scale. The original second-order factor structure includes four first-order factors (Depressed Affect, Somatic Activity, Interpersonal, and Positive Affect/Well-Being) that indicate a single higher order Depression factor. Internal consistency of the scale has ranged from 0.79 to 0.92 (Dierker et al., 2001; Radloff, 1977, 1991; Roberts, Lewinsohn, & Seeley, 1991). The CES–D total score has factorial validity and invariance among adolescent boys and girls (Motl, Dishman, Birnbaum, & Lytle, 2005) and among Black and White 12th-grade girls (Hales et al., 2006). It has moderate predictive validity (about 75%) for screening major depressive episode among adolescent girls (Garrison, Addy, Jackson, McKeown, & Waller, 1991).

Self-concept. The Physical Self-Description Questionnaire (PSDQ) (Marsh, Richards, Johnson, Roche, & Tremayne, 1994) was used to measure self-esteem and GPSC, and attributes specific to physical self-concept were measured by subscales (i.e., Strength, Body Fat, Endurance, Sports Competence, Physical Activity, Coordination, Health, Appearance, and Flexibility). The PSDQ consists of 70 statements rated on a 6-point, true–false scale. Each subscale includes six to eight items that are paired and averaged to form item parcels (three or four indicators per scale), yielding advantages for psychometrics and structural modeling over the use of single-item indicators (Little, Cunningham, Shahar, & Widaman, 2002). Research on the PSDQ has supported measurement invariance between men and women and over time (Guérin et al., 2004; Marsh, 1996b). The PSDQ is similarly invariant between Black and White adolescent girls using either items or item parcels as indicators (Dishman et al., 2006). Internal consistencies for the 11 subscales are generally high ($>.80$) and stability coefficients range from 0.69 to 0.83 for 14- and 3-month retests, respectively.

Physical activity and sport participation. Physical activity was measured using the 3-Day Physical Activity Recall (3DPAR; Pate, Ross, Dowda, Trost, & Sirard, 2003). The 3DPAR provides a reliable estimate of usual physical activity by assessing recall of 3 days (2 weekdays and 1 weekend day; in this study, the preceding Tuesday, Monday, and Sunday) of physical activity in a single reporting session. Responses are converted into 30-min blocks of METs (i.e., physical activity level expressed as multiples of basal metabolic rate) for each day. Criterion-related validity of the 3DPAR has been established on the basis of its relation with an objective measure of physical activity derived by accelerometry (Pate et al., 2003), and factorial invariance between Black and White adolescent girls across 12 months has been established (Motl, Dishman, Dowda, & Pate, 2004).

Sport participation (Sport_P) was calculated as the sum of two items adapted from the Youth Risk Behavior Surveillance Survey (Centers for Disease Control and Prevention, 2004): "During the past 12 months, how many sports teams run by your school did you play on? (DO NOT include PE classes)," and "During the past 12 months, how many sports teams run by organizations outside your school did you play on?" Scores for each item range from 0 to 3.

Covariates: Physical fitness and BMI. The measure of physical fitness, PWC_{170}, required participants to cycle on an ergometer at three submaximal rates of power output (kgm · min^{-1}). Heart rate and workload measured at each stage was used to estimate power output at a heart rate of 170 beats/min. PWC_{170} was expressed per kilogram (kgm · min^{-1} · kg^{-1}) in an attempt to control for differences in body size. Height and weight were measured and used to calculate BMI, a measure of excess weight for height (kg/m^2) commonly used as an indicator of body fatness.

Procedures

All testing was approved by the University of South Carolina Institutional Review Board. Participants, and a parent or legal guardian for girls under 18 years, provided written informed consent. Measures were administered by trained data collectors. Data for the 3DPAR were collected on a Wednesday, and then PWC_{170}, BMI, Sport_P, CES–D, and PSDQ were normally assessed within 2 days.

Data Analysis

Confirmatory factor analysis and structural equation modeling (SEM) were used to test models with full-information maximum likelihood estimation using AMOS 5.0 (Arbuckle, 2003; Arbuckle & Wothke, 1999). Post hoc results were also obtained from LISREL 8.5 (Jöreskog & Sörbom, 1996a). Preliminary analyses, creation of item parcels, and comparison of individuals with and without missing data were conducted using SPSS 13.0 and PRELIS (Jöreskog & Sörbom, 1996b). After Bonferroni adjustment for multiple comparisons, indicators did not differ significantly ($p > .05$) across schools; ICC(1) (intra-class correlation coefficient; McGraw & Wong, 1996) values ranged from .001 to .025. However, to correct for any nesting effect of schools in the SEM, each indicator was adjusted for school by multiple linear regression, and the residuals were used in the analysis (Cohen & Cohen, 1983). Overall, 5.9% of data for the 1250 girls was missing (4,495 of 76,250 responses). The missing responses were 3.9% for PSDQ, 8.7% for CES–D, 7.7% for 3DPAR, 2.9% for Sport_P, 20.2% for PWC_{170}, and 3.1% for BMI. Full-information maximum likelihood has been shown to yield accurate fit indices and parameter estimates with up to 25% simulated missing data and is considered one of the best methods for handling missing data in confirmatory factor analysis and SEM (Arbuckle, 1996; Arbuckle & Wothke, 1999; Enders & Bandalos, 2001).

The root mean square error of approximation (RMSEA), nonnormed fit index (NNFI), comparative fit index (CFI), and the chi-square test were used to evaluate and compare model fit. The chi-square test is very sensitive to sample size and in most SEM analyses calls for rejection of the hypothesized model (Bollen, 1989; Jöreskog, 1993). Values for the CFI and NNFI approximating 0.95 suggest good fit (Hu & Bentler, 1998), whereas acceptable fit is often associated with values approximating 0.90 (Bentler & Bonett, 1980; Hu & Bentler, 1998). RMSEA values approximating .05–.08 reflect close and reasonable fit (Browne & Cudeck, 1993; Hu & Bentler, 1998). Incremental fit indices such as the CFI and NNFI are biased downward when the number of indicators in the model becomes large (Kenny & McCoach, 2003). Therefore, judgment of model fit was based on model interpretability and the cumulative evidence from all measures of fit, guided by current suggestions that strict cutoff values for specific indices may not always be appropriate (Byrne, 1998; Hu & Bentler, 1998; Marsh, Hau, & Wen, 2004).

Nested models were compared using chi-square difference tests and changes in the values of the RMSEA and CFI (Cheung & Rensvold, 2002). Parameter estimates, standard errors, z values (parameter estimate/standard error), and squared multiple correlations were inspected for sign and magnitude. Parameters with nonsignificant z values, a sign opposite the expected direction, and/or large standard errors were not considered meaningful for interpretation (Jöreskog, 1993; Raykov & Marcoulides, 2000).

Measurement equivalence among groups should be established to support conclusions and implications drawn from constructs measured by self-report (Aiken & West, 1990). The factorial validity and multigroup invariance of the PSDQ and the CES–D have been supported in this sample of adolescent girls (Dishman et al., 2006; Hales et al., 2006) and elsewhere (Motl et al., 2005; Guérin et al., 2004). Before testing the structural model, the factorial validity and multigroup invariance of the 3DPAR were tested in this sample of girls—the factor structure, loadings, and item uniquenesses, but not factor variances, were found to be invariant (CFI = 1.00, NNFI = 1.00, RMSEA = .011, 90% confidence interval [CI] = 0.001, 0.043).

Specifications for the measurement portion of the model were based on previous confirmatory analyses for each of the measurement instruments (Marsh & Redmayne, 1994; Motl et al., 2005). The latent variables in the model included CES–D, self-esteem, GPSC, nine physical self-concept subscales (Strength, Body Fat, Endurance, Sports Competence, Physical Activity, Coordination, Health, Appearance, and Flexibility), 3DPAR, and Sport_P. The CES–D was represented by a second-order latent factor indicated by four first-order factors. The number of items indicating the first-order factors ranged from two to seven. GPSC, self-esteem, and the nine individual components of physical self-concept were each indicated by three- or four-item parcels that were each the average of two consecutive items on a given subscale of the PSDQ. Physical activity was indicated by three single-day estimates of total METs from the 3DPAR. Sport_P was modeled with a single-item indicator.

The hypothesized structural model shown in Figure 1 depicts the relations between the exogenous and endogenous latent variables. Disturbance terms among the nine endogenous factors representing specific aspects of physical self-concept were allowed to correlate to account for unexplained common variance not hypothesized in the model. In addition, the covariance between physical activity and sport participation was estimated. Although tested, path coefficients with critical scores (i.e., z values) less than 2.0 are not pictured in Figure 1.

Two alternative models were tested to confirm the hypothesized mediation effects. The first alternative model included all paths specified for Figure 1 and additional direct paths from 3DPAR and Sport_P to GPSC, self-esteem, and CES–D. The second model included a direct path from GPSC to CES–D. Examination of the path coefficients and comparisons between these alternative models with the hypothesized mediation model in Figure 1 were used to examine whether the effects of 3DPAR and Sport_P on GPSC, self-esteem, and CES–D were completely or partially mediated by the individual aspects of physical self-concept and whether the effect of GPSC on CES–D was completely or partially mediated by self-esteem.

Invariance of the structural parameters was tested by comparing a series of nested models. The measurement portion of each model (relationships of observed variables to their respective factors) was held invariant throughout. The first model (M1) tests the equivalence of the hypothesized pattern of paths and covariance across groups. In this model, all structural parameters are freely estimated in the two groups. The next model (M2) restricts all paths from 3DPAR to the nine specific measures of physical self-concept to be equivalent. Model M3 adds the paths from Sport_P to the nine specific measures of physical self-concept and the covariance between 3DPAR and Sport_P to those being held invariant. Model M4 restricts paths from the nine specific measures of physical self-concept to GPSC. Finally, Model M5 sets the remaining two path coefficients to be equivalent across groups.

Finally, to examine whether cardiorespiratory fitness and body fatness might confound the relations of 3DPAR and Sport_P with the subcomponents of physical self-concept, we tested an additional structural model that included PWC_{170} and BMI scores as single-item, exogenous variables along with the 3DPAR and Sport_P. The model (see Figure 2) was similar to the model in Figure 1 with the addition of paths leading from PWC_{170} and BMI to each of the nine subdomains of physical self-concept. To simplify the depiction of the model, we have not included paths having coefficients with critical values (z values) less than 2.0 in Figure 2.

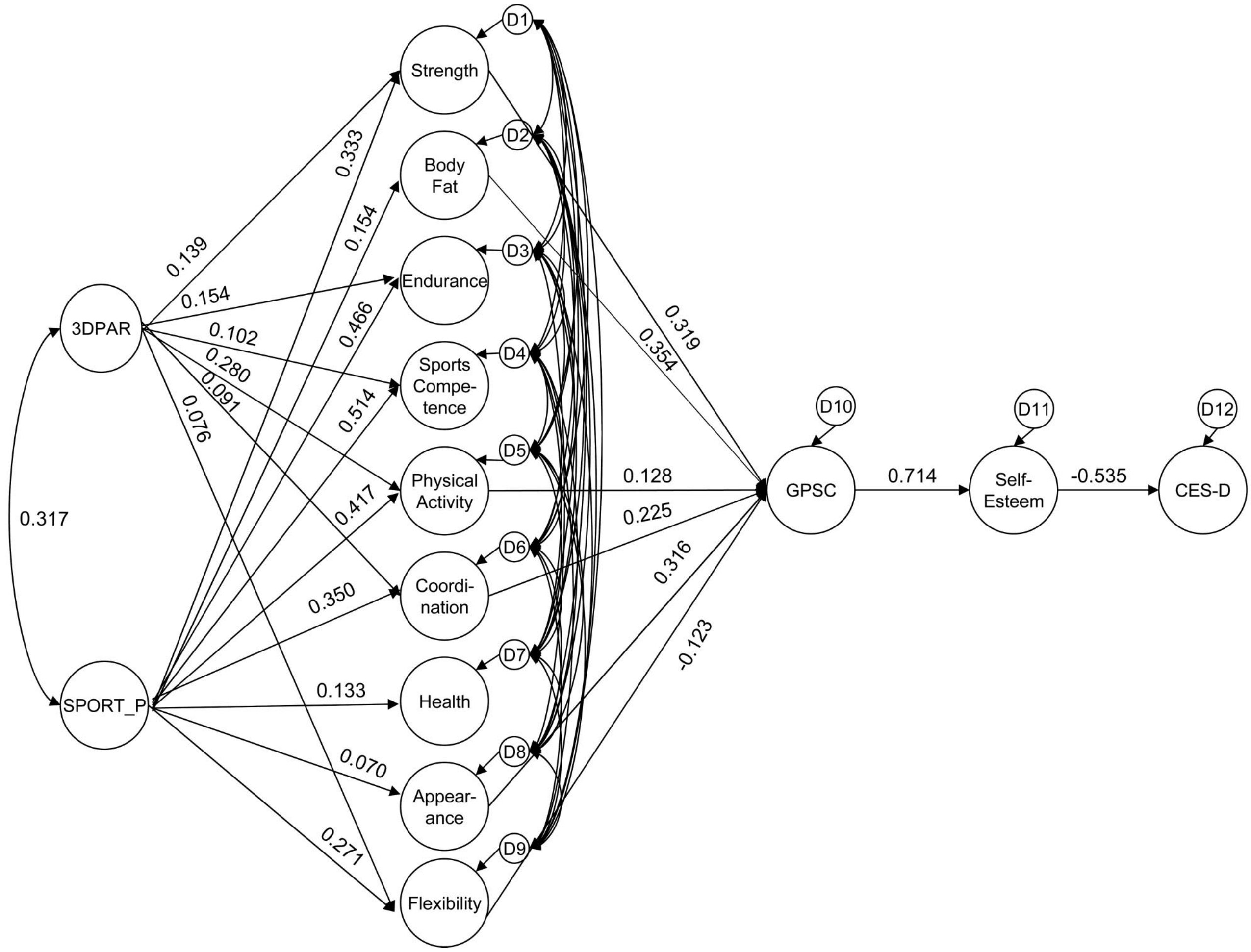

Figure 1. Model of hypothesized associations among physical activity (3-Day Physical Activity Recall; 3DPAR), sport participation (Sport_P), specific dimensions of physical self-concept, global physical self-concept (GPSC), self-esteem, and depressive symptoms (Center for Epidemiological Studies—Depression Scale; CES–D). Standardized path coefficients were obtained from analysis using the entire sample of Black and White girls (N = 1597). D1–D12 represent disturbance terms (variance not explained by each endogenous latent variable). The measurement portion of the model and structural paths having critical values <2.0 are not pictured.

Results

Descriptives

Univariate and multivariate skewness and kurtosis values were obtained using PRELIS 2.5 (Jöreskog & Sörbom, 1996b). Mardia's coefficient of multivariate kurtosis was significant (z = 40.953, $p < .01$), indicating a violation of multivariate normality. This value is sensitive to large sample sizes and is often significant when model fit, parameter estimates, and standard errors would not be substantially affected (Bollen, 1989; Kline, 1998; Mardia, 1970). The relative kurtosis index (1.18) and univariate kurtosis values indicated that violations of multivariate normality were minimal and not likely to substantially affect the model estimates (Kline, 1998).

Invariant standardized factor loadings for the measurement portion of the model ranged from 0.346 to 0.977 for the CES-D, 0.581 to 0.923 for the PSDQ, and 0.387 to 0.853 for 3DPAR. All were statistically significant. The squared multiple correlations for the items and/or parcels ranged from 0.158 to 0.955 for the CES-D, 0.338 to 0.852 for the PSDQ, and 0.150 to 0.727 for 3DPAR. Descriptive statistics and bivariate correlations can be found in Table 1.

Model fit: Entire sample. The results for the entire sample provide evidence that supports the hypothesized structural relations (see Table 2). The RMSEA (90% CI) indicates that the model in Figure 1 provides good fit, whereas the CFI and NNFI suggest acceptable fit of the model to the data. For the model pictured in Figure 1, 3DPAR had significant, direct relations with the subscales of Strength, Endurance, Sports Competence, Physical Activity, Coordination, and Flexibility. Significant path coefficients were also found from Sport_P to each of the subscales of physical self-concept. Physical activity assessed by 3DPAR exhibited a

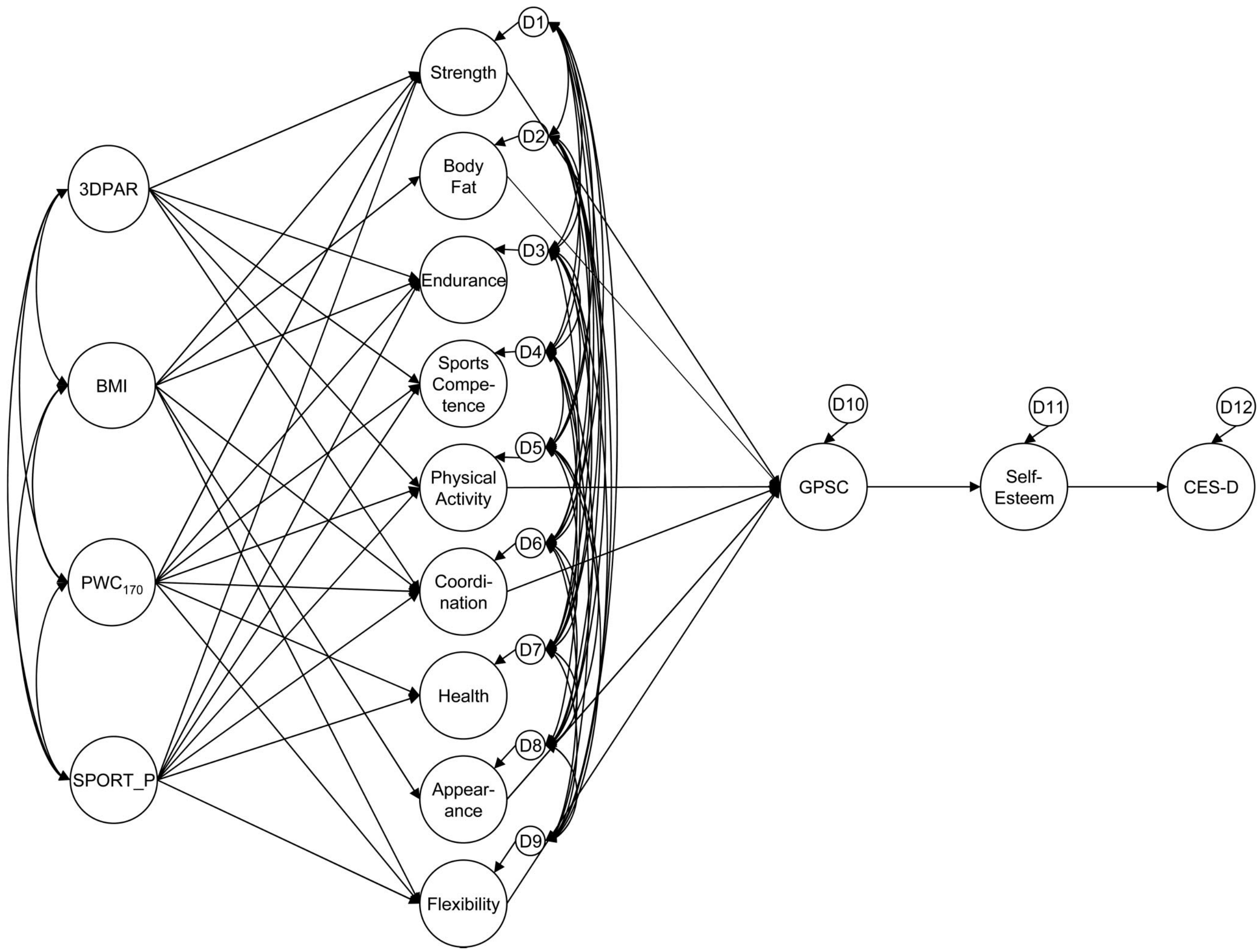

Figure 2. Model examining the effect of including fitness (Physical Work Capacity 170; PWC_{170}) and body mass index (BMI) on the relationships between physical activity (3-Day Physical Activity Recall; 3DPAR) and sport participation (Sport_P) and among specific dimensions of physical self-concept, global physical self-concept (GPSC), self-esteem, and depressive symptoms (Center for Epidemiological Studies—Depression Scale; CES–D). D1–D12 represent disturbance terms (variance not explained by each endogenous latent variable). The measurement portion of the model and structural paths having critical values <2.0 are not pictured.

standardized indirect relation with GPSC (0.068) that was mediated by the subscales of Strength, Coordination, Physical Activity, and Flexibility. Sport_P had a standardized indirect relation with GPSC (0.280) that was mediated by PSDQ subscales of Strength, Body Fat, Coordination, Physical Activity, Appearance, and Flexibility.

The fit of the two alternative models used to test whether 3DPAR and Sport_P had direct effects on GPSC, self-esteem, or CES–D and whether GPSC had a direct effect on CES–D were not significantly different from the hypothesized mediator model depicted in Figure 1 (CFI, NNFI, and RMSEA were unchanged; chi-square difference tests were nonsignificant). In addition, none of the direct paths from 3DPAR and Sport_P to GPSC, self-esteem, or CES–D, or from GPSC to CES–D, were significant.

Model fit: Black and White girls. Model fit was minimally acceptable for Black girls (CFI = 0.893, NNFI = 0.881, RMSEA = .045, 90% CI = 0.044, 0.047) and White girls (CFI = 0.902, NNFI = 0.891, RMSEA = .050, 90% CI = 0.048, 0.052). The fit of model M1 for the multigroup analysis was also acceptable (CFI = 0.895, NNFI = 0.884, RMSEA = .034, 90% CI = 0.033, 0.035). The similarity of fit (see Table 3) for models M1, M2, M3, M4, and M5 supports the invariance of path coefficients in this sample of Black and White girls. Table 4 contains both invariant and standardized structural model parameters for Black and White girls from Model M5. Similar to the results from the entire sample, physical activity assessed by the 3DPAR had significant direct relations with the Strength, Endurance, Sports Competence, Physical Activity, Coordination, and Flexibility subscales of the PSDQ. All parameters for paths from Sport_P to the specific dimensions of physical self-concept had critical values greater than 2.0. In addition, the PSDQ subscales of Strength, Body Fat, Physical Activity, Coordination, and Appearance each had a significant

Table 1
Descriptive Statistics and Pearson Correlation Coefficients

Variable	Descriptives																		
	N	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Self-esteem	1,201	5.08	0.79	—															
2. GPSC	1,201	4.28	1.22	.529	—														
3. Strength	1,201	4.11	1.04	.397	.531	—													
4. Physical Activity	1,202	3.70	1.48	.209	.405	.482	—												
5. Endurance	1,201	3.22	1.28	.252	.469	.528	.667	—											
6. Coordination	1,202	4.34	1.02	.478	.535	.556	.555	.571	—										
7. Health	1,202	4.45	0.97	.316	.163	.209	.081	.152	.191	—									
8. Appearance	1,201	4.75	0.99	.576	.561	.356	.036	.141	.309	.151	—								
9. Flexibility	1,201	4.32	1.13	.428	.457	.513	.416	.507	.697	.185	.297	—							
10. Body Fat	1,202	4.14	1.57	.407	.547	.130	.116	.268	.269	.155	.423	.313	—						
11. Sports Competence	1,201	3.75	1.31	.309	.498	.630	.596	.664	.620	.155	.187	.477	.217	—					
12. CES–D	1,142	14.48	9.69	−.513	−.336	−.184	−.096	−.097	−.226	−.289	−.305	−.188	−.291	−.123	—				
13. 3DPAR	1,154	62.28	12.24	.047	.117	.203	.344	.261	.160	.031	−.034	.129	.036	.234	−.035	—			
14. Sport participation	1,214	1.05	1.26	.153	.273	.324	.460	.459	.334	.121	.043	.249	.139	.503	−.077	.265	—		
15. PWC_{170}	997	11.38	3.72	.177	.250	.175	.341	.355	.279	.120	.057	.227	.342	.316	−.148	.162	.287	—	
16. BMI	1,211	25.17	6.54	−.197	−.274	.040	−.137	−.247	−.240	−.050	−.123	−.230	−.658	−.189	.174	−.027	−.166	−.518	—

Note. GPSC = global physical self-concept; CES–D = Center for Epidemiological Studies—Depression Scale; 3DPAR = 3-Day Physical Activity Recall; PWC_{170} = Physical Work Capacity 170; BMI = body mass index.

direct association with GPSC. The direct relations between GPSC and self-esteem and between self-esteem and CES–D were also significant for Black and White girls. The standardized indirect associations of 3DPAR and Sport_P with GPSC were 0.069 and 0.292, respectively, and the standardized indirect associations of 3DPAR and Sport_P with CES–D were −0.026 and −0.107, respectively.

Model fit: Adding BMI and PWC_{170}. The model that included BMI and PWC_{170} as covariates, along with 3DPAR and Sport_P (see Figure 2), had adequate fit in the entire sample, $\chi^2(1678) = 5{,}656.969$ (CFI = 0.907, NNFI = 0.895, RMSEA = .044, 90% CI = 0.042, 0.045). Significant unstandardized and standardized path values and standard errors for the model in Figure 2 can be found in Table 5. All but two of the significant path coefficients from 3DPAR and Sport_P to the specific domains of physical self-concept were of similar magnitude to those observed in Figure 1. The exceptions were the paths from Sport_P to the PSDQ subscales of Body Fat and Appearance, which dropped substantially and were no longer significant when BMI and PWC_{170} were included in the model. Thirteen of the 18 parameters for paths from PWC_{170} and BMI to the nine specific dimensions of physical self-concept had critical values greater than 2.0. The paths from PWC_{170} to Body Fat and Appearance and from BMI to Sports Competence, Physical Activity, and Health were nonsignificant. The correlations among BMI, PWC_{170}, 3DPAR, and Sport_P ranged from −0.519 to 0.317. The standardized indirect relation of 3DPAR with GPSC remained virtually unchanged (0.060) with the addition of BMI and PWC_{170} to the model, whereas the indirect relation of Sport_P with GPSC was reduced to 0.211. The standardized indirect relation of 3DPAR with CES–D remained unchanged, and the indirect relation of Sport_P was reduced slightly to −0.081.

Discussion

The results provide initial evidence suggesting that physical self-concept mediates the relations of physical activity and sport participation with self-esteem, which is inversely related to depression symptoms among girls in late adolescence. Moreover, the relations of physical activity (3DPAR) and Sport_P with GPSC were each mediated by specific self-perceptions of strength, physical activity, coordination, and flexibility. These relations were virtually unchanged when measures of physical fitness and BMI were tested as covariates. As expected, the relation of perceived sports competence with Sport_P was stronger than with physical activity. However, sports competence was not related to GPSC after accounting for the other subcomponents of physical self-concept. Hence, the observed relations with GPSC are explainable by variation in physical activity and sport participation among the girls, rather than by a confounding of physical activity and sport participation with measures of physical fitness and body fatness or perceived sports competence.

Moreover, although perceptions of appearance and body fat were each related to GPSC, neither was related to physical activity. Similarly, perceived body fat and appearance were unrelated to Sport_P after controlling for fitness and BMI. Hence, the results indicate that physical activity and sport participation are potentially unique, positive influences on physical self-concept that operate independently of perceptions of appearance, which are

Table 2
Fit of the Multigroup Factorial Invariance Tests for Black and White Girls

Model (M)	*df*	χ^2	RMSEA	90% CI	CFI	NNFI
Entire sample	1582	5,510.04*	.045	0.043, 0.046	0.905	0.894
Black girls	1582	3,799.22*	.045	0.044, 0.047	0.893	0.881
White girls	1582	3,496.48*	.050	0.048, 0.052	0.902	0.891
Path structure (M1)	3210	7,448.18*	.034	0.033, 0.035	0.895	0.884
3DPAR–PSDQ (M2)	3219	7,469.15*	.034	0.033, 0.035	0.895	0.884
Sport_P–PSDQ (M3)	3229	7,497.06*	.034	0.033, 0.035	0.894	0.884
PSDQ–GPSC (M4)	3238	7,522.44*	.034	0.033, 0.035	0.894	0.884
All (M5)	3240	7,529.57*	.034	0.033, 0.035	0.894	0.884

Note. RMSEA = root mean square error of approximation; CI = confidence interval; CFI = comparative fit index; NNFI = nonnormed fit index; 3DPAR = 3-Day Physical Activity Recall; PSDQ = Physical Self-Description Questionnaire; Sport_P = sport participation; GPSC = global physical self-concept.
* $p < .01$.

known to be strong influences on increased risk of depression risk among adolescent girls (Franko & Striegel-Moore, 2002).

The hypothesized structural model accounted for 77% of the variability in GPSC, 51% of the variability in self-esteem, and 29% of the variability in depression symptoms. Physical activity and Sport_P accounted for small portions of the variation in the subdomains of physical self-concept (0.5%–33.0%). The indirect relation with depression symptoms was larger for Sport_P than for physical activity. Although each relation was small by traditional standards for sample statistics, when expressed as a binomial effect (Rosenthal & Rubin, 1982), the cumulative effect would be equivalent to a reduction in depression symptoms in 6% of our sample, approximately 75 girls. Such an effect could be practically meaningful in a population of 12th-grade girls. Coincident, or prospective, assessments of depression by clinical diagnosis would, of course, be needed to determine the practical meaning of our findings derived by a cross-sectional assessment of depression symptoms.

The invariance of the structural model between Black and White girls was supported but should be interpreted cautiously because of the large number of parameters in the measurement model. For White girls, 64% and 34% of the variance in self-esteem and depression symptoms were explained, whereas for Black girls, 40% and 29%, respectively, were explained. Post hoc examination revealed that when BMI and PWC_{170} were included in the model, the only substantial change occurred in the paths from Sport_P to self-perceptions of body fat and appearance. This suggests that at least part of the indirect relation of sport participation with GPSC is associated with fitness and fatness.

Prior studies did not examine whether the direct, inverse relations of physical activity or sport participation with the depression symptoms they observed might have been explained by mediating variables such as physical self-concept or self-esteem. They also did not simultaneously examine the relations of physical activity and sport participation with depression symptoms, so it is not possible to discern from those studies whether relations attributed to overall physical activity or sport participation were independent of each other or additive. In the present study, Sport_P was recalled for the past year, whereas physical activity assessed by the 3DPAR was based on the recall of activity during the previous 3 days. The 3DPAR provides a reliable estimate of objectively measured physical activity across a week (Pate et al., 2003), and it was moderately correlated with Sport_P in the present sample. However, the 1-year stability coefficient (.41) of the 3DPAR among adolescent girls is only moderate in size (Motl, Dishman, Dowda, & Pate, 2004), which might partly explain the small associations we observed among physical activity, GPSC, and depression symptoms. Although perceptions of sports competence did not mediate the relations of physical activity and sport participation with GPSC in this sample of 12th-grade girls, future research might examine whether, under certain conditions, sport participation has a negative influence on physical self-concept among some girls because of social pressure leading to negative self-appraisals and possibly increased risk of depression symptoms.

The Physical Activity subscale of the PSDQ was independently correlated with the 3DPAR measure of physical activity and with Sport_P, but those relations do not clarify the Physical Activity subscale's meaning in this study. The physical activity items of the PSDQ ask the respondent about the frequency of behavior, but they do not ask for judgments about the self as do items on the other PSDQ subscales. Assessment of the PSDQ concurrently with another measure of physical self-concept and objective validation criteria for the assessment of physical activity (e.g., accelerometry, heart rate monitoring or direct observation; Sirard & Pate, 2001) would help clarify whether the physical activity subscale of the PSDQ assesses physical self-concept or physical activity.

Studies are needed to determine whether the mechanisms underlying the association of physical activity and sport participation with depression symptoms are additionally explained by neurobiological systems or by other psychological variables (e.g., perceived control or self-efficacy). Nonetheless, given the incomplete effectiveness of psychotherapy (Brent et al., 1997) and the unclear

Table 3
Comparison of the Multigroup Factorial Invariance Tests for Black and White Girls

Model comparisons (M)	df_{diff}	χ_{diff}^2	*p*	CFI_{diff}
M1 vs. M2	9	20.97	.02	0.00
M2 vs. M3	10	27.91	.01	0.001
M3 vs. M4	9	25.38	.01	0.00
M4 vs. M5	2	7.13	.03	0.00

Note. CFI = comparative fit index.

Table 4
Invariant and Standardized Parameter Estimates for Model M5[a]

Path			Parameter estimates			
					Standardized	
			Unstandardized	*SE*	White	Black
3DPAR	→	Flexibility	0.006	0.003[b]	0.059	0.073
3DPAR	→	Coordination	0.005	0.002[b]	0.074	0.094
3DPAR	→	Sports Competence	0.011	0.003[b]	0.098	0.109
3DPAR	→	Endurance	0.014	0.003[b]	0.128	0.158
3DPAR	→	Body Fat	−0.005	0.005	−0.034	−0.041
3DPAR	→	Strength	0.012	0.003[b]	0.123	0.158
3DPAR	→	Appearance	−0.003	0.003	−0.036	−0.049
3DPAR	→	Health	−0.001	0.003	−0.014	−0.017
3DPAR	→	Physical Activity	0.027	0.003[b]	0.240	0.299
Sport_P	→	Flexibility	0.259	0.033[b]	0.279	0.262
Sport_P	→	Coordination	0.223	0.022[b]	0.354	0.341
Sport_P	→	Sports Competence	0.559	0.032[b]	0.567	0.481
Sport_P	→	Endurance	0.472	0.032[b]	0.484	0.455
Sport_P	→	Body Fat	0.220	0.044[b]	0.174	0.161
Sport_P	→	Strength	0.286	0.029[b]	0.337	0.330
Sport_P	→	Appearance	0.088	0.028[b]	0.110	0.111
Sport_P	→	Health	0.098	0.025[b]	0.144	0.139
Sport_P	→	Physical Activity	0.423	0.003[b]	0.430	0.406
Health	→	GPSC	−0.009	0.030	−0.007	−0.006
Appearance	→	GPSC	0.391	0.037[b]	0.334	0.308
Strength	→	GPSC	0.301	0.048[b]	0.271	0.258
Body Fat	→	GPSC	0.258	0.020[b]	0.345	0.349
Endurance	→	GPSC	−0.022	0.043	−0.023	−0.022
Sports Competence	→	GPSC	0.051	0.036	0.053	0.058
Coordination	→	GPSC	0.275	0.074[b]	0.184	0.178
Flexibility	→	GPSC	−0.08	0.043	−0.078	−0.078
Physical Activity	→	GPSC	0.143	0.034[b]	0.149	0.147
GPSC	→	self-esteem	0.482	0.024[b]	0.765	0.696
Self-esteem	→	CES–D	−0.436	0.032[b]	−0.567	−0.534

Note. 3DPAR = 3-Day Physical Activity Recall; Sport_P = sport participation; GPSC = global physical self-concept; CES–D = Center for Epidemiological Studies—Depression Scale.
[a] See Figure 1.
[b] Critical value (z) > 2.0.

efficacy and safety of pharmacotherapy (Jureidini et al., 2004) for the treatment of adolescent depression, the present findings are sufficiently positive to encourage longitudinal cohort studies and randomized controlled trials designed to understand whether other low-risk interventions that might increase physical self-concept and self-esteem, such as those that increase physical activity and sport participation, may reduce the risk of depression and be more acceptable to youth and families. Studies of patients being treated for depression and other medical conditions (e.g., Keats, Courneya, Danielsen, & Whitsett, 1999) are especially encouraged. In addition to the novel findings of the study, the results add to the body of evidence regarding physical self-concept in two ways. First, they suggest that the associations of sport participation with GPSC and its subdomains reported previously among adolescents (Marsh, Hey, Roche, & Perry, 1997) are not confounded by levels of overall physical activity. Second, the patterns of associations between the subdomains of physical self-concept and the objective measure of cardiorespiratory fitness (e.g., positive associations with perceptions of endurance, sports competence, strength, coordination, physical activity, and health) and with BMI (e.g., the strong, inverse association with body fatness) provide additional convergent and discriminant evidence for the construct validity of the PSDQ (Marsh, 1996a, 1996b; Marsh & Redmayne, 1994).

The conceptualization of self-concept for this study was based on the multidimensional and hierarchical structure proposed by Shavelson, Hubner, and Stanton (1976). In this bottom-up model, causal flow is considered to occur from lower order factors to higher order factors. The hierarchical nature of the model has recently been questioned (Kowalski, Crocker, Kowalski, Chad, & Humbert, 2003; Marsh & Yeung, 1998). Although not derived from a specifically designed test of hierarchical structure, our results are generally consistent with other cross-sectional findings that support the bottom-up model of physical self-concept among adolescents (e.g., Hagger et al., 2005). The direction and magnitude of relations we report among GPSC, its subdomains, and self-esteem are similar to the results reported by others (Fox & Corbin, 1989; Kowalski et al., 2003; Sonstroem, Speliotis, & Fava, 1992).

Although causal mediation cannot be inferred from the cross-sectional data we report, the use of structural equation modeling allowed us to estimate the relations among variables simultaneously, test group differences, and compare alternative, direct

Table 5
Parameter Estimates for Model Including Physical Work Capacity 170 (PWC_{170}) and Body Mass Index (BMI)[a]

Path			Parameter estimates		
			Unstandardized	*SE*	Standardized
3DPAR	→	Flexibility	0.006	0.003	0.070
3DPAR	→	Coordination	0.005	0.002[b]	0.085
3DPAR	→	Sports Competence	0.009	0.003[b]	0.096
3DPAR	→	Endurance	0.013	0.003[b]	0.144
3DPAR	→	Body Fat	−0.001	0.004	−0.016
3DPAR	→	Strength	0.010	0.003[b]	0.118
3DPAR	→	Appearance	−0.004	0.003	−0.052
3DPAR	→	Health	−0.002	0.003	−0.018
3DPAR	→	Physical Activity	0.026	0.003[b]	0.253
PWC_{170}	→	Flexibility	0.030	0.014[b]	0.093
PWC_{170}	→	Coordination	0.028	0.009[b]	0.130
PWC_{170}	→	Sports Competence	0.056	0.014[b]	0.149
PWC_{170}	→	Endurance	0.063	0.013[b]	0.183
PWC_{170}	→	Body Fat	0.003	0.014	0.008
PWC_{170}	→	Strength	0.050	0.012[b]	0.169
PWC_{170}	→	Appearance	0.001	0.013	0.003
PWC_{170}	→	Health	0.029	0.011[b]	0.125
PWC_{170}	→	Physical Activity	0.074	0.013[b]	0.207
BMI	→	Flexibility	−0.028	0.006[b]	−0.160
BMI	→	Coordination	−0.015	0.004[b]	−0.132
BMI	→	Sports Competence	−0.007	0.006	−0.037
BMI	→	Endurance	−0.020	0.006[b]	−0.104
BMI	→	Body Fat	−0.162	0.007[b]	−0.677
BMI	→	Strength	0.025	0.006[b]	0.160
BMI	→	Appearance	−0.023	0.006[b]	−0.149
BMI	→	Health	0.003	0.005	0.020
BMI	→	Physical Activity	0.009	0.006	0.046
Sport_P	→	Flexibility	0.208	0.033[b]	0.218
Sport_P	→	Coordination	0.183	0.022[b]	0.292
Sport_P	→	Sports Competence	0.510	0.034[b]	0.467
Sport_P	→	Endurance	0.403	0.032[b]	0.398
Sport_P	→	Body Fat	0.040	0.035	0.031
Sport_P	→	Strength	0.272	0.030[b]	0.318
Sport_P	→	Appearance	0.035	0.031	0.042
Sport_P	→	Health	0.070	0.026[b]	0.103
Sport_P	→	Physical Activity	0.384	0.033[b]	0.369
Health	→	physical self-concept	−0.022	0.030	−0.015
Appearance	→	GPSC	0.371	0.036[b]	0.318
Strength	→	GPSC	0.379	0.052[b]	0.331
Body Fat	→	GPSC	0.268	0.020[b]	0.352
Endurance	→	GPSC	−0.020	0.043	−0.021
Sports Competence	→	GPSC	0.012	0.037	0.014
Coordination	→	GPSC	0.341	0.079[b]	0.218
Flexibility	→	GPSC	−0.125	0.045[b]	−0.121
Physical Activity	→	GPSC	0.123	0.034[b]	0.130
GPSC	→	self-esteem	0.462	0.023[b]	0.714
Self-esteem	→	CES-D	−0.417	0.031[b]	−0.535

Note. 3DPAR = 3-Day Physical Activity Recall; PWC_{170} = Physical Work Capacity 170; BMI = body mass index; Sport_P = sport participation; GPSC = global physical self-concept; CES–D = Center for Epidemiological Studies—Depression Scale.
[a] See Figure 2.
[b] Critical value (z) > 2.0.

models with the hypothesized mediational model. The findings suggest aspects of physical self-concept that, if changed, might have the greatest effect on GPSC, self-esteem, or depression symptoms. Physical activity interventions might include aspects that emphasize strength and coordination as well as general physical activity. Also, body self-concept (i.e., appearance and body fat) seems to play an important role in the development of physical self-concept and self-esteem in adolescent girls, regardless of whether the primary outcome of physical activity might be depression symptoms. Longitudinal studies describing the natural course of change in self-concept exist (Cole et al., 2001; Marsh & Yeung, 1998), but there seems to be no information on the mechanisms for this change or how these changes relate to other variables commonly associated with self-concept. A key to understanding the relations among physical activity, sport participation, physical self-concept, self-esteem, and depression symptoms will be the examination of how these variables change with respect to each other over time or as the result of an intervention.

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