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Physical Activity and Physical Self-Concept among Sedentary Adolescent Females; An Intervention Study

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Abstract

Problem—Physical activity has been promoted as a means of enhancing self-concept, yet the evidence for this connection is far from compelling. In particular, experimental research investigating this association during adolescence, a period during which many youth struggle to maintain a positive self-image, is noticeably lacking. This study investigates the impact on self-concept of a 9-month physical activity intervention among sedentary adolescent females.

Method—Female adolescents who were sedentary at baseline were assigned either to an exercise intervention or a comparison group as part of the controlled trial. The intervention was school-based, and assignment to groups was based on school attended. Intervention participants engaged in supervised activity 4 times per week and received didactic instruction promoting activity outside of school 1 day per week. Self-concept, physical activity participation, and cardiovascular fitness were assessed before, mid-way through, and after the 9-month intervention.

Results—The intervention had a significant positive impact on participation in vigorous activity and cardiovascular fitness. The intervention did not significantly influence any of the self-concept dimensions overall. There was, however, a three-way interaction such that there was an increase in global physical self-concept among those intervention participants who increased cardiovascular fitness.

Conclusions—These findings indicate that a physical activity intervention among sedentary adolescent females enhanced global physical self-concept for a subset of intervention participants who manifested positive changes in fitness.

Keywords

Female; Intervention; Physical self-concept; Physical Activity

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Introduction

Over the last couple of decades, the critical role of physical activity (PA) in promoting health and preventing disease has become apparent. Strong evidence exists for PA as a factor in reducing the risk of heart disease (Thompson, Buchner, Pina, Balady, Williams et al., 2003), diabetes (Kriska, 2003), osteoporosis (Todd & Robinson, 2003) and some forms of cancer (Friedenreich & Orenstein, 2002). Evidence for the role of PA in psychological well-being also has accumulated, with research indicating that PA may be effective in treating and/or reducing the risk of depression and anxiety (Hall, Ekkekakis, & Petruzzello, 2002).

Concern with the link between PA and psychological well-being has also brought attention to the role that PA may play in bolstering self-esteem, the value we place on our self, and self-concept, our perception of self (Ekeland, Heian, Hagen, Abbott, & Nordheim, 2004; Sonstroem, 1997). These two terms are often used interchangeably and, as self-concept is the broader concept from which self-esteem is derived, we will henceforth use the term self-concept. Evidence shows that self-concept is protective against depression and obesity (Park, 2003) as well as maladaptive behaviors such as substance abuse and violence (Kirkcaldy, Shephard, & Siefen, 2002; Nelson & Gordon-Larsen, 2006).

Correlational evidence suggests that PA is positively related to self-concept (Asci, Kosar, & Isler, 2001; Crocker, Sabiston, Forrestor, Kowalski, & McDonough, 2003; Dishman, Hales, Pfeiffer, Felton, Saunders *et al.*, 2006; Nigg, Norman, Rossi, & Benisovich, 2001; Raustorp, Stahle, Gudasic, Kinnunen, & Mattsson, 2005), and a recent review of intervention studies among children and adolescents supported the hypothesis that increasing PA yields a short-term improvement in self-concept among youth (Ekeland et al., 2004). The authors of the review, however, note that many of the studies among youth have been subject to methodological limitations; only one of the 25 studies included in the review was judged to have a “low risk of bias”, and 14 had a “high risk of bias”. Similarly, a meta-analysis of interventions among adults (Spence, McGannon, & Poon, 2005) concluded that participation in physical activity results in small significant improvements in self-concept, yet issued a call for more studies of the PA-self-concept link that test for changes in actual physical fitness.

Interestingly, the studies reviewed by Ekeland et al. (Ekeland et al., 2004) and those reviewed by Spence et al (Spence et al., 2005) uniformly employed global measures of self-concept, despite the fact that self-concept research has increasingly moved toward an approach that goes beyond assessing simply global self-concept. Based on a multi-dimensional and hierarchical model of self-concept (Fox & Corbin, 1989; Haggar, Biddle, Chow, Stambulova, & Kavussanu, 2003; Marsh, Richards, Johnson, Roche, & Tremayne, 1994; Shavelson, Hubner, & Stanton, 1976), recent research in the field incorporates specific sub-domains of self-concept, including a dimension termed physical self-concept: an individual’s opinion of his or her appearance, strength, body fat, coordination and other related aspects of the physical self (Marsh et al., 1994). Physical self-perception is an aspect of self-concept that is especially likely to be affected by PA participation (Fox, 1997), is particularly salient during adolescence (Ecklund & Bianco, 2000), and is hypothesized to contribute toward the more integrative construct of global self-concept (Fox, 1999).

Among those studies that have specifically examined the association between PA and physical self-concept among adolescents, there appears to be some support for the link (Crocker, Eklund, & Kowalski, 2000; Daley & Buchanan, 1999; Lindwall & Lindgren, 2005), although methodological limitations weaken the argument. There has been a scarcity of intervention studies investigating the link between PA and physical self-concept among adolescent females, despite the fact that adolescence is a period characterized by declining PA (CDC, 2004), and despite the central role that self-appraisals of physical appearance may play in adolescent self-esteem (Harter, 1999). One study that stands out in terms of its strong research design and direct relevance to the adolescent female population is a Swedish study looking at the effects of a 6-month exercise intervention on physical self-perception in non-physically active girls ranging in age from 13 to 20 (Lindwall & Lindgren, 2005). This study, in which 110 participants were randomly assigned (by school attended) to either a twice-per-week exercise program or a non-intervention control, provides a modicum of support for the association between exercise participation and physical self-concept. Both intent-to-treat analyses and multivariate analysis of study completers revealed no significant effect of the intervention on physical self-concept. Post-hoc univariate analyses among study completers, however, found a significant effect of the intervention on 3 out of the 5 dimensions of physical self-concept assessed. Limitations of this study included a very high drop-out rate (i.e., 52% of intervention participants and 36% of control participants failed to complete the study) as well as the low frequency of the intervention exercise sessions and the absence of objective documentation of the intervention intensity.

The present investigation is a controlled trial that extends prior research in several ways. Like the Lindwall and Lindgren study (Lindwall & Lindgren, 2005), we examine the impact of school-based PA intervention on physical self-concept among sedentary adolescent females. Our study goes beyond earlier work, however, in that it includes participant heart rate monitoring to document intervention intensity, and in that we analyze the data in light of participant changes in cardiovascular fitness and vigorous activity participation. Adolescent females were targeted because they represent a high-risk group for low levels of activity leading to an elevated risk of chronic disease. Sedentary adolescents were targeted for this study as it was expected that they would be most likely to experience benefits from increased levels of activity.

We hypothesized that intervention participants would report increased physical self-concept in multiple domains as a function of the exercise intervention, and that this improvement would be accompanied by an increase in global self-concept. In other words, we expected a Group (Intervention vs Comparison) by Time (Baseline, Semester One, and Semester Two) interaction predicting change in Physical Self-Concept and in Global Self-Esteem. We further hypothesized that the enhancements in self-concept would be more pronounced among those intervention participants who increased their physical activity and/or their cardiovascular fitness.

Method

Recruitment

Recruitment materials including flyers, mailers, posters, and announcements were distributed at two public high schools in Southern California. Materials specified that participants must be female, must not be a member of a sports team or club, and must not be a regular exerciser. The two participating schools had similar demographics and levels of academic achievement (as documented by publicly available data on SES, ethnic distribution, and API scores). Inclusion criteria were: 1) enrollment in the 10^{th} or 11^{th} grade, 2) participation in insufficient levels of PA to maintain physical fitness (i.e., fewer than three 20-minute bouts per week of vigorous PA and fewer than five 30-minute bouts per week of moderate PA), 3) performance at or below the 75^{th} percentile of predicted cardiovascular fitness, and 4) ability to exercise without restrictions.

Participants

At baseline, 146 eligible participants enrolled in the study (*n* = 79 [intervention]; *n* = 67 [comparison]). Reasons for attrition across the 9 months of the intervention included changing schools (*n* = 12), missing more than 10 days of the PE class in the first 2 months of the study (*n* = 6), unwillingness to fully participate in the intervention (*n* = 9), joining a sports team (*n* = 1) and choosing to discontinue participation (*n* = 2). Two participants were dropped because of missing data. Final analyses were conducted on 120 adolescent females (*n* = 61 [intervention]; *n* = 59 [comparison]). Data were collected across three consecutive years involving sequential cohorts of *n* = 41 (yr 1; 20 intervention and 21 comparison), *n* = 39 (yr 2; 20 intervention and 19 comparison) and *n* = 40 (yr 3; 21 intervention and 19 comparison).

Measures

Physical activity—Self-reported PA level was measured using a validated 3-Day Physical Activity Recall (3DPAR) (Motl, Dishman, Dowda, & Pate, 2004). Participants recalled their activity for the previous three days between 7:00am and 11:30pm, segmented into 30-min intervals. Activities were converted into Metabolic Equivalents (METs) using the compendium published by Ainsworth et al. (Ainsworth, Haskell, Leon, Montoye, Sallis *et al.*, 1993; Ainsworth, Haskell, Whitt, Irwin, Swartz *et al.*, 2000). The converted values were used to calculate the average daily minutes expended in vigorous (greater than or equal to 6 METs) activity. At baseline, participants were on summer vacation and completed the 3DPAR for the three days leading up to their clinic visit, which was arranged according to their availability. For the subsequent assessments, which occurred during the school year, one weekday and two weekend days were assessed, in order to obtain an estimate of leisure-time activity. Steps were taken to ensure that the weekday recalled was a day when the PE class engaged in a discussion, rather than supervised activity. Therefore, any reported activity occurred during participants' free time.

Cardiovascular fitness—Cardiovascular fitness was obtained through a ramp-type progressive exercise test on an electronically-braked cycle ergometer (Whipp, Davis, Torrers, & Wasserman, 1981). After a three-minute warm-up with unloaded pedaling (i.e., 0 W), the power output increased in a progressive fashion (i.e., 15 $W{\cdot}min^{-1}$). Participants were encouraged to maintain a pedaling rate of 70 $rev{\cdot}min^{-1}$ during the test phase of the protocol. The ramp power output increased continuously until participants reached voluntary fatigue. The duration of the test portion of the protocol lasted between 8–12 minutes. Each test was followed by an appropriate cool down period.

Using the SensorMedics Vmax 229 metabolic cart (Yorba Linda, CA), measurements of peak oxygen consumption (VO_2peak in $L{\cdot}min^{-1}$), heart rate, and work rate were obtained through a method previously designed for children and adolescents (Cooper, Weiler-Ravell, Whipp, & Wasserman, 1984). Gas exchange was measured breath-by-breath throughout the exercise protocol (Beaver, Lamarra, & Wasserman, 1981).

Body Mass Index—Standard, calibrated scales and stadiometers were used to determine height, weight, and Body Mass Index (BMI).

Body fat—Fat and lean body mass were measured by a dual x-ray absorptiometer (DEXA) using a hologic QDR *4500 densitometer (Hologic, Inc. Bedford, MA). A series of scans were performed by a licensed x-ray technician and analyzed using software designed for a pediatric population. Participants were scanned in a hospital patient gown while lying flat on their backs. On each day of testing, the DEXA machine was calibrated using the procedures provided by the manufacturer.

Physical Self-Concept—Physical self-concept was assessed through the 70-item Physical Self-Description Questionnaire (PSDQ) (Marsh et al., 1994). Respondents indicated the extent to which they agreed with each statement (1 = strongly disagree; 6 = strongly agree). Individual responses were summed and averaged to provide scores on eight specific components of physical self-concept (body fat, appearance, endurance, strength, coordination, flexibility, sports competence, and health) and two global measures of self-concept (Global Physical Self-Concept and Global Self-Esteem). One of the subscales included in the original PSDQ measure (i.e., "physical activity") was found to be very highly correlated with our behavioral measures and was omitted from analyses to reduce confounding. In studies of Australian adolescents, the PSDQ has been found to have good test-retest reliability (r = .83, 3 months; Marsh, 1996), as well as high alpha coefficients and factor loadings for each of the scales (Marsh et al., 1994). The factor loadings of these scales were recently replicated in an American University sample (Nigg et al., 2001). In addition, a study of sedentary female adolescents provided support for the validity of the PSDQ in terms of correlations between the subscales and external criteria of physical fitness and activity (Dunton, Schneider Jamner, & Cooper, 2003).

Procedures

Intervention—Group assignment was non-random and at the school level (i.e., one school served as the intervention group for logistic reasons and the other school served as the comparison group). Study participants at the intervention school enrolled in a special physical education class available only to study members. This class met five days per week for 60 minutes each day (approximately 40 minutes of activity time). The intervention differed from traditional PE classes in several ways. First, all of the students in the class had been determined to be sedentary and unfit at baseline, as described above. Second, the types of activities offered in the course were selected based on focus groups with members of the target population during pilot testing for the intervention. Examples of these class activities included aerobic dance, yoga, basketball, swimming, and Tae Bo. Third, one day per week of class time was devoted to a lecture or discussion focusing on the health benefits of PA and strategies for becoming physically active. Fourth, standards of participation in the class activities were higher than in a typical physical education class (i.e., non-participation was actively discouraged every day). Fifth, because the class was open only to study participants, the intervention class did not include any males. In order to ensure consistency across the intervention cohorts, the same instructor led the PE class and the same lecturers led the discussion component for the three years. Therefore, the activities were comparable in frequency, duration, intensity, and content for all intervention participants.

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In contrast, members of the comparison group were given no particular instructions with regards to PA. Because PE is required for at least two years during high school for students in these high schools, some members of the comparison group were enrolled in PE classes during the study, and school records were used to document enrollment in PE within the comparison group. Physical Education programs at the two schools were similar in structure, with students at both schools meeting five times per week for one class period.

Assessments—Self-reported PA, cardiovascular fitness, body composition, and self-concept were assessed at three time points: baseline (during the summer), semester one (at the end of fall semester; approximately four months after baseline), and semester two (at the end of spring semester; approximately nine months after baseline). Research staff was not blinded to the participants' group assignments. The study protocol was reviewed and approved by the university's Institutional Review Board, all participants provided written informed assent, and their parents or guardians gave written informed consent.

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Heart rate monitoring—Heart rates were monitored for one class period every other week within the intervention class using the Polar® Heart Rate Monitor. This device consists of an elastic belt, which is worn around the lower portion of the chest, and a watch-like receiver worn on the wrist. Monitors were set to record the average heart rate during the PE class and the number of minutes at or above 120 beats per minute. This cut-off was selected to approximate 60% of maximum heart rate as obtained from cardiovascular fitness tests at baseline. Monitoring sessions varied by day of the week in order to obtain an equal representation of the different class activities. Intervention students participated in the monitoring on a rotating basis. Valid heart rate data were collected for all 61 intervention participants, with monitoring occurring for each participant on approximately four separate occasions over the school year.

Data analysis

Initially, variables were screened for violations of statistical assumptions (e.g., normality, linearity). Differences in demographics and major study variables due to group assignment, cohort membership, and attrition were tested using student's t-tests and one-way ANOVAs, as appropriate. To account for the dependence of observations, the effects of the intervention on cardiovascular fitness, percent body fat, and self-concept were assessed using multi-level random coefficient modeling (HLM, version 6.0, Scientific Software International, Lincolnwood, IL) (Bryk & Raudenbush, 2002; Raudenbush, Bryk, Cheong, & Congdon, 2000). The multilevel models tested group assignment (i.e., intervention versus comparison) as a predictor of baseline (i.e., intercept) and rate of change (i.e., slope).

Participation in vigorous exercise was dichotomized ("some" vs. "none") owing to the high number of respondents who reported no vigorous exercise. The extent to which the intervention influenced vigorous activity was tested using the Hierarchical Generalized Linear Model (HGLM*)* function in HLM, a non-linear analysis for binary outcomes using the Bernoulli distribution. Predictors of slope but not intercept were entered in this model. Initially, an intent-to-treat approach was taken that included all eligible participants ($n = 146$), regardless of whether they completed the study or not (Hollis & Campbell, 1999). Follow-up analyses used the less conservative approach of including only those participants who successfully completed the entire study ($n = 120$). Because of a baseline difference between the intervention and comparison groups, all multi-level models controlled for ethnicity (i.e., non-Hispanic white vs. other) in the prediction of the intercepts and slopes. All PSDQ subscales were tested separately. To account for the multiple tests conducted, the alpha level was adjusted to $p < .005$.

Follow-up analyses examined whether changes in cardiovascular fitness and vigorous physical activity moderated the effects of the intervention on self-concept. Only participants who complete the study ($n = 120$) were included in these analyses. Nine-month difference scores for cardiovascular fitness and vigorous physical activity were calculated and centered. Interaction terms for Change in Fitness × Group and Change in Vigorous Activity × Group were created and subsequently entered in to the multilevel models predicting change in PSDQ scores. All analyses controlled for ethnicity (i.e., non-Hispanic white vs. other). Post-hoc paired t-tests were employed to assist with interpretation of the interactions. Pre- and post- values on the global self-concept subscale were compared within the intervention and comparison groups who either increased their fitness/activity or did not.

Results

Descriptive Statistics

Group comparisons—The intervention ($n = 61$) and comparison ($n = 59$) groups were comparable in age ($M = 15.02$, $SD = 077$ years), self-reported health ($M = 2.98$, SD .81 on a 5-point scale), height ($M = 1.62$, $SD = 0.06$ m), weight ($M = 61.00$, $SD = 11.89$ kg), BMI ($M = 23.22$, $SD = 4.54$), self-reported Grade Point Average (GPA) ($M = 3.24$, $SD = 0.77$ on a 4-point scale), and participation in vigorous activity (43%[Comparison] vs. 51%[Intervention]).

There were no group differences in physical fitness or body composition at baseline (Table 1). There was, however a significant difference between the two groups in terms of ethnic composition ($\chi^2(df = 1) = 4.01$, $p < .05$). Sixty-six percent of the intervention group was non-Hispanic white, whereas forty-seven percent of the comparison group was non-Hispanic white.

Participants who successfully completed the study were significantly different at baseline from participants who dropped out prior to its completion in a few ways. Specifically, participants completing the study had a higher GPA ($t(167) = 3.30$, $p = .001$), lower body weight ($t(176) = -2.13$, $p = .034$), lower cardiovascular fitness ($t(173) = -3.32$, $p = .001$), and lower perceived sports competence (PSDQ) ($t(174) = -2.19$, $p = .030$) as compared to participants who failed to complete the study.

Heart rate monitoring—On average, participants exercised at or above 120 beats per minute for 18.66 minutes (*SD* = 11.64) per class period. The average mean heart rate during the monitoring period was 128.73 beats per minute (*SD* = 17.09). Monitors were worn for an average of 34.10 (*SD* = 8.79) minutes per class.

Participation in physical education within the comparison group—Twenty-four percent ($n = 14$) of the comparison group participants were enrolled in PE for one semester, and 76% ($n = 44$) were enrolled in PE for two semesters during the intervention year.

Impact of the Intervention on Physical Fitness and Physical Activity

Intent to treat analyses ($n = 146$), showed that nine-month improvements in cardiovascular fitness were significantly larger for the intervention group than the comparison group ($\gamma = 0.97$, SE = 0.37, $p = .010$). Changes in percent body fat (DEXA) and BMI were similar across groups. Furthermore, among the intervention participants, participation in vigorous activity significantly increased from 51% at baseline to 83% at 9 months, whereas the proportion of comparison group participants reporting some vigorous activity showed no significant change (43% at baseline to 58% at 9 months). This effect of the intervention on vigorous activity was statistically significant ($\gamma = 0.61$, SE = 0.18, $p = .001$). Results were analogous when the less conservative analyses including only those participants who completed the study ($n = 120$) were conducted.

Changes in Physical Self-Concept

Using an intent-to-treat approach ($n = 146$), multilevel modeling found a significant effect of Time on sports competence ($\gamma = 0.12$, SE = 0.03, $p = .001$), appearance ($\gamma = 0.15$, SE = 0.03, $p = .001$), strength ($\gamma = 0.15$, SE = 0.04, $p = .001$), global physical self-concept ($\gamma = 0.22$, SE = 0.05, $p = .001$), and overall self-esteem ($\gamma = 0.14$, SE = 0.04, $p = .001$). Scores on these four scales increased across the study for members of both the intervention and comparison group. There was no significant effect of the intervention on any of the PSDQ scales (i.e., nonsignificant Group × Time interactions). The results were similar when using the less conservative approach of including only those participants who successfully completed the entire study ($n = 120$).

Multilevel analyses examined whether changes in cardiovascular fitness and vigorous physical activity moderated the effects of the intervention on PSDQ scales for participants who completed the study ($n = 120$). After adjusting the p-value required for statistical significance (due to multiple tests), the interaction between change in cardiovascular fitness and group (intervention versus comparison) was marginally significant for global self-concept ($\gamma = 0.05$, SE = 0.02, $p = .007$). Post-hoc analyses of the group means (Table 2) shows that, within the intervention group, improvements in global physical self-concept were greater for participants who increased cardiovascular fitness ($p < .01$) but not for participants who either decreased or did not change in cardiovascular fitness ($p > .05$). The pattern was reversed in the comparison group. That is, comparison participants who failed to increase fitness showed an improvement in global physical self-concept ($p < .01$), whereas comparison participants who increased fitness showed no change in physical self-concept ($p > .05$) (See Table 2). The interaction between group and change in vigorous physical activity was not significant for any of the PSDQ scales.

Discussion

This study found that a nine-month school-based PA intervention among sedentary adolescent females was not effective overall for enhancing physical self-concept. Despite an increase in self-reported vigorous activity, and a significant improvement in cardiovascular fitness within the intervention group, there was no overall effect of the intervention on physical self-concept or global self-esteem. There was, however, an interaction between the intervention and improvements in cardiovascular fitness. Within the intervention group, participants who increased their fitness did experience enhanced global physical self-concept.

The absence of an overall effect on self-concept contrasts with a recent report of a school-based intervention to increase physical activity among adolescents in Chile (Bonhauser, Fernandez, Puschel, Yanez, Montero et al., 2005). This study compared a group of adolescents receiving three 90-minute sessions of physical activity per week to a group receiving one 90-minute session per week across a school year. Those in the more active group experienced an increase in global self-esteem of 2.3%, compared to a decrease of 0.1% in the comparison group. One possible explanation for this discrepancy in results may reside in the characteristics of the samples studied. Whereas the study in Chile specifically targeted low SES children, our participants were recruited from an upper-middle-class school district. The hypothesis that a physical activity intervention may be more effective for improving self-concept among less advantaged children is further supported by a study conducted among low-income Hispanic children (Crews, Lochbaum, & Landers, 2004); this study found that an aerobic exercise program increased global self-esteem among low-income elementary-school children. More studies among adolescents are needed, however, in order to determine whether programs that increase physical activity in this age group will concurrently bring about improvements in self-concept.

Given the central role that body fat plays in adolescent females' self-concept (Dunton et al., 2003; Ecklund & Bianco, 2000), the present finding that the intervention did not bring about reduced body fat supports the hypothesis that the intervention may not have been sufficiently intense to bring about changes in self-concept in this sample. Sedentary, unfit female adolescents may be more likely to experience improved physical self-concept following an exercise intervention that results in reduced body fat. Although our data suggest that the intervention did come close to meeting current guidelines for improving cardiovascular fitness (i.e., a minimum of 3 times per week of moderate-to-vigorous activity for 20 minutes at a time; (Pollock & al, 1998)), it clearly did not approach the current recommendations for weight loss (i.e., 2.5 to 3.5 hours of moderate-intensity activity per week; (Jakicik, Clark, Coleman, Donnelly, Foreyt *et al.*, 2001). For this population, then, it may be necessary to increase PA substantially in order to bring about improvements in self-concept.

Another possible explanation for the lack of significant group differences in physical self-concept within this study is that a substantial proportion of the comparison group did enroll in regular PE over the course of the study. Although the intervention PE class improved fitness and PA to a greater extent than regular PE, it may not have had the same advantageous effect on self-concept. This explanation raises the question as to whether simple participation in group-based physical activities is sufficient to raise self-concept among sedentary adolescents, regardless of the content or intensity of the group activity.

The results of this study suggest that change in fitness may have moderated the treatment effect of exercise on self-concept. This finding is consistent with other research demonstrating that interventions may be differentially effective for specific subgroups (Kiernan, King, Kraemer, Stefanick, & Killen, 1998; King, Kiernan, Oman, Kraemer, Hull et al., 1997), and supports the meta-analytic finding that change in fitness moderated the effects of exercise on global self-concept among adults (Spence et al., 2005). It is interesting to note that no such moderating effect was detected for the domain-specific self-concept measures, especially since it has been theorized that the domain-specific constructs are more closely related to physical activity than are the global variables (Shavelson et al., 1976). This finding may reflect a dilution of treatment effect brought about by analyzing all of the domain-specific scales simultaneously.

An alternative explanation for the interaction between the intervention and change in fitness is rooted in the message that was imparted to intervention participants that they “should” be exercising and working to improve their fitness. Participants who internalized this message may have experienced enhanced perceptions of global self-concept concurrent with successful increases in fitness. Among comparison group participants, no such proscriptive message was delivered, so any change in fitness occurred in the absence of an evaluative dimension. In fact, we found that, among the comparison participants, enhanced physical self-concept emerged in the subgroup that did *not* increase fitness. This finding suggests that the observed trend for self-concept to increase over time regardless of group assignment may have been dampened within the intervention participants, resulting in unchanged physical self-concept in the intervention participants who failed to manifest the changes they were being encouraged to adopt. Future work in this area should explore this interaction to determine whether change in self-concept commensurate with fitness change occurs only in the context of an intervention that attaches a positive value to changes in fitness.

In sum, this study does not offer strong support to the hypothesis that increased physical activity leads to enhanced self-concept among sedentary adolescent females. Rather, it appears that there may be a trend for enhanced physical self-concept over time within this particular population, and increased fitness will accelerate this trend only in the context of an intervention that includes a didactic component informing the participants as to the reasons why physical activity is important. This study thus raises new questions about the relative roles of cognitive and behavioral interventions for increasing physical self-concept among adolescent females. Moreover, the results suggest that future school-based interventions should provide female adolescents with the necessary support for being physically active if they encourage increased activity. To do otherwise would invite a negative impact on physical self-concept.

The strengths of this study include the focus on a population at risk for future health and self-esteem concerns, the prospective intervention design, the use of rigorous and validated assessment tools, and validation of the intervention effect via both cardiovascular fitness testing and heart rate monitoring. Limitations of this study include a lack of random assignment that threatens the internal validity of the study and participation selection criteria that may limit the generalizability of the results. Participants were recruited from two high schools, and group assignment was determined according to the school in which a student was registered. Because students were recruited individually during the spring of the school year preceding the actual intervention, we avoided the possible pitfalls of recruiting intact classes. In addition, comparison of data across the two groups at baseline indicates that they were comparable on all major study variables with the exception of ethnicity. Thus, it would appear that the method of group assignment was not especially problematic. Nevertheless, the lack of random assignment should be noted.

In addition, the study was limited to adolescent females who were determined to be both sedentary and relatively unfit at baseline. The participants thus represent a special population that may be characterized by a number of undocumented traits that distinguish them from the larger population of adolescent females. The results, therefore, should not be generalized to other populations. In terms of attrition, we took a proactive approach to the intervention participants, and terminated participation for individuals who either were absent from school an unusually high number of days (thus limiting their exposure to the intervention) or manifested a behavior pattern in the intervention class that threatened to disrupt the intervention for other participants. This proactive approach may have increased our probability of having an impact on cardiovascular fitness among those who completed the study, and may therefore limit the generalizability of the findings.

Finally, the sample size may have been too small to detect a small treatment effect. Spence et al. (Spence et al., 2005), in their meta-analysis of adult studies examining the effect of exercise on self-concept, concluded that a sample size of at least 200 would be required to detect a small treatment effect for exercise on self-concept. Our sample of 120 may have been insufficient to demonstrate an effect of the intervention on self-concept. Nevertheless, it bears pointing out that many of the group means didn’t even move in the hypothesized direction.

In sum, we found that a school-based PA intervention designed to increase the cardiovascular fitness of sedentary adolescent females did not enhance physical self-concept overall, but did improve physical self-concept among those who increased their cardiovascular fitness. Future work should explore whether an intervention that is sufficiently intense to bring about changes in percent body fat might have a greater impact on physical self-concept within this population.

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Table 1

Descriptive Statistics for Cardiovascular Fitness, Body Composition, and Physical Self-Concept

	Intervention (n = 61)			Comparison (n = 59)		
	Baseline *M* (*SD*)	Semester One *M* (*SD*)	Semester Two *M* (*SD*)	Baseline *M* (*SD*)	Semester One *M* (*SD*)	Semester Two *M* (*SD*)
VO_2peak ($L \cdot min^{-1}$)[a]	1.42 (.27)	1.44 (.27)	1.53 (.27)	1.38 (.25)	1.29 (.24)	1.33 (.21)
Body fat (%)[b]	33.43 (6.07)	33.09 (5.75)	33.09 (6.44)	31.32 (5.69)	30.75 (6.13)	31.38 (6.60)
BMI (m/kg^2)	24.08 (5.11)	24.35 (5.21)	24.79 (5.32)	22.44 (3.74)	22.51 (3.79)	22.43 (3.77)
PSDQ						
Health	4.72 (0.76)	4.48 (1.00)	4.46 (1.00)	4.73 (0.82)	4.84 (0.77)	4.79 (0.80)
Coordination	3.97 (0.86)	3.83 (1.05)	3.75 (1.11)	3.84 (0.86)	3.95 (1.02)	3.96 (1.02)
Body Lean	3.48 (1.61)	3.56 (1.47)	3.58 (1.46)	4.02 (1.53)	4.00 (1.45)	4.04 (1.52)
Sports Comp.	2.89 (1.24)	3.05 (1.28)	3.10 (1.23)	3.03 (1.03)	3.25 (1.12)	3.22 (1.16)
Appearance	3.71 (1.05)	3.87 (1.24)	3.92 (1.16)	4.14 (1.14)	4.22 (1.02)	4.43 (0.86)
Strength	3.24 (1.25)	3.37 (1.30)	3.52 (1.21)	3.45 (0.99)	3.56 (0.95)	3.68 (0.95)
Flexibility	3.76 (1.13)	3.65 (1.23)	3.67 (1.31)	3.78 (1.11)	3.83 (1.25)	3.81 (1.30)
Endurance	2.37 (0.89)	2.31 (0.81)	2.39 (0.87)	2.66 (1.02)	2.70 (1.18)	2.78 (1.17)
Global Physical	3.24 (1.22)	3.44 (1.08)	3.55 (1.12)	3.38 (1.27)	3.77 (1.18)	3.73 (1.18)
Global Self-Esteem	4.62 (0.91)	4.72 (0.97)	4.79 (1.05)	4.71 (1.83)	4.89 (0.86)	5.00 (0.81)

[a] $p < .05$ for Group X Time interaction

[b] Percent body fat as measured by DEXA.

Table 2

Means and Standard Deviations for Global Physical Self-Concept by Group, Time, and Change in Fitness.

	VO_2peak ($L \cdot min^{-1}$)					
		Decrease or No Change			Increase	
	Baseline *M* (*SD*) n	Semester One *M* (*SD*) n	Semester Two *M* (*SD*) n	Baseline *M* (*SD*) n	Semester One *M* (*SD*) n	Semester Two *M* (*SD*) n
Intervention	3.79 (1.26) 21	3.77 (1.11) 21	3.86 (1.07) 21	3.00[a] (1.12) 40	3.37 (1.07) 40	3.64[a] (1.11) 40
Comparison	3.19[b] (1.28) 39	3.61 (1.15) 39	3.69[b] (1.18) 39	3.75 (1.17) 20	4.06 (1.21) 20	3.81 (1.18) 20

[a] $t = -3.11$; $p = .007$

[b] $t = -3.63$; $p = .001$