

PSYCHOSOCIAL MEDIATORS OF THE FITNESS-DEPRESSION RELATIONSHIP  
WITHIN ADOLESCENTS

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Adolescence is a developmental period during which boys and girls are at high risk of developing major or minor depression. Increases in fitness have been associated with lower levels of depressive symptomatology and improvements in psychological well-being, yet the mechanisms that underlie this relationship have not been thoroughly examined. Three such psychosocial variables (i.e. body satisfaction, social physique anxiety, and physical activity self-efficacy) have been identified as possible mechanisms and although they have theoretical support, additional research is needed to demonstrate empirically the potential effects of these variables. Self-report measures were used to assess the psychosocial variables and the Progressive Aerobic Cardiovascular Endurance Run (PACER) in conjunction with age, Body Mass Index [BMI], and sex was used to determine an estimate of aerobic capacity ( $VO_{2max}$ ). Path analyses were used to test the proposed model using version 6.2 EQS Multivariate Software. Results of study revealed that the boys' and girls' depressive scores were determined based on the extent that their fitness levels improved their satisfaction with their bodies and lowered the anxiety they experience in relation to real or imagined judgments of their physique. Although all pathways in the model were significant, with the exception of physical activity self-efficacy to depression, differences emerged between the boys and girls in terms of the strength of some of the relations amongst the variables. Limitations include restricted generalizability, self-report measures, and cross-sectional design. Results have implications for individuals in a context intended to improve physical and psychosocial well-being of adolescents.

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## CHAPTER 1

### INTRODUCTION

During adolescence boys and girls are at high risk of experiencing depressive symptomatology; prevalence rates of major depressive disorder (MDD) and dysthymia ranges from 7.7% (boys) to 15.9% (girls) within the United States (Merikangas et al., 2010). Adolescent depression is associated with a range of adverse outcomes, including suicidality, aggressive behavior, social isolation, and lower GPA (Brooks, et al., 2010; El-Ray et al. 2011; Orth et al., 2008), as well as comorbid mental disorders, such as anxiety disorders and conduct disorder (Sihvola et al., 2007). Further, depressive symptoms tend to increase over the course of adolescence and are associated with other health related problems in adulthood, including obesity, type II diabetes, and smoking daily (Schwarz, 2012), as well as the development of major depression disorder (MDD; Wit et al., 2010). Recent research, however, suggests that cardiorespiratory fitness (e.g., aerobic conditioning) has salutary effects with respect to depression, beginning in adolescence and extending into adulthood (Crews, Lochbaum, & Landers, 2004; Dishman et al., 2012; Kelly et al., 2011; Sui et al., 2009). What is not clear, however, is the extent to which these effects are direct and/or mediated through the development of other psychosocial states.

CRF, which is often referred to as aerobic capacity (Meredith & Welk, 2010), is a component of physical fitness that reflects the overall capacity of the cardiovascular and respiratory systems (Mitchell, Sproule, & Chapman, 1958; Buskirk, & Taylor, 1957) and the ability to perform prolonged strenuous exercise (Astrand et al., 2003). Although physical activity and CRF are associated positively (Aires et al., 2011; Martín-Matillas et al., 2012; Silva et al., 2013), they actually are different in that physical activity is a behavior whereas CRF is the physical/physiological outcome that results from being active (Meredith & Welk, 2010).



Over the past two decades there have been consistent declines in the physical activity and aerobic fitness levels of adolescents (Finne, Bucksch, Lampert, & Kolip, 2011; Grunbaum et al., 2004; Kimm et al., 2000; Tomkinson et al., 2003). A meta-analysis of 55 studies of children and adolescents (ages 9-19 years) from developed countries (e.g., U.S.) revealed that their performance on a 20-meter shuttle run test, used to measure CRF, declined by 2% per year over a 20-year period (Tomkinson et al., 2003). Inactivity levels among female adolescents within the United States are particularly concerning. Over the course of high school approximately 10% fewer female adolescents compared to male adolescents were found to be meeting the recommended standards for physical activity (Grunbaum et al., 2004).

Through both cross-sectional and longitudinal studies, increases in cardiorespiratory fitness (CRF) have been associated with lower levels of depressive symptomatology and improvements in general psychological well-being among adolescents (Crews, Lochbaum, & Landers, 2004; Dunton et al., 2007; Greenleaf et al., 2010; Ortega, Ruiz, Castillo, & Sjostrom, 2008; Van Voorhees et al., 2008) and among younger and older adults (Dishman et al., 2012; Galper, Trivedi, Barlow, Dunn, & Kampert, 2006; Knubben et al., 2007; Sui et al., 2009; Valtonen et al., 2009; Voderholzer et al., 2010). For example, even after controlling for SES level, female adolescents who were in the healthy fitness zone [HFZ] for aerobic endurance had significantly lower scores on a measure of depressed mood compared to those whose fitness scores fell in the needs improvement zone; no significant relation existed between fitness and depression for the male adolescents (Greenleaf et al., 2010). Similarly, in a study of low-income Hispanic 4<sup>th</sup> graders ( $M_{age} = 9.7$  years), improvement in CRF over the course of 6-weeks led to significantly fewer depressive symptoms among the boys and girls (Cohen's  $d = -.24$ ; Crews et al., 2004). Moreover, Kelly et al. (2011) conducted a 6-month cardiorespiratory fitness

intervention with obese adolescents and found among boys and girls a significant decrease in depressive symptoms from pretest to post-test (Cohen's  $d = .40$ ).

Although being physically fit may be related directly to reductions in depressive symptomatology, it is more likely that fitness brings about changes in other important psychosocial states that, in turn, lessen risk. Although many such mediators have been identified, we selected three for inclusion in this study: body satisfaction (Babiss & Gangwisch, 2009; Monshower, Have, Poppel, Kemper, & Vollebergh, 2012; Ortega et al. 2008), social physique anxiety (Lindwall and Lindgren, 2005; Niven, Fawkner, Knowles, Henretty, & Stephenson, 2009), and physical activity self-efficacy (Babiss & Gangwisch, 2009; Paluska, & Schwenk, 2000). To date, no study has examined the combined mediational potential of these variables in male and female adolescents, despite theoretical support for their effects (Landers & Arent, 2001). In the sections that follow, we discuss why each one has been included in our model.

### 1.1 Body Satisfaction

Body satisfaction is considered an “attitudinal” component of body image and can be defined as a positive evaluation of one’s body shape or size, or of particular body parts (Cash, 1994). Whereas body dissatisfaction occurs for both sexes, it is more prevalent (and salient) for girls than boys (Finne et al., 2011; Sujoldzić & De Lucia, 2007). The combination of pubertal changes, increased self-introspection, and more interest in romantic relationships can contribute to adolescents being critical of their physical appearance and dissatisfied with their body size and shape (Ferreiro, et al. 2012). An established risk factor for eating disorders (Allen, Byrne, McLean, & Davis, 2008), body dissatisfaction also has been found to predict future depressive symptoms across both sexes (Ferreiro et al., 2012). Furthermore, the subjective perception of being overweight or dissatisfied with one’s body, as opposed to one’s actual body weight, is

what appears to be the stronger predictor of depressive symptoms during adolescence (Al Mamun et al., 2007; Sujoldzić, & De Lucia, 2007).

High levels of cardiorespiratory fitness are associated with increases in body satisfaction (Campbell & Hausenblas, 2009; Greenleaf et al., 2010; Ortega et al., 2008), which result from the decreases in body weight and improvements in physical structure (e.g., muscularity, leanness) that accompany improved fitness. When fit, boys and girls feel positively about themselves physically because of how their bodies look and what their bodies can do. Such positive body-related feelings are associated with greater overall worth (e.g., higher self-esteem) and the experience of fewer negative emotions, including sadness/depression (Paluska, & Schwenk, 2000; Kirkcaldy et al., 2002; Monshouwer et al., 2012; Ortega et al. 2008). Whereas some research has found support for the mediating role of body-weight perception and self-image on the relation between physical activity and depression among adolescents (Kirkcaldy et al., 2002; Monshouwer et al., 2012), no study has considered fitness directly nor used an actual measure of body satisfaction to examine this question in this age group.

## 1.2 Social Physique Anxiety

Social physique anxiety (SPA), which is a subtype of social anxiety (Martin, Rejeski, Leary, McAuley, & Bane, 1997), is the anxiety experienced in response to real or imagined judgments by others of one's physical appearance (Hart, Leary, & Rejeski, 1989). Although related to body-image, SPA is conceptually distinct (Ackard, Croll, & Kearney-Cook, 2002; Lantz, Hardy, & Ainsworth, 1997; Markey & Markey, 2005). SPA captures the anxiety experienced when bodies and appearance are being scrutinized, as opposed to self-perceptions of one's body (i.e., body image) and the thoughts and feelings that result (Lantz et al., 1997). Although girls may be more aware of (and likely to experience) negative body evaluations than

boys, such appraisals from others can be detrimental to both sexes (Davison & McCabe, 2006; Erikson, 1968; Hagger et al., 2010). During adolescence, boys and girls may be particularly vulnerable to such anxiety because they experience a heightened sense of self-consciousness and engage in peer comparisons about their physical appearance (Ferreiro et al. 2012; Petrie, Greenleaf, & Martin, 2010).

Being aerobically fit has been related to lower levels of social physique anxiety among adolescents (Lindwall & Lindgren, 2005; Niven et al., 2009). For example, among sedentary Swedish girls (ages 13-20 years), Lindwall and Lindgren (2005) found that the girls who improved their fitness levels over the course of a six month exercise intervention showed decreases in their SPA ( $\eta^2 = 0.06$ ). Among young adult women, the association between SPA and depressive symptomatology also has been supported (Diehl, Johnson, Rogers, & Petrie, 1998; Jackson, Grilo, & Masheb, 2000; Woodman & Steer, 2011). Among adolescents, researchers have linked high SPA to lower self-esteem, body dissatisfaction, and more peer victimization, which are related strongly to depressive symptoms (Davison & McCabe, 2006; Storch et al., 2007). Similar to body satisfaction, as adolescents improve their CRF (and experience positive bodily changes, such as weight loss and increased leanness), their bodies more closely approximate societal ideals and they feel thus less anxious about the possibility of others evaluating them. In turn, lower levels of anxiety surrounding physique evaluations would be expected to predict less depressive symptomatology.

### 1.3 Physical Activity Self-Efficacy

Physical activity self-efficacy is defined as confidence in one's ability to be physically active across situations (Motl et al., 2000), and may be improved through successfully engaging in different physical activities (Ryan, 2008). Further, as adolescents develop their aerobic fitness,

they also report higher levels of self-efficacy with respect to being active (Dunton et al., 2007; Whipp, Davis, Torrers, & Wasserman, 1981). For example, Dunton et al. (2007) found in a sample of female adolescents (ages 14-17 years) that improved CRF over the course of 9-months predicted greater levels of self-efficacy for physical activity (Cohen's  $d = .63$ ) and exercise enjoyment (Cohen's  $d = .17$ ).

According to Sonstroem and Morgan's (1989) exercise and self-esteem model (EXSEM), participation in physical activities and improvements in fitness leads to increases in perceived physical competencies (i.e., physical activity self-efficacy), which can be generalized to improvements in physical self-esteem and eventually global self-esteem. Because low global self-esteem is a prominent symptom of depression (American Psychiatric Association, 1994), increases in physical activity may lead to lower depressive symptoms through self-efficacy mechanisms (Ryan, 2008).

With adult samples, researchers have examined the interplay among physical activity, different types of self-efficacy toward exercising and depression (Ryan, 2008; White, Kendrick & Yardley, 2009). For example, during an 8-week physical activity intervention that involved walking and cycling classes, depressed men and women's (ages 18 – 45 years) decrease in symptoms occurred in conjunction with significant increases in their physical activity self-efficacy (White et al., 2009). Although White et al. (2009) did not examine CRF specifically, sustained moderate to vigorous levels of exercise for 8-weeks likely improved the men's and women's CRF. Thus, physical activity self-efficacy needs to be examined in relation to the CRF – depressive symptomatology relationship, in both adolescents and adults.

#### 1.4 Statement of Purpose

The purpose of this study was to examine three potential mediators of the relation between CRF and depressive symptomatology among middle-school students. Early adolescents were selected because boys and girls often experience significant increases in depressive symptoms as well as decreases in fitness during this period of their lives (Beardslee et al., 2012; Clarke & Harvey, 2012). Based on previous research (e.g., Monshower et al., 2012; Niven et al., 2009; Ryan, 2008), we hypothesized that the three proposed variables -- body satisfaction, social physique anxiety, and physical activity self-efficacy -- would mediate fully the direct effects of CRF on depressive symptomatology. Because sex differences do exist across the proposed variables (e.g., Finne et al., 2011; Hagger et al., 2010), the mediational effects were tested separately for boys and girls, though no specific hypotheses were made.

## CHAPTER 2

### METHOD

#### 2.1 Participants

Participants were 528 boys ( $M_{age} = 12.33$  years;  $SD = .92$ ) and 507 girls ( $M_{age} = 12.32$  years;  $SD = .83$ ) drawn from six middle schools located in a suburban school district located in Texas. Regarding the boys' race/ethnicity, 65% ( $n = 343$ ) were White/NonHispanic, 22.9% ( $n = 121$ ) Hispanic/Latino, 8.7% ( $n = 46$ ) Black or African American, 2.7% ( $n = 14$ ) Asian, 0.4% ( $n = 2$ ) American Indian/Alaska Native, 0.2% ( $n = 1$ ) multiple races, and 0.2% ( $n = 1$ ) Native Hawaiian/Pacific Islander. In terms of the boys' year in school, 40% ( $n = 211$ ) were in 6<sup>th</sup> grade, 33.3% ( $n = 176$ ) 7<sup>th</sup> grade, and 24.4% ( $n = 129$ ) 8<sup>th</sup> grade. Eighty-six (16.3%) of the boys received meals at the schools for free and 3.4% ( $n = 18$ ) received them at a reduced cost.

The girls' race/ethnicity was White/NonHispanic (61.9%,  $n = 314$ ), Hispanic/Latina (21.9%,  $n = 111$ ), Black/African American (12.4%,  $n = 63$ ), Asian American (2.2%,  $n = 11$ ), American Indian/Alaska Native (1%,  $n = 5$ ), and multiple races (0.6%,  $n = 3$ ). In terms of year in school, 40% ( $n = 203$ ) were in 6<sup>th</sup> grade, 34.1% ( $n = 173$ ) 7<sup>th</sup> grade, and 22.1% ( $n = 112$ ) 8<sup>th</sup> grade. Eighty-six (17.0%) received meals at the schools for free and 3.4% ( $n = 17$ ) received them at a reduced cost.

#### 2.2 Instruments

##### 2.2.1 Depression

The 20-item Center for Epidemiological Studies-Depression Scale for Children (CES-DC; Faulstich, Carey, Ruggiero, Enyart, & Gresham, 1986) assesses behavioral and cognitive dimensions of depression in addition to general happiness. On items such as, "I felt down and unhappy," the adolescents responded based on how they had felt during the past week (7 days)

from 0 (*not at all*) to 3 (*a lot*). Total score was the sum of the items and ranged from 0 (*no symptoms of depression*) to 60 (*high level of depressive symptoms*). Greenleaf, Petrie, and Martin (2010) reported a Cronbach alpha of .89 in a sample of male and female adolescents; alpha in the current study was .90. Researchers have demonstrated that the CES-DC is a valid measure of depressive symptomatology among adolescents (Faulstich et al., 1986; Fendrich, Weissman, & Warner, 1990).

### 2.2.2 Cardiorespiratory Fitness

The Progressive Aerobic Cardiovascular Endurance Run (PACER; Leger & Lambert, 1982; Leger, Mercier, Gadoury, & Lambert, 1988) from the FITNESSGRAM (Meredith & Welk, 2010) measures the maximum number of 20-meter laps completed in a specified period of time, which was considered in conjunction with age, body mass index [BMI], and sex to determine the estimate of aerobic capacity ( $VO_{2max}$ , mL/kg/min; Meredith & Welk, 2008; 2010). Meredith and Welk (2010) have provided extensive information on the validity of the  $VO_{2max}$  score as an estimate of cardiorespiratory fitness.

### 2.2.3 Body Satisfaction

The 7-item Body Factor from the Body Part Satisfaction Scale-Revised (BPSS-R; Petrie, Tripp, & Harvey, 2002) assesses girls' body satisfaction through ratings of different body parts (i.e., arms, stomach, butt, hips, upper thighs, muscle tone, and weight). For each item, the girls indicated their level of satisfaction from 1 (*extremely dissatisfied*) to 6 (*extremely satisfied*). Total score was the mean; higher scores indicated greater satisfaction. Petrie et al. (2010) reported a Cronbach's alpha of .90 among female adolescents; alpha for the current study was .91. Petrie and colleagues (Petrie et al., 2002; Petrie, Greenleaf, & Martin, 2010) have provided



extensive information about the factor's validity as a measure of body satisfaction amongst female adolescents.

Fourteen items from the Upper Body factor of the Body Parts Satisfaction Scale for Men (BPSS-M; McFarland & Petrie, 2012) assess boys' satisfaction with leanness and muscularity of specified body parts (e.g., shoulders, arms, stomach/abdomen) as well as overall body (e.g., overall leanness of body). The boys rated each item from 1 (*extremely dissatisfied*) to 6 (*extremely satisfied*). Total score was the mean; higher scores indicated greater satisfaction. McFarland and Petrie (2012) reported a Cronbach's alpha of .97; alpha in the current sample was .97. McFarland and Petrie (2012) also provided extensive information regarding the scale's validity.

#### 2.2.4 Social Physique Anxiety

The 9-item Social Physique Anxiety Scale (SPAS; Martin et al., 1997; Hart, Leary, & Rejeski, 1989) assesses the anxiety experienced when individuals believe others are (or may be) evaluating their bodies. On items such as, "I am comfortable with how physically fit my body/figure appears to others," the adolescents responded from 1 (*not at all characteristic of me*) to 5 (*extremely characteristic of me*). Total score was the mean; higher scores indicated greater social physique anxiety. A Cronbach's alpha of .91 has been reported amongst female adolescents (Monsma, Pfeiffer, & Malina, 2008); alpha from the current study was .80. Martin et al. (1997) reported significant correlations between the SPAS and body dissatisfaction, whereas Hart et al. (1989) found SPAS scores were positively correlated (.35 to .47) with general concerns with others' evaluations, interaction anxiousness and fear of negative evaluation among male and female adolescents.

### 2.2.5 Physical activity self-efficacy

The 8-item Physical Activity Self-efficacy Scale (PASES; Motl et al., 2000) assesses individuals' beliefs in their ability to be physically active across a variety of contexts. On items such as "I have the coordination I need to be physically active," the adolescents indicated their level of agreement from 1 (*disagree a lot*) to 5 (*agree a lot*). Total score was the mean; higher scores indicated greater perceived self-efficacy. Cronbach's alphas have ranged from .74 to .88 in a sample of children and adolescents (Bartholomew, Loukas, Jowers, & Allua, 2006); alpha in the current sample was .87. Among male and female adolescents, Jago et al. (2009) found that the PASES correlated significantly with boys' light intensity physical activity after school ( $r = 0.17$  to  $0.33$ ) and their sedentary behavior ( $r = -0.29$  to  $-0.12$ ) as determined by accelerometer readings; no significant relationships existed for girls.

### 2.2.6 Demographic and Background Information

The school district provided data on the participants' race/ethnicity, age, grade level, and social economic status (SES). SES was based on whether the student qualified for a free, reduced-price, or no meal benefits, according to the guidelines set by the federal government on family income (United States Department of Agriculture, 2012).

## 2.3 Procedures

The university's Institutional Review Board for Human Subjects Research in addition to the school district's administrative office for research and principals at each school provided approval for the study. Prior to participation, parental consent was obtained as well as assent from each student. At each middle school, in conjunction with the state-mandated FITNESSGRAM physical fitness testing that occurred during the 2010 - 2011 academic year, the students completed the previously described questionnaires as part of a larger study on middle

school students' physical and psychological well-being. Students completed the questionnaire packets in small groups during scheduled PE classes; they took approximately 30 minutes to finish each of the two questionnaire packets. Students provided their school ID numbers on each packet so data from the FITNESSGRAM and school district could be matched to their questionnaire responses. After completing the questionnaire, students at each school were entered into a lottery to win one of several \$10.00 cash prizes.

#### 2.4 Data Analysis

Missing value analyses (MVA) were conducted with the SPSS Missing Values program; data were found to be missing either completely or at random and missing values ranged from 0.4% to 3.5%. Missing data were replaced using expectation maximization (Schlomer, Bauman, & Card, 2010). After computing total scores, data were checked for distributional normality (i.e., skewness, kurtosis, and outliers) and found to be within normal ranges, thus no transformations were undertaken (Tabachnick & Fidell, 2007).

Path analysis (Kline, 2005) was used to test the proposed model (See Figure 1). I used the maximum likelihood estimation procedure provided by version 6.2 EQS Multivariate Software. Both direct and indirect effects were obtained for the pathways in the model. An indirect effect implies a causal relation in which the independent variable (IV) creates a mediating variable (M) which in turn creates a dependent variable (DV) (Sobel, 1990). The indirect effect is the product of regression estimates  $(IV \times M) + (M \times DV)$ , within the sequence of variable effects (Hanushek & Jackson, 1977).

Across both sexes, two models were tested, one with and one without a direct path between cardiorespiratory fitness (CRF) and depressive symptoms. Because the two models were nested, I examined the improvement in fit through a chi-square difference test and changes in the

value of the Aikake Information Criterion (AIC) (Kline, 2005). Overall fit of each model was based on Hu & Bentler's (1999) two index strategy using the Comparative Fit Index (CFI) and Standardized Root Mean Square Residuals (SRMR). Alpha was set at .01 for all analyses.

## CHAPTER 3

### RESULTS

Table 1 presents the correlations, means, and standard deviations of all variables included in the models presented by gender.

#### 3.1 Boys

The models with (CFI = 1.0, SRMR = .01, AIC = -0.85), and without (CFI = 1.0, SRMS = .02, AIC = -2.38), the direct path from CRF to depression fit the data well. The comparison of the two models was non-significant,  $\Delta\chi^2(1, N = 528) = .47, p = .49$ , suggesting that the model without the direct path (the simpler model) was the preferred choice. See Figure 2 for the model with standardized parameter estimates.

CRF was related directly and significantly to social physique anxiety ( $\beta = -.69, R^2 = .48$ ), physical activity self-efficacy ( $\beta = .55, R^2 = .30$ ), and body satisfaction (BS;  $\beta = .60, R^2 = .36$ ). Subsequently, the pathways from social physique anxiety ( $\beta = .46$ ) and body satisfaction ( $\beta = -.10$ ), but not physical activity self-efficacy ( $\beta = -.02$ ), to depression were significant, explaining 26% of the variance. The indirect effect of CRF on depression also was significant ( $\beta = -.383; B = -3.638; 95\% CI = -4.38$  to  $-2.89$ ). More specifically, the indirect effects for body satisfaction ( $\beta = -.06$ ) and social physique anxiety ( $\beta = -.32$ ) were significant.

#### 3.2 Girls

The model with (CFI = 1.0, SRMR = .01; AIC = -3.53) and without (CFI = 1.0, SRMS = .02, AIC = -0.61), the direct path from CRF to depression fit the data well. The comparison of the two models was non-significant,  $\Delta\chi^2(1, N = 507) = 4.92, p = .03$ , suggesting that the model without the direct path was the better (and simpler) overall model. See Figure 3 for the model with standardized parameter estimates.

CRF was related directly and significantly to social physique anxiety ( $\beta = -.72, R^2 = .51$ ), physical activity self-efficacy ( $\beta = .39, R^2 = .15$ ), and body satisfaction ( $\beta = .85, R^2 = .72$ ). Subsequently, social physique anxiety ( $\beta = .42$ ) and body satisfaction ( $\beta = -.22$ ), but not physical activity self-efficacy ( $\beta = -.02$ ), were related significantly to depression ( $R^2 = .35$ ). The indirect effect of CRF on depression also was significant ( $\beta = -.496; B = -5.349; 95\% CI = -6.21$  to  $-4.49$ ). More specifically, the indirect effects for body satisfaction ( $\beta = -.19$ ) and social physique anxiety ( $\beta = -.30$ ) were significant.

## CHAPTER 4

### DISCUSSION

For the boys and girls, the indirect effects model had a better fit with the data than the direct effects model, suggesting that the effects of CRF on depression were mediated through the psychosocial variables, in particular body satisfaction and social physique anxiety. Although all pathways in the model were significant, with the exception of physical activity self-efficacy to depression, differences emerged between the boys and girls in terms of the strength of some of the relations amongst the variables.

Consistent with past research (Etzbach, 2000; Lindwall & Lindgren, 2005; Niven et al., 2009), and as hypothesized, CRF was associated with lower levels of social physique anxiety, accounting for 48% (boys) to 51% (girls) of the variance. The boys and girls who had higher levels of aerobic fitness also reported being less concerned or anxious about real or imagined evaluations of their physiques by classmates, teachers, or other people in their lives. Similarly, in a sample of sedentary Swedish girls (ages 13-20 years), Lindwall and Lindgren (2005) found that improvements in physical fitness, assessed using a bicycle ergometer to measure submaximal oxygen uptake (Astrand, 1976), over the course of a 6-month exercise intervention were associated with decreases in social physique anxiety; girls who did not improve their physical fitness reported experiencing higher levels of social physique anxiety over the course of the study.

Furthermore, CRF was related to the boys ( $R^2 = .36$ ) and girls ( $R^2 = .72$ ) being more satisfied with their body size and shape, which is consistent with past research (Campbell & Hausenblas, 2009; Greenleaf et al., 2010; Ortega et al., 2008). Kirkcaldy et al. (2002) found that boys and girls who frequently performed endurance exercise had a more positive self-image

compared to adolescents who reported seldom exercising. Moreover, after controlling for social economic status (SES), boys and girls who had CRF levels that fell within the healthy fitness range reported higher body satisfaction and rated themselves as being stronger and having greater endurance than adolescents whose CRF levels were in the needs improvement range (Greenleaf et al., 2010).

So, why is improved CRF associated with greater body satisfaction and lower social physique anxiety among adolescents? First, for adolescents and young adults, being involved in sports and being physically active result not only in higher levels of fitness (e.g., aerobic), but also a greater comfort and competence in what their bodies can do physically (Cuenca-Garcia et al., 2013; Greenleaf et al., 2009; Petrie et al., 2010). Greenleaf et al. (2009) found that female undergraduates who had been involved in sports in high school reported higher levels of body satisfaction as college students; this relationship, however, was not direct, but occurred through increases in the women's physical competence and sense of instrumentality. When adolescents view their bodies as highly functional and rate themselves as being able to engage competently in physical activities (e.g., strength and endurance tasks), they will be less focused on their appearance and thus less concerned with others' perceptions/evaluations of their physique and more satisfied, overall, with their body size and shape.

Second, boys and girls who are aerobically fit generally have bodies that approximate societal physical ideals, being thinner and leaner (Cuenca-Garcia et al., 2013; Yoo, 2009). For example, Cuenca-Garcia et al. (2013) found that physically active adolescent boys and girls experienced changes to their bodies, such as weight loss and increased muscularity, which aligned them with the physiques of models and athletes. In general, and especially among adolescents, the smaller the real – ideal discrepancy in appearance and physique, the more



satisfied they are with their body size and shape (McCabe, Ricciardelli, Waqa, Goundar, & Fotu, 2009). When individuals' bodies look like the ideal, they report being satisfied and happy with their physiques and relaxed with respect to others' evaluations of their bodies.

Aerobic fitness also seems to be particularly important for girls with respect to their body satisfaction. During adolescence, girls become increasingly aware of their bodies and begin to monitor how they look. Through this monitoring process, they identify physical flaws and come to see how their bodies generally do not coincide with those portrayed in the media (e.g., swimsuit models). As a result, girls and young women experience increases in body shame and general appearance anxiety (Moradi, 2010); and this process is more salient and harmful for girls than boys (Martins, Tiggemann, & Kirkbride, 2007; Moradi & Huang, 2008; Wiseman & Moradi, 2010). But, as girls experience the decreases in body weight and improvements in physical structure (e.g., muscular strength, coordination) that often result from heightened levels of cardiorespiratory fitness and they begin to view their bodies from a more functional (than aesthetic) perspective, they are likely to feel more satisfied with how they look and be less concerned with the opinions of others (Bass et al., 2000; Campbell & Hausenblas, 2009; Cuenca-Garcaa et al., 2013; Greenleaf et al., 2010; Ortega et al., 2008). Thus, encouraging physical activity, and the concomitant improvements in cardiorespiratory fitness, has tangible benefits, particularly in relation to girls' psychosocial health and well-being.

As hypothesized, CRF was related to increases in the boys ( $R^2 = .30$ ) and girls ( $R^2 = .15$ ) beliefs in their ability to be physically active across different contexts. In a sample of female adolescents (aged 14-17 years), Dunton et al. (2007) found that improvements in CRF over 9-months predicted stronger self-efficacy for physical activity. Similarly, among male and female adolescents ( $M_{age} = 12.8$  years), higher levels of physical activity were associated with more

general self-efficacy (Rutkowski & Connelly, 2012). Given the strong connection between physical activity levels and being aerobically fit (Aires et al., 2011; Martín-Matillas et al., 2012; Silva et al., 2013; Stabelini et al., 2011), it makes sense that both would be related to increased confidence in the ability to be physically active when desired, though this relation appears stronger for boys than girls. Adolescent boys are encouraged to participate in sports and receive positive messages from peers for being physically active; girls' participation, however, generally is less supported by peers and they perceive more barriers to being active than do boys (Wu, Pender, & Noureddine, 2003). Thus, boys are socialized to be (and supported when they are) physically active and experience few barriers (and many opportunities) to physical activity that likely strengthens the connection between aerobic fitness and this dimension of self-efficacy.

Body satisfaction was associated with lower depressive symptomatology among adolescent boys and girls, which is consistent with previous research (Ferreiro et al., 2012; Holsen, Kraft, & Røysamb, 2001; Paxton, Neumark-Sztainer, Hannan, & Eisenberg, 2006; Stice, 2002; Stice, Burton, & Shaw, 2004; Sujoldzić, & De Lucia, 2007). For example, in a 4-year longitudinal study among Hispanic adolescents, body dissatisfaction was a significant predictor of depressive symptoms for both the girls and boys (Ferreiro et al., 2012). Furthermore, research has demonstrated that negative body evaluations can be detrimental to both boys and girls, particularly during adolescence (Cohane & Pope, 2001; Davison & McCabe, 2006; Erikson, 1968; Hagger et al., 2010; Kruisselbrink et al. 2004). Body satisfaction has been conceptualized as a structural component of the self (Guerin, Marsh, & Famose, 2004; Marsh, Martin, & Jackson, 2010), and is thought to contribute to overall feelings of general worth. For example, amongst middle school boys and girls, body satisfaction explained 15% to 25% of the variance in the students' general self-esteem (Petrie et al., 2010). Self-esteem and depression are on

opposite ends of a continuum of well-being, thus boys and girls with high body satisfaction, and likely high self-esteem, will experience fewer symptoms of depression (Paxton et al., 2006).

As hypothesized, social physique anxiety was associated with higher levels of depressive symptomatology for the boys and girls. Although not previously studied directly among adolescents, researchers have linked social physique anxiety to other indices of psychological well-being, such as disordered eating attitudes (i.e., Turkish version of the Eating Attitudes Test [EAT]; Bas, Asci, Karabudak, & Kiziltan, 2004), and low self-esteem, body dissatisfaction, and poor opposite sex relations (Davison & McCabe, 2006). Further, Storch et al. (2007) found that among children and adolescents who were at risk for overweight or were overweight, higher social physique anxiety was related to depressive symptoms ( $r = .49, p < .001$ ). Consistent with objectification theory (Moradi, 2010), being anxious about one's appearance and physique, particularly as related to being observed and evaluated by others, is likely to heighten girls' focus on their body's flaws and shortcomings. As a result of this increased self-awareness, girls may experience negative affect in relation to their perceived physical defect (i.e., not having a body that fits the societal ideal). Such negative affect may include feelings of sadness and depressive symptoms. At the bivariate level, physical activity self-efficacy was related to lower levels of depressive symptomatology, which is consistent with the past research (Ryan, 2008). However, once all the psychosocial variables were included within the model, the path from physical activity self-efficacy became non-significant. Given that previous research supporting the effects of physical activity self-efficacy and depression was conducted with adults (Ryan, 2008; White, 2009), age may play a role in determining the strength of the relationship. For early adolescents, there are few constraints on being physically active; in fact the students in this study were attending physical education classes on a daily basis. Thus they already were active on most

days. In comparison, being physically active as an adult requires more effort and planning and may not be a normal part of the day for many of them (like it is for school children). The belief that one can be physically active may therefore have a stronger effect on adults' psychological well-being compared to adolescents due to the differences in life circumstances and responsibilities. Future studies should examine how physical activity self-efficacy changes from adolescents into adulthood and how those changes may be related to different indices of psychological well-being.

Overall, body satisfaction and social physique anxiety accounted for 26% (boys) to 35% (girls) of the variance in depressive symptomatology. Further, the indirect effects of CRF were significant, suggesting that the boys' and girls' scores on the CES-DC were determined based on the extent to which their fitness levels improved their satisfaction with their bodies and lowered the anxiety they experience in relation to real or imagined judgments of their physique. Girls specifically are likely to experience greater body satisfaction resulting from improved cardiorespiratory fitness. In comparison, boys are likely to generalize their improvement in fitness to greater confidence in their ability to be physically active. These findings support the important role that psychosocial factors have in explaining the fitness-depression relation among adolescents.

#### 4.1 Limitations and Future Directions

Limitations existed in the current study. First, although the sample was representative of the demographics of the larger school district, it was drawn from a suburban area that was mostly middle to upper-middle class. Thus, generalizability is limited to comparable populations. Because lower SES (Greenleaf et al., 2010) and certain minority groups (Latino, African American; Doi, Roberts, Takeuchi, & Suzuki, 2001; Kubik, Lytle, Birnbaum, Murray, Perry,

2003) have been associated with higher levels of depressive symptomatology, researchers might purposefully sample from these groups to examine the generalizability of the relations found in the current study. It may be that the mediators have different effects within other populations.

Second, with the exception of CRF, all of the psychosocial variables were measured by self-report, which can be subject to responding in a socially desirable manner. Although students were not required to put their names on the surveys and completed them independent of their peers, the presence of the researchers and the physical education instructors, who were onsite to answer questions, may have created demand characteristics that affected the students' responses. Third, our design was cross-sectional, thus we were limited in our ability to make conclusions about the temporal nature of the relations amongst the variables. Further, due to the design of the study we also cannot assume directionality of the results. For instance, we cannot assume that the only significant path is from social physique anxiety to depressive symptoms because it is also possible that a decrease in depressive symptoms lead to a decrease in social physique anxiety.

In future studies, researchers may use a longitudinal design to determine the extent to which improvements of CRF lead to changes in social physique anxiety and body satisfaction, for example, and ultimately result in decreases in depressive symptoms. Given increases in obesity and depression among adolescents, combined with declines in fitness levels (Dyrstad et al., 2012; Finne et al., 2011; Grunbaum et al., 2004; Kimm et al., 2000; Olds et al., 2006; Tomkinson et al., 2003; Tomkinson et al., 2007), there is a need to understand how these three conditions interrelate and develop from childhood through adolescence. Moreover, we did not examine personality factors, such as neuroticism, or underlying biomarkers (e.g., changes in neurotransmitters) related to depression which may provide further explanations or impact the

results. These are other factors that future researchers may want to include when examining the CRF-depression relation.

Fourth, we only used one measure of fitness (i.e., aerobic) in relation to the mediators and ultimately depressive symptomatology. Research with adults (Dishman et al., 2012; Knubben et al., 2007; Sui et al., 2009; Valtonen et al., 2009) has suggested that muscular strength and endurance also may play a positive role in well-being and such relations should be considered with adolescents. Further, the relative contribution of different types of fitness on depression may be studied.

## 4.2 Implications

The results from this study provide useful information on psychosocial mediators of the relation between cardiorespiratory fitness and depressive symptomatology among male and female adolescents. Given the benefits of being aerobically fit on well-being (as measured by depressive symptomatology), schools should focus on activities that enhance fitness levels, improve body satisfaction, and decrease the anxiety individuals experience around bodily evaluations. Such activities might include moderate to vigorous levels of physical activity, such as running, which might be implemented in physical education classes or before or after school activity program (Silva et al. 2013). Further, previous research supports participation in physical activity programs as well as increased peer support (Sabiston, Sedgwick, Crocker, Kowalkski, & Mack, 2007; Cox, Ullrich-French, Madonia, & Witty, 2011) as ways of buffering against social physique anxiety.

More specifically, given the strong association between improved aerobic fitness and greater body satisfaction for girls, it is important that more efforts are made to foster environments that encourage girls to be more physically active and to reduce perceived barriers

to physical activity, such as lack of encouragement or socialization that girls are physically weak and vulnerable (Moradi, 2010). Furthermore, girls particularly tend to benefit from participating in eating disorder prevention programs that use dissonance-induction techniques to reduce thin-ideal internalization and focus on increasing resistance to sociocultural pressures as well as increasing body satisfaction, self-esteem and healthy weight management skills (Stice, Shaw, & Marti, 2007). Boys also experience body dissatisfaction and societal pressures that have negative effects on their psychological well-being. Thus, they may benefit from similar programs that have been tailored to their experiences, including different societal ideals (e.g., muscularity) and gender roles (e.g., dominance)

#### 4.3 Conclusions

This study provided information about mediators of the fitness-depression relation among adolescents. For both boys and girls, social physique anxiety and body satisfaction were significant mediators of the effects of cardiorespiratory fitness levels. Our findings reinforce the crucial role that improvements in cardiorespiratory fitness have on improving the psychological well-being of adolescents. Our results are particularly relevant to physical and mental health professionals and could be used to shape government policy in addressing the rise in depressive symptoms and decline in physical activity that is occurring over the course of adolescence (Beardslee, et al., 2012; Clarke & Harvey, 2012; Diamantopoulou et al., 2011; Dunton et al., 2007; Finne et al., 2011; Greenleaf et al., 2010; Kessler, et al., 2001; Kimm et al., 2000; Lewinsohn et al., 2004; Parish & Treasure, 2003).

Table 1

*Correlations, Means, and Standard Deviations of all Non-Standardized Variables (n = 1035)*

Variable	1	2	3	4	5	6	M	SD
1 VO2max	-	.28	-.37	.27	-	-.23	45.21	5.71
2 PASES	.18	-	-.34	.34	-	-.20	3.68	0.86
3 SPAS	-.35	-.25	-	-.40	-	.48	19.26	6.33
4 BPSS-M	-	-	-	-	-	-.28	4.27	1.28
5 BPSS-R	.40	.32	-.58	-	-	-	-	-
6 CES-DC	-.16	-.20	.53	-	-.46	-	11.29	9.75
M	41.45	3.49	21.82	-	4.46	13.50	-	-
SD	4.85	0.93	7.27	-	1.17	11.08	-	-

Note. Values above the diagonal are for boys ( $n=528$ ) and values below the diagonal are for girls ( $n=507$ ). Cardiorespiratory fitness (VO2max) ranges in score from 0 to 100; Physical Activity Self-Efficacy Scale (PASES) ranges in scores from 1 (low) to 5 (high); Social Physique Anxiety Scale (SPAS) ranges in scores from 9 (*low*) to 45 (*high*); Body Parts Satisfaction Scale for Men (BPSS-M) ranges in scores from 1 (extremely dissatisfied) to 6 (extremely satisfied); Body Part Satisfaction Scale-Revised (BPSS-R) ranges in scores from 1 to 6; Center for Epidemiological Studies-Depression Scale for Children (CES-DC) ranges in scores from 0 to 60. All correlations were significant at the  $p<.001$

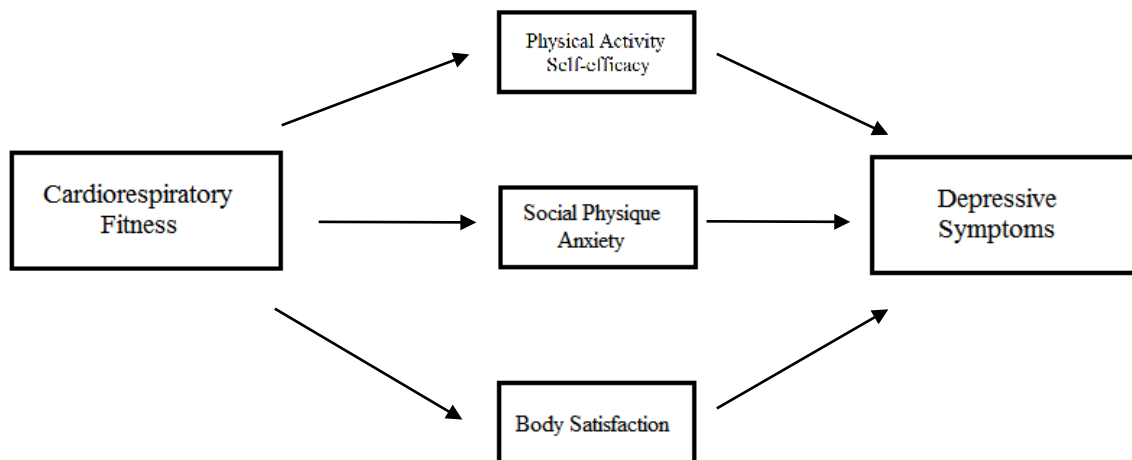


Figure 1. Hypothesized model for boys and girls.



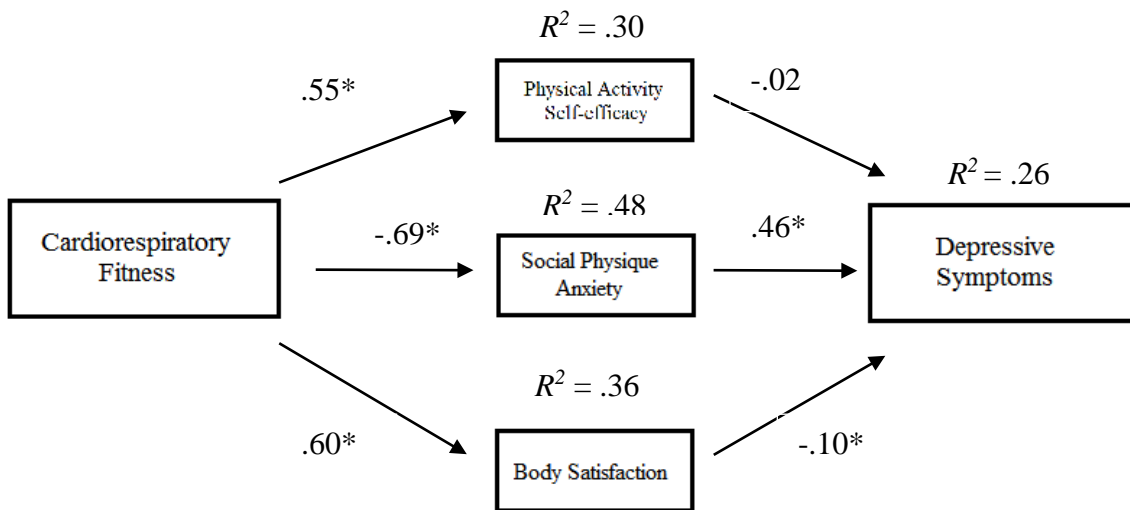


Figure 2. Model for boys with beta ( $\beta$ ), and  $R^2$  values for the model with no direct path between CRF and depressive symptoms. The dashed line represents the direct effect between CRF and Depressive symptoms. \* $p < .05$

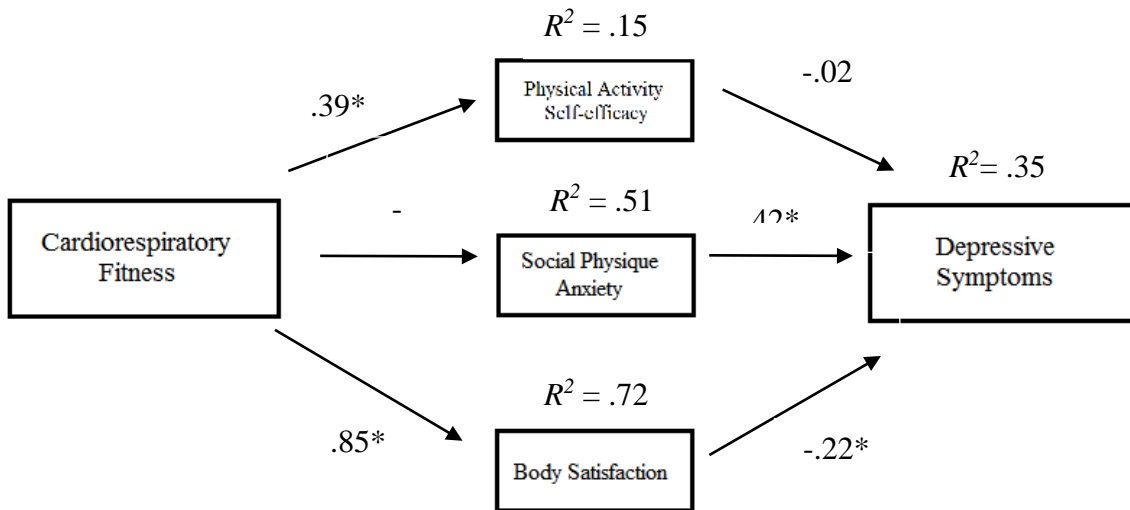


Figure 3. Model for girls with beta ( $\beta$ ), and  $R^2$  values for the model with no direct path between CRF and depressive symptoms. The dashed line represents the direct effect between CRF and Depressive symptoms. \* $p < .05$

APPENDIX  
LITERATURE REVIEW

Adolescence is a time during which boys and girls are at high risk for experiencing increases in depressive symptomatology (Beardslee, Gladstone, & O'Connor, 2012; Clarke & Harvey, 2012; Diamantopoulou, Verhulst, & Ende, 2011; Greenleaf, Petrie, & Martin, 2010; Kessler, Avenevoli, & Merikangas, 2001; Lewinsohn, Shankman, Gau, & Klein, 2004). Depression has been associated with obesity and other related physical and mental health issues, such as type II diabetes, anxiety disorders, conduct disorder, and smoking daily, during adolescence and into adulthood (Herva et al., 2006; Wit et al., 2010; Pine, Goldstein, Wolk, & Weissman, 2001; Schwarz, 2012). These health-related issues (e.g., obesity, smoking) are likely exacerbated by declines in physical activity and fitness (Dunton, Schneider, & Cooper, 2007; Finne, Bucksch, Lampert, & Kolip, 2011; Kimm et al., 2000; Parish & Treasure, 2003), as well as the physical, social and psychological changes that occur during adolescence (Greenleaf et al., 2010).

Increases in fitness have been associated with lower levels of depressive symptomatology and improvements in psychological well-being among adolescents (Crews, Lochbaum, & Landers, 2004; Dunton et al., 2007; Greenleaf et al., 2010; Ortega, Ruiz, Castillo, & Sjostrom, 2008; Van Voorhees et al., 2008), yet the mechanisms that underlie this relationship have not been thoroughly examined (Landers & Arent, 2001). Although improved fitness may be related directly to lower levels of depressive symptomatology, it is more likely that fitness brings about changes in other psychological variables that, in turn, lead to changes in levels of depressive symptoms. Three such psychological variables have been identified as possible mechanisms, including: body satisfaction (Babiss & Gangwisch, 2009; Kirkcaldy, Shephard, & Siefen, 2002; Monshower, Have, Poppel, Kemper, & Vollebergh, 2012; Ortega et al. 2008), social physique anxiety (Hart, Leary, & Rejeski, 1989; Lindwall and Lindgren, 2005; Niven, Fawkner, Knowles,

Henretty, & Stephenson, 2009), and physical activity self-efficacy (Babiss & Gangwisch, 2009; Paluska, & Schwenk, 2000; Vilhjalmsson & Thorlindsson, 1992). Although supported theoretically, additional study is needed to demonstrate empirically the potential meditational effects of these variables.

### Depression during Adolescence

Major depressive disorder (MDD, *Diagnostic and Statistical Manual of Mental Disorders* [4<sup>th</sup> ed., text rev], *DSM-IV-TR*; American Psychiatric Association [APA], 2000) which can comprise a single or recurrent episode, is defined by having five or more symptoms that are present nearly daily during the same two-week period, represent a change from previous functioning, and where at least one of the symptoms is either depressed mood or loss of interest in pleasurable activities. Other symptoms that are needed for this diagnosis include significant weight loss or change in appetite, insomnia or hypersomnia, psychomotor agitation or retardation, fatigue or loss of energy, feelings of worthlessness or excessive guilt, diminished ability to concentrate, and recurrent thoughts of death. In comparison, minor depression or depressive disorder NOS, is diagnosed when individuals' symptoms do not meet all the criteria for MDD and include experiencing two to four of the symptoms previously described, one of them needing to be depressed or irritable mood. Depressed mood can include symptoms of sadness, unhappiness or blue feelings for most days or an unspecified amount of time.

Adolescence is a developmental time period during which boys and girls experience considerable stress related to physical, social, and emotional changes (Greenleaf et al., 2010), such as physical changes resulting from puberty (e.g., hair growth, change in weight), changes in peer relationships (e.g., starting romantic relationships), and hormonal changes that contribute to fluctuations in emotions. Adolescence is a time period during which levels of depressive

symptoms increase (Beardslee et al. 2012; Clarke & Harvey, 2012; Diamantopoulou et al., 2011; Kessler et al., 2001; Lewinsohn et al., 2004). For example, Ferreiro, Seoane, and Senra (2012) found in a sample of Spanish adolescents, from ages 11 years to 13 years to 15 years respectively, rates of clinical depression defined according to a cut-off on a depressive symptom inventory (Children's Depressive Inventory (CDI); Kovacs, 1992) were 8.7% to 11.2% to 16.8% (for girls) and 9.1% to 10.4% to 8.7% (for boys). At age 15 years, but not 11 or 13 years, the female adolescents had significantly higher levels of depression compared to the male adolescents. In a nationally representative sample of U.S. adolescents (ages 13-18 years), Merikangas et al. (2010) found that 15.9% of the girls and 7.7% of the boys had MDD or dysthymic disorder according to a clinical diagnostic interview. Across both sexes, ages 13 to 14 years, 15 to 16 years, and 17 to 18 years, respectively, 8.4%, 12.6%, and 15.4% met the diagnosis for MDD or dysthymic disorder; 8.7% of the boys and girls experienced severe impairment, which meant that additional high levels of distress and deficiencies in daily activities were present. Finally, a meta-analysis of 310 longitudinal studies of youth ages 8 to 16 years showed that beginning at age 13 years, girls had significantly higher levels of depressive symptoms compared to boys based on the CDI (Twenge, & Nolen-Hoeksema, 2002). Furthermore, girls showed a significant increase in depressive symptoms from age 8 years to age 16 years, whereas boys did not. Although rates of depressive symptoms generally are higher for girls at 16 to 18 years than boys, prior to that age, both boys and girls experience rates of depressive symptomatology that are similar and moderately high (Céspedes, Y.M., & Huey, S.R., 2008; Diamantopoulou et al., 2011; Ferreiro et al. 2012; Twenge and Nolen-Hoeksema, 2002).

Researchers have examined adolescent depression according to changes in depressive symptomatology, as well as, meeting the criteria for a type of clinical depression. In this study, I am going to examine depression according to the number of depressive symptoms indicated on a self-report survey by middle school students.

#### Health Problems Associated with Adolescent Depression

Depression during adolescence has been associated inversely with emotional (e.g., self-esteem), social (e.g., social support) and academic (e.g., GPA) functioning (Brooks, Iverson, Sherman and Roberge, 2010; El-Ray, Fathy, Amin, & Nasreldin, 2011; Galambos, Leadbeater, & Barker, 2004; Kim, 2003; Orth, Robins, & Roberts, 2008; Santos, Richards, & Bleckley, 2007; Sihvola et al., 2007). For example, depressive symptoms are associated with low self-esteem, which plays a central role in adolescents' general level of life satisfaction (Kim, 2003; Orth et al., 2008). Moreover, in a 4-year longitudinal study of male and female adolescents, Galambos et al. (2004) found that high levels of depressive symptomatology determined by a structured survey (Composite International Diagnostic Interview [CIDI]; World Health Organization, 1990) increased the adolescents' risk of becoming more socially isolated over the course of four years. In terms of academic functioning, male and female Arabic adolescents (ages 12-15 years) whose end of school year grades were less than 60%, or 60 to 70% had significantly higher levels of depressive symptoms, as measured by the Children Depression Inventory [CDI- Arabic version, Gharib, 1988], compared to the adolescents whose grades were 70 to 80% or greater than 80% (El-Ray et al., 2011). Furthermore, Brooks et al. (2010) found in a sample of boys and girls (ages 9-17 years) that the children diagnosed with clinical depression based on clinicians semi-structured interview performed worse on delayed verbal memory (*Cohen's d* = .63), delayed

visual memory ( $d = .34$ ), measures of reaction time ( $d = .34-.53$ ), and accuracy/inhibition on complex attention tasks ( $d = .49-.65$ ) compared to the non-depressed children.

Adolescents with minor depression and MDD tend to have similar patterns of comorbidity with other mental disorders, such as conduct disorder and General Anxiety Disorder (GAD; Rapaport et al., 2002; Kessler et al., 1994, Kessler, Zhao, Blazer, & Swartz, 1997; Sihvola et al., 2007). For instance, in a longitudinal study of Finish adolescent twins, Sihvola et al. (2007) found that those pairs with minor and major depression, respectively, 22.5% and 37.2% had conduct disorder, 9.45% and 23.3% suffered from GAD, and 20.5% and 32.6% smoked daily. In terms of suicidality among adolescents with minor and major depression, respectively, 31.8% and 53.5% had suicidal thoughts, 8.6% and 27.9% had a suicide plan, and 2.3% and 11.6% attempted suicide. Overall, these findings indicate that both minor depression and MDD have immediate and long-term negative effects in adolescents' lives (Sihvola et al., 2007).

Moreover, experiencing any level of depressive symptoms during adolescence could lead to the development of major depression (González-Tejera et al., 2005; Herva et al., 2006; Wit et al., 2010; Pine, Cohen, Cohen, & Brook, 1999; Reinherz et al., 2006), as well as other mental health concerns, such as eating disorders, anxiety disorders, and substance abuse disorders, in adulthood (Aalto-Setälä, Marttunen, Tuulio-Henriksson, Poikolainen, & Lönnqvist, 2002). Among male and female adolescents ( $M_{age} = 16.8$  years) who self-reported experiencing depressive symptoms, Aalto-Setälä et al. (2002) reported increased risk of experiencing a depressive disorder (i.e., MDD or dysthymia; *Odds Ratio [OR]* = 3.0), eating disorder (*OR* = 2.4), anxiety disorder (*OR* = 1.9), and substance abuse disorder (*OR* = .9) by early adulthood compared to the adolescents who did not report depressive symptoms during adolescence.

In addition, depressive symptoms beginning in adolescence are a strong predictor of weight gain by early adulthood (Herva et al., 2006; Wit et al., 2010; Pine et al., 2001; Schwarz, 2012), which is a major health problem for adults, particularly in terms of high rates of overweight and obesity (Flegal, Carroll, Kit, & Ogden, 2012). In a 10 to 15 year longitudinal study of boys and girls (beginning ages 6-17 years), Pine et al. (2001) found children who were clinically depressed had an average BMI that was 1.9 kg/m<sup>2</sup> greater than the children who were not clinically depressed. Furthermore, childhood clinical depression significantly predicted BMI in early adulthood when controlling for childhood BMI, as well as adulthood household income. A meta-analysis of 15 longitudinal studies including mostly adolescents and some adults revealed that 71% of clinically depressed individuals and 48% of those with minor depression were at risk of becoming obese later in life (Wit et al., 2010).

Obesity beginning in childhood and adolescence has been associated with future medical problems in adulthood. For instance, being overweight or obese in adolescence increases ones risk for being obese in adulthood, which is associated with heart disease, stroke, type II diabetes, and certain types of cancer (Centers for Disease Control and Prevention [CDC], 2007). In addition, clinical depression and depressive symptoms in adulthood are associated with the development and worsening of coronary heart disease (Frasure-Smith & Lesperance, 2005; Frasure-Smith & Lesperance, 2006). Women with depression, and no known heart disease, are two times more likely to experience sudden cardiac death and fatal coronary heart disease than women with low to no depressive symptoms (Whang et al., 2009). In addition, women with worse symptoms of depression were also more likely to be smokers, obese and have lower rates of physical activity (Whang et al., 2009). In a meta-analysis that included 20 longitudinal studies of mostly older adults who had a coronary heart disease event (e.g., coronary bypass surgery,



myocardial infarction, coronary angioplasty), Barth, Sehumacher and Herrmann-Lingen (2004) concluded that the risk of depressed individuals dying two years after their initial cardiac event was two times greater than that of the non-depressed individuals.

In summary, adolescents with depressive symptomatology experience impairment in their emotional, social and academic functioning (Brooks, et al., 2010; El-Ray et al. 2011; Galambos et al., 2004; Kim, 2003; Orth et al., 2008; Santos et al., 2007; Sihvola et al., 2007), have comorbid mental disorders, such as anxiety disorders and conduct disorder (Kessler et al., 1994, 1997; Sihvola et al., 2007), and are at increased risk of developing more severe mental disorders and physical health problems as they progress into adulthood (González-Tejera et al., 2005; Herva et al., 2006; Wit et al., 2010; Pine et al., 1999; Reinherz et al., 2006). The increasing rate of obesity beginning in childhood and progressing into adulthood is well documented (Finkelstein et al., 2012; Flegal et al., 2012; Wit et al., 2010) as is the link between adolescent depression and adult obesity (Herva et al., 2006; Wit et al., 2010; Pine et al., 2001; Schwarz, 2012). Given depression's relation to future physical and psychological problems, understanding what may worsen these symptoms during adolescence is essential.

#### Physical Activity and the Fitness-Depression Relation

Any activity that increases an individual's heart rate or causes a person to feel out of breath is considered to be physical activity (Prochaska, Sallis, & Long, 2001). Among adolescents, physical activity often occurs when participating on sport teams, playing with friends, or walking to and from school (Prochaska et al., 2001). The American College of Sports Medicine (Colberg et al., 2010) defined physical activity as "bodily movement produced by the contraction of skeletal muscle that substantially increases energy expenditure" (p. 2692). Furthermore, as defined by the FITNESSGRAM standards (Meredith & Welk, 2010), physical

activity levels can vary according to their intensity (e.g., light, moderate, vigorous), duration (e.g., some of the time, most of the time), as well as, the type of activity (e.g., active sport, muscle fitness exercise; Meredith & Welk, 2010).

In comparison, cardiorespiratory fitness (CRF), often used interchangeably with aerobic capacity (Meredith & Welk, 2010), is a component of physical fitness that reflects the overall capacity of the cardiovascular and respiratory systems (Mitchell, Sproule, & Chapman, 1958; Buskirk, & Taylor, 1957) and the ability to perform prolonged strenuous exercise (Astrand et al., 2003). Although physical activity and CRF are associated positively (Aires et al., 2011; Martín-Matillas et al., 2012; Silva et al., 2013; Stabelini et al., 2011), they actually are different in that physical activity is a behavior whereas CRF is considered to be a physical/physiological outcome achieved through physical activity (Meredith & Welk, 2010). For instance, in a sample of boys and girls (ages 11-19 years), Aires et al., (2011) found a significant positive association between CRF, evaluated using the 20-meter shuttle run test, and a physical activity questionnaire. Furthermore, physical activity, objectively measured with accelerometers during engagement in competitive club sports, was related to increased levels of CRF in a sample of boys and girls ages 11 to 18 years old (Silva et al., 2013).

Unfortunately, physical activity and CRF tend to decline across adolescence (Dyrstad, Berg, & Tjelta, 2012; Finne, Bucksch, Lampert, & Kolip, 2011; Grunbaum et al., 2004; Kimm et al., 2000; Olds, Tomkinson, Leger, & Cazorla, 2006; Tomkinson, Leger, Olds, & Cazorla, 2003; Tomkinson, Olds, Kang, & Kim, 2007). For example, in a sample of German boys and girls between ages 11 and 17 years, there was a significant negative association between age and physical activity levels across the boys and girls (Finne et al., 2011). Further, during the course of high school, 70% of the boys and 35% of the girls changed from exercising daily to exercising

only one to two times a month or less (Finne et al., 2011). Inactivity levels among female adolescents within the United States are particularly concerning. Within a sample of Black and White female adolescents, over the course of 3 to 5 years, their activity levels declined by approximately 22% (Kimm et al., 2000). Similarly, over the course of high school approximately 10% fewer female adolescents compared to male adolescents were found to be meeting the recommended standards for physical activity (Grunbaum et al., 2004).

Consistent with the declines in physical activity levels are decreases in fitness levels. A meta-analysis of 55 studies of children and adolescents (ages 9-19 years) from 11 developed countries (e.g. United States, Australia, Canada) revealed that their performance on a 20-meter shuttle run test, used to examine CRF, between 1981 and 2000 declined by an average of 0.4% per year for children and 1% per year for adolescents; more specifically, within the United States CRF declined by 2% per year for adolescent boys and girls (Tomkinson et al., 2003). Furthermore, in a sample of Norwegian adolescents (ages 16-18 years) CRF, measured by performance on a 3000-meter running test, declined for boys by .5% per year and for girls by .3% per year; the decline in annual running performance was significantly greater for boys than girls (Dyrstad et al., 2012).

Such declines in physical activity and fitness are associated with increased risk of major health issues, including significant weight gain (Fogelholm & Kukkonen-Harjula, 2000; Lahti-Koski, Pietinen, Heliövaara, & Vartiainen, 2002; Rieck, Jackson, Martin, Petrie, & Greenleaf, 2013; Schmitz, Jacobs, Leon, Schreiner, & Sternfeld, 2000). In contrast, increases in physical activity (Biddle & Asare, 2011; Boone & Leadbetter, 2006; Dunton, Atienza, Tscherne, & Rodriguez, 2011; Kelly et al., 2011; Motl, Birnbaum, Kubik, & Dishman, 2004) and improvements in CRF (Dunton et al., 2007; Greenleaf, et al., 2010; Ortega et al., 2008) are

associated with psychological and physical health, and more specifically reduction in depression scores among adolescents. Over the past few decades, researchers have demonstrated that higher levels of CRF and physical activity are associated with lower levels of depressive symptoms among younger and older adults (Dishman et al., 2012; Galper, Trivedi, Barlow, Dunn, & Kampert, 2006; Knubben et al., 2007; Sui et al., 2009; Valtonen et al., 2009; Voderholzer et al., 2010).

More recently, the fitness-depression relationship has been examined among adolescents and, consistent with the adult findings, CRF is related to lower levels of depressive symptomatology in both cross-sectional (Greenleaf et al., 2010; Ortega et al., 2008; Shomaker et al., 2012; Rieck et al., 2013; Tomson, Pangrazi, Friedman, & Hutchison, 2003), as well as, longitudinal studies (Crews et al., 2004; Dunton et al., 2007; Kelly et al., 2011; Voorhees et al., 2008). For example, Greenleaf et al. (2010) found that after controlling for Social Economic Status (SES) female adolescents whose fitness scores fell in the Healthy Fitness Zone [HFZ], based on a standardized CRF test, had significantly lower scores on a measure of depressed mood compared to the female adolescents whose fitness scores fell in the Needs Improvement Zone [NIZ] ( $r = 0.54$ ;  $R^2 = .29$ ); no significant relation existed between fitness and depression for the male adolescents. Similarly, in a study of low-income Hispanic 4<sup>th</sup> graders ( $M_{age} = 9.7$  years), Crews et al. (2004) reported that improvement in CRF over the course of 6-weeks lead to lower depressive symptoms among the boys and girls ( $Effect\ size = -.24$ ). Moreover, Kelly et al. (2011) conducted a 6-month cardiorespiratory fitness intervention with obese adolescents and found among boys and girls a significant decrease in depressive symptoms reported before ( $M = 10.16$ ) compared to after ( $M = 7.36$ ) the fitness intervention ( $t(92) = -1.73$ ,  $p < 0.07$ ).

Improvement in CRF is related to lower depressive symptomatology among adolescents (Crews et al., 2004; Dunton et al., 2007; Greenleaf et al., 2010; Kelly et al., 2011; Ortega et al., 2008; Rieck et al., 2013; Shomaker et al., 2012; Tomson et al., 2003; Voorhees et al., 2008), but what has not been sufficiently studied is why. Few studies have specifically examined the potential mechanisms that underlie the relationship between fitness and depression, and thus more research is needed to address this issue. In the sections that follow, I describe three such variables that may help explain the effects of fitness on depression, including body satisfaction, social physique anxiety, and physical activity self-efficacy.

### Mediators of the Fitness – Depression Relationship

#### Body Satisfaction

Body satisfaction is considered an “attitudinal” component of body image and can be defined as a positive evaluation of one’s body shape or size, or of particular body parts (Ferreiro et al., 2012; Greenleaf et al., 2010). The combinations of physical changes that result from puberty, increased self-introspection, and increased interest in dating and romantic relationships during adolescence can contribute to adolescents being self-critical of their physical attractiveness and thus increase their reported dissatisfaction with their body size and shape (Ferreiro, et al. 2012).

Whereas body dissatisfaction occurs for both sexes (Paxton et al., 2006; Ferreiro et al., 2012), it is more prevalent for girls than boys (Finne, 2011; Sujoldzić & De Lucia, 2007). For instance, among German adolescents, approximately half of the girls reported high levels of body dissatisfaction compared to only one third of the boys (Finne, 2011). One explanation for such sex differences is that the physical changes experienced by girls during adolescence, such as noticeable increases in body fat, are inconsistent with the cultural thinness ideal (Cohn et al.,

1987; Feingold & Mozella, 1998); that is, the physical changes girls go through during puberty often result in their bodies being more discrepant from societal body ideals than before puberty, which may contribute to higher body dissatisfaction. For boys, pubertal changes often result in increases in musculature, leanness, and height that make their bodies more consistent with male societal body ideals (Koff, Rierdan & Stubbs, 1990), and thus increase the chances that they will be more satisfied with their bodies.

An established risk factor for eating disorders (Allen, Byrne, McLean, & Davis, 2008; Stice, 2002), body dissatisfaction also has been considered in relation to the development of depression (Hankin & Abramson, 2001; Hyde, Mezulis, & Abramson, 2008; Stice, Hayward, Cameron, Killen, & Taylor, 2000). Among adolescents, body dissatisfaction has been shown to be a strong predictor of future depressive symptoms across both sexes (Ferreiro et al., 2012; Holsen, Kraft, & Røysamb, 2001; Paxton et al., 2006; Stice, 2002; Stice, Burton, & Shaw, 2004; Sujoldzić, & De Lucia, 2007). For example, in a 4-year longitudinal study among Hispanic adolescents, high body dissatisfaction was a significant predictor of depressive symptoms for both the girls and boys (Ferreiro et al., 2012). Furthermore, the subjective perception of being overweight or dissatisfied with one's body, as opposed to one's actual body weight, is what appears to be the stronger predictor of depressive symptoms during adolescence (Al Mamun et al., 2007; Sujoldzić, & De Lucia, 2007).

Being cardiorespiratory fit is associated with higher levels of body satisfaction (Campbell & Hausenblas, 2009; Greenleaf et al., 2010; Ortega et al., 2008), which result from the decreases in body weight and improvements in physical structure (e.g., muscle leanness, trimmed appearance) that often are associated with improved fitness. And, when fit, boys and girls feel positively about themselves physically because of how their bodies look and what their bodies

can do. Such positive feelings about one's body generally are associated with greater overall worth (e.g., higher self-esteem) and the experience of fewer negative emotions, including sadness/depression (Paluska, & Schwenk, 2000; Kirkcaldy et al., 2002; Monshouwer et al., 2012; Ortega et al. 2008).

Although examining physical activity, not fitness, a study conducted by Kirkcaldy et al. (2002) among male and female German adolescents (ages 14-18 years) provides some initial support for body satisfaction as a mediator. Kirkcaldy et al. (2002) found that the boys' and girls' who frequently performed endurance exercise had more positive self-image and fewer depressive symptoms compared to adolescents' who reported seldom exercising. They suggested that positive changes in one's physical appearance that can result from being physically active and fit, especially during adolescence, are noticed by peers and can lead to boys and girls receiving positive feedback about their bodies and feeling more satisfied with how they look. Similarly, in a sample of boys and girls (ages 11-16 years), Monshouwer et al. (2012) examined body-weight status (i.e., too heavy, too thin, or good) as a potential mediator of the relation between physical activity and internalizing problems, such as somatic complaints, social withdrawal, and other depressive symptoms. They found that including self-image, as represented by weight status, partially mediated the association between physical activity and internalizing problems.

Adolescent boys (Bearman & Stice, 2008; Paxton et al., 2006) and girls (Ferreiro et al., 2012; Finne, 2011; Sujoldzić & De Lucia, 2007) experience body dissatisfaction, though it may be less for those who are aerobically fit (Campbell & Hausenblas, 2009; Greenleaf et al., 2010; Ortega et al., 2008). And, body satisfaction is associated with fewer depressive symptoms among male and female adolescents (Paluska, & Schwenk, 2000; Kirkcaldy et al., 2002; Monshouwer et al., 2012; Ortega et al. 2008). Whereas some research has examined the mediating role of body-

weight perception and self-image on the relationship between physical activity and depression among adolescents (Kirkcaldy et al., 2002; Monshouwer et al., 2012), no study has considered fitness directly or used an actual measure of body satisfaction to test whether it mediates the relation between fitness and depression among adolescents.

### Social Physique Anxiety

Adolescence is a time period during which boys and girls experience a heightened sense of self-consciousness and engage in comparisons about their physical appearance (Ferreiro, et al. 2012; Petrie, Greenleaf, & Martin, 2010). Such evaluations and comparisons can result in their experiencing increases in social physique anxiety (SPA), which is a subtype of social anxiety (Martin, Rejeski, Leary, McAuley, & Bane, 1997). More specifically, SPA is the anxiety experienced in response to real or imagined judgment by others of one's physical appearance (Hart, Leary, & Rejeski, 1989). Although related to body-image, SPA is conceptually distinct (Ackard, Croll, & Kearney-Cook, 2002; Lantz, Hardy, & Ainsworth, 1997; Markey & Markey, 2005). SPA emphasizes the anxiety experienced due to the perceived evaluation of one's body by others, as opposed to self-perceptions of one's body (i.e., body image) and the thoughts and feelings that result (Lantz et al., 1997).

Schlenker and Leary (1982) suggested that because individuals are motivated to make favorable impressions on others and because one's physique is an important component in one's self-evaluation, individuals are cognizant of how others view their bodies, desiring favorable evaluations of their physical appearance and feeling anxious when such evaluations do not occur. Moreover, in response to their SPA (Lantz et al., 1997), individuals may avoid situations in which they believe their bodies and physical appearance may be evaluated (e.g., wearing a



bathing suit at the beach) and/or may wear clothing that de-emphasizes their physique (e.g., baggy sweatshirts).

SPA is prevalent among male and female adolescents, though girls tend to report higher levels than boys (Davison & McCabe, 2006; Hagger et al., 2010; Kruisselbrink, Dodge, Swanburg, & MacLeod, 2004). In a sample of adolescents ( $M_{age} = 13.92$  years), girls were much more concerned about other's evaluating their bodies (i.e., social physical anxiety) than boys and concealed their bodies more often (Davison & McCabe, 2006). Further, among Portuguese and Spanish adolescents, girls had significantly higher SPA levels and lower physical self-concept compared to boys (Hagger et al., 2010). One explanation for these sex differences is that girls' self-esteem, compared to boys', is tied more closely to how others view their bodies (Davison & McCabe, 2006). Girls tend to be more interpersonally oriented than boys (Meeus, 1989), which often results in them being more aware of and responsive to others' negative evaluations of them.

Although girls may be more aware of negative body evaluations from others than boys, such evaluations can be detrimental to both sexes, particularly during adolescence (Cohane & Pope, 2001; Davison & McCabe, 2006; Erikson, 1968; Hagger et al., 2010; Kruisselbrink et al. 2004). The process of identity formation (Erikson, 1968), a crucial developmental milestone experienced across both sexes, involves developing a sense of self and is determined at least in part by evaluations from one's peer group. Moreover, as adolescents' progress from middle school to high school, there tends to be a transition from family to peers being the primary source of social support (Greca & Harrison, 2005; Furman & Buhrmester, 1992). Thus, peer evaluations become more meaningful, have a stronger influence on adolescents' self-concept and well-being, and can lead to greater anxiety about future evaluations by others, as well as, feelings of

depression (Greca & Harrison, 2005; Hecht, Inderbitzen, & Bukowski, 1998; Greca & Lopez, 1998).

Higher SPA consistently has been associated with greater depressive symptomatology among young female adults (Diehl, Johnson, Rogers, & Petrie, 1998; Jackson, Grilo, & Masheb, 2000; Woodman & Steer, 2011). To date, no study has examined the SPA – depression relationship among adolescents, though researchers have linked SPA to other indices of psychological well-being (Bas, Asci, Karabudak, & Kiziltan, 2004; Davison & McCabe, 2006; Storch et al., 2007). In a sample of male ( $M_{age} = 18.23$  years) and female Turkish adolescents ( $M_{age} = 18.25$  years; Bas et al., 2004), there was a positive correlation between SPA and disturbed eating attitudes across both sexes. Moreover, Davison and McCabe (2006) found among boys and girls (12 – 15 years) that SPA was associated negatively with self-esteem, satisfaction with their bodies, as well as, positive opposite –sex relations. In a sample of overweight children and adolescents (8-18 years); SPA was associated positively with peer victimization, which is strongly linked to depressive symptoms (Storch et al., 2007).

Moreover, greater CRF has been related to lower levels of SPA among adolescents (Lindwall & Lindgren, 2005; Niven et al., 2009). For example, in a sample of sedentary Swedish girls (ages 13-20 years), Lindwall and Lindgren (2005) found that the girls who participated in a 6-month exercise intervention that improved their fitness levels, measured using the Åstrand submaximal work test with the bicycle ergometer (Åstrand, 1976), showed decreases in their SPA from beginning to the end of the intervention. The girls who did not improve their fitness reported elevated SPA scores over the course of the study. Although examining physical activity, not fitness, a study conducted by Etzbach (2000) found that among girls greater physical activity behavior was associated with less fear of negative evaluation by others (i.e., lower social

physique anxiety), whereas for boys increases in physical activity behavior was related to lower levels of presentation discomfort, a component of SPA.

In summary, as adolescents become more physically active and improve their CRF they become more comfortable with their bodies and thus less anxious about the possibility of others evaluating them. This more positive psychological state, in turn, would be expected to be related to lower levels of depressive symptomatology, though to date, no study has tested directly the mediating potential of SPA in the fitness – depression relationship, particularly in relation to the experiences of adolescents.

#### Physical Activity Self-Efficacy

Self-efficacy is defined as confidence in one's ability to perform task-specific actions, such as having physical endurance and believing one can participate in active sports, and generally is viewed as being situation specific (Bandura, 1997). Thus, individuals' self-efficacy increases primarily as a result of successfully performing the behaviors to complete the specific task or action. Physical activity self-efficacy, which is defined as confidence in one's ability to be physically active (Motl et al., 2000), can result from successfully engaging in physical activities and thus believing that one is able do so again in the future (Ryan, 2008).

Most studies have verified the relation of physical activity to physical self-efficacy among adults (Bodin & Martinsen, 2004; Brannagan, 2011; Craft, 2005; Davis-Berman, 2001; Lockwood & Wohl, 2012), though a few studies have these constructs in adolescents (Dunton et al., 2007; Whipp, Davis, Torrers, & Wasserman, 1981). For example, Dunton et al. (2007) found in a sample of female adolescents (ages 14-17 years) that improved CRF over the course of 9-months predicted greater levels of self-efficacy for physical activity. Similarly, Rutkowski and Connelly (2012) found in a sample of male and female adolescents ( $M_{age} = 12.8$  years) that

greater levels of physical activity, assessed by a physical activity screening measure (Patient-Centered Assessment and Counseling for Exercise Plus Nutrition; Prochaska, Sallis, & Long, 2001), was associated with higher levels of general self-efficacy (GSE; Jerusalem & Schwarzer, 1992) in boys and girls.

In contrast, feeling a loss of control over one's body, which is similar to having low physical self-efficacy, is correlated with higher depressive symptomatology (Mellion, 1985). Bandura's (1986) social cognitive theory (SCT) has posited that individuals' mastery experiences have an impact on their perception of personal capabilities (i.e., self-efficacy), which in turn influences their affective states. Adolescents who believe they have successfully gained mastery over a physical activity may generalize this confidence to other parts of their lives (Griest, Klein, Eischens et al., 1979; Paluska & Schwenk, 2000), and thus generally feel good about themselves and their abilities. Thus, self-efficacy in one's exercise abilities may form a foundation from which individuals improve their mood, increase self-confidence, enhance ability to handle stressors, and reduce depressive symptoms (Bandura, 1986; Gauvin & Spence, 1996; Paluska & Schwenk, 2000, North, McCullagh, & Tran, 1990).

Although there is limited research among adolescents, studies using adult samples have examined the interplay among physical activity, different types of self-efficacy toward exercising (Bodin & Martinsen, 2004; Craft, 2005; Davis-Berman, 2001), and depression (Ryan, 2008; White, Kendrick & Yardley, 2009). For example, in a sample of male and female undergraduates (ages 18-25 years), Ryan (2008) found that the direct path between physical activity and depressive symptoms became non-significant when general self-esteem and physical activity efficacy were controlled; further, efficacy toward completing aerobic exercise, and efficacy in behaviors to maintain exercise was associated with lower depressive symptomatology among

men and women. Further, during an 8-week physical activity intervention that involved walking and cycling classes, depressed men and women (ages 18 – 45 years) experienced the most significant decrease in depressive symptomatology when they experienced a significant increase in their physical activity self-efficacy (White et al., 2009). This finding suggests that physical activity self-efficacy may be a potential mediator for both sexes.

Research in adult samples and a limited number of studies with adolescents provide support for physical activity self-efficacy as a potential mediator of the fitness-depression relation (Dunton et al, 2007; Paluska & Schwenk, 2000; Ryan, 2008; White et al., 2009). Improved CRF is associated with greater levels of physical activity self-efficacy among girls (Dunton et al, 2007) and men (Lockwood & Wohl, 2012). Further, increased physical activity self-efficacy has resulted in decreased depressive symptoms among men and women (Ryan, 2008; White et al., 2009). No study has yet examined whether physical activity self-efficacy mediates the relation between CRF and depressive symptoms among adolescents.

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