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Cardiorespiratory Fitness May Help in Protecting Against Depression Among Middle School Adolescents

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A B S T R A C T

Purpose: Cross-sectional studies demonstrate a robust association between depression, physical activity, and cardiorespiratory fitness in adolescents, but longitudinal evidence that can better parse the direction of these effects is scarce and conflicting, and no such studies in adolescents have considered the importance of fitness (as opposed to physical activity per se) for preventing depression. Therefore, the present study sought to determine if cardiorespiratory fitness in the first year of middle school (sixth grade) would protect against developing depression a year later (seventh grade), even after controlling for other risk factors (i.e., preexisting depression levels and weight status).
Methods: Participants (N = 437 with 54.9% female) were recruited from six different middle schools during their sixth-grade year and reassessed during the seventh grade. At each assessment, participants completed self-report measures of depression and fitness. Participants were also weighed and were asked to complete a shuttle-run at both points.
Results: A cross-lagged panel model indicated that cardiorespiratory fitness in the sixth grade was associated with significantly less depression by the seventh grade in girls, even after controlling for preexisting depression and weight. The effect was in the same direction for boys, but was nonsignificant. In both cases, effects were modest to small.
Conclusions: Cardiorespiratory fitness had a small, but significant protective effect against developing depression in middle school girls, and may have a similar but smaller effect in boys. Promotion of cardiorespiratory fitness can be an important strategy for preventing depression in middle school adolescents, but needs to be coupled with interventions that more directly address symptom treatment.

IMPLICATIONS AND CONTRIBUTION

Adolescents with greater cardiorespiratory fitness have fewer depressive symptoms at any given point in time; however, cardiorespiratory fitness, particularly among girls, may also help prevent the onset of new depressive symptoms during middle school.

Depression is the single leading cause of disability among adolescents as indexed by the World Health Organization's survey of disability-adjusted life years, a measure of years spent with the consequences of an illness or years of life lost because of it [1,2]. The disorder is associated with more disability than other common sources of impairment during youth, such as injuries, road traffic accidents, asthma, or mental or behavioral health problems [1]. Depressive symptoms, including anhedonia and difficulty concentrating, can contribute to academic and social difficulties [3,4]. Moreover, depression is common in youth. A nationally representative survey of more than 10,000 adolescents in the United States between the ages of 13 and 18 years found 7.7% of boys and 15.9% of girls had a depressive disorder [5]. Symptoms

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that begin during adolescence can follow a chronic or recurring pattern into adulthood, portend a worse course, and are associated with myriad other health related problems later in life [6–8]. Hence, adolescence represents a critical period of risk with respect to depression that underscores the need to identify factors and interventions that can delay or prevent the onset of symptom [9].

One promising, malleable factor that may protect adolescents is cardiorespiratory fitness (CRF). Often used interchangeably with aerobic capacity [10], CRF is a component of physical fitness that reflects the overall capacity of the cardiovascular and respiratory systems and the ability to perform prolonged strenuous exercise [11]. It is correlated (i.e., $r > .30$) with measures of physical activity [12–14], but CRF is not synonymous with physical activity and tends to be related to more vigorous forms of activity [13]. Moreover, physical activity can fluctuate from week-to-week, whereas CRF reflects a physiological outcome achieved through prolonged physical activity [10].

Research on aspects of CRF and depression in adolescents has been extensive though marked with methodological limitations. For example, many studies [15–20] have reported associations between CRF and depression in adolescent populations (e.g., *d*'s from .30 to >3.00) [16,19,20], but most of these were cross-sectional in nature, which precludes the ability to determine the direction of effects. Randomized clinical trials involving exercise-based interventions provide more direct support; adolescent studies tend to find a small, but positive effect from exercise on depression posttreatment (*d*'s from .26 to .66) [21,22], mirroring effects seen in adult samples [23]. However, the extent to which these effects persist beyond a few months or prevent (as opposed to treat) depression over the long-term remains unclear. Moreover, these interventions involve other aspects of treatment (e.g., behavioral activation; increased social support) that may account for their benefit.

Longitudinal studies (e.g., ≥1 year) of the link between CRF and depression in adolescents that would complement and inform this literature are even scarcer. In fact, most longitudinal studies have not considered CRF per se, focusing instead on physical activity and using self-report methods exclusively [24–29]. Even within these studies, findings are equivocal: three studies [25,26,28] found a small prospective association (i.e., $\beta < .25$) between physical activity on depression over the long-term, but two others [24,27] reported no such connection, and a sixth [29] found only a partial effect. Reviews from the adult literature support a link [23,30], although evidence specifically tied to CRF, and to long-term benefits (≥1 year), is much less robust. Thus, longitudinal evidence directly supporting the promotion of CRF for the prevention of adolescent depression is incomplete and remains inconsistent.

Given this background, the present study is the first to assess whether CRF (as opposed to physical activity per se) in middle school students was prospectively related to lower depressive symptomatology from one school year to the next. Given that weight status has been shown to prospectively predict depression, we controlled for its effects as well. A diverse group of students were recruited and assessed in the sixth grade (Time 1) and then reassessed a year later in the seventh grade (Time 2). The present study has a number of innovations: it explores for the first time in adolescence the prospective roles of CRF, a more enduring marker of health than physical activity per se and it assesses these associations only after first controlling for preexisting depression and body mass index (BMI), thereby clarifying the importance of CRF for new depressive symptoms, as opposed to existing ones, as well as whether these associations are independent of body composition.

The primary hypothesis was that higher levels of Time 1 fitness as defined through an objective measure of aerobic capacity and self-report measures of physical self-concept (i.e., endurance, strength) would be associated with less depression at Time 2, even after controlling for preexisting depression and BMI. In other words, we applied a strict test of the role of CRF in predicting the development of new depressive symptoms. We also hypothesized this association would be more apparent for girls than for boys given the greater variability in rates of depression among females (i.e., restricted range of depression in males would attenuate any association).

Methods

Participants and procedures

Participants were male (n = 197) and female (n = 240) middle school students assessed in the sixth and seventh grades; they were drawn from six middle schools from a metropolitan county in North Texas. Mean age in the sixth grade was 11.55 years (standard deviation = .59). Participants were mostly white (89.0%) or African-American (9.2%), with a significant portion also identifying as Hispanic (23.6%). Based on federal guidelines, almost one fourth (23.5%) of the students qualified for free or reduced-fee lunch programs.

All participants were part of a larger, state-mandated district-wide program to assess physical fitness. As part of this study, students in these middle schools were assessed annually regarding their weight, height, physical fitness, and other self-report measures of psychological well-being. Part of this annual assessment included the FITNESSGRAM testing protocol (see measures in the following), which was completed during their physical education class and supervised by the physical education teachers as well as the current researchers. During each year of this study, fitness testing (and the subsequent collection of measures of psychological well-being) was conducted during the same 1 week period for each school. For example, if School A had completed their fitness testing during the second week of September during Time 1, they completed the measures and fitness assessment that same week of September during Time 2. The study was approved by the authors' institutional review board, the school district's administrative offices, and the principals at each of the six middle schools that participated.

Of the students in this district-wide program, only those for whom written parental consent (and child assent) was obtained in both the sixth and seventh grades, and who completed the self-report measures in both grades, were included in this study. In other words, the present analyses and results were based exclusively on students (N = 437) who consented to participating across both years. To better understand how our sample generalizes to nonparticipating students, this sample was compared with 1,233 students who initially enrolled in the sixth grade but did not reenroll in the seventh grade and were not part of the present study analyses. Students who re-consented in the seventh grade, versus those who did not, did not differ with respect to age, gender, Hispanic background, free lunch status, or BMI. However, sixth grade students who re-consented in the seventh grade were significantly less depressed (Cohen's $d = -.19$), more