Abstract

Effects of a mentor-led exercise intervention on physical self-perceptions, fitness, body composition, and physical activity of overweight adolescents.

By Megan Sawyer

May 1st, 2013

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DEPARTMENT OF KINESIOLOGY

In recent decades, the prevalence of youth obesity has been on the rise (Ogden et al, 2010) highlighting the need for research evaluating interventions targeting eating behaviors and lifestyle activity. Although it is important to examine the impact of interventions on physical activity, fitness, and body composition given their relationship with physical health, it is also important to assess the impact of interventions on mental well-being. Self-perceptions, including self-esteem, are important indicators of mental well-being (Blaine et al., 2006). In fact, Biddle (2011) found poor self-perceptions to be a predominant mental health issue in overweight adolescents. Although exercise is associated with improved self-esteem, the changes in self-esteem are often not large in magnitude (Spence et al., 2005). The greatest improvements are likely to occur in those populations that would benefit the most such as overweight individuals (Lox, Ginis, & Petruzzello, 2010). In addition to exercise, mentoring programs have also had positive effects on youth self-esteem (King, 2002). Thus, exercise combined with mentoring may by an effective strategy for enhancing self-perceptions. This study evaluated the impact of a mentor-based exercise program on the self-perceptions, body composition, physical activity, and fitness level of overweight adolescents. Adolescents participated in mentor-led, weekly exercise

sessions for approximately 14 weeks. The program also involved a lifestyle-coaching component through weekly behavioral challenges designed to enhance self-regulatory skills related to physical activity and healthy eating. To date, 28 participants with a mean age of 14 and a baseline BMI of 32 have participated in the mentoring intervention. An additional 12 adolescents were randomly assigned to a wait-list control condition. In addition to fitness (maximum treadmill test), physical activity (accelerometers) and body composition (DXA) assessments, participants completed a questionnaire that examined exercise specific self-perceptions, physical self-worth, and global self-esteem (Whitehead, 1995; Harter 1988) pre/post intervention and after a no treatment maintenance period. A series of 2 (condition) X 2 (time) repeated measures ANOVA's combined with effect size inspection revealed that participants in the mentoring condition showed improved aerobic fitness (d = .44) compared to the control condition, which exhibited a negative change (d = -.06). Participants in the mentoring condition showed increased moderate-vigorous intensity activity (d = .41), compared to the control group (d = .14). While BMI-Z score improvements did not differ across conditions, percent body fat change for the experimental group showed a small, positive change (d = .22), compared to the control group (d = .08). In terms of self-perceptions, mentor participants reported improved self-esteem, physical self-worth, and perceived physical condition with the effect sizes being in the moderate to large range (i.e., d = .52, .79, .82), while the control group showed minimal change (i.e., d = .11, .26, .30). However, when evaluated after a no contact follow-up period, all variables in the experimental condition had regressed toward baseline. These results suggest a mentor-based exercise intervention has a positive impact while adolescents are in the program. However the program does not seem to be effective at helping participants maintain healthy changes when the program ends.

Effects of a mentor-led exercise intervention on physical self-perceptions, fitness, body composition, and physical activity of overweight adolescents.

A Thesis

Presented To

The Faculty of the Department of Kinesiology

East Carolina University

In Partial Fulfillment

of the Requirements for the Degree

Master of Science in Exercise and Sport Science

By:

Megan Sawyer

May 1st, 2013

EFFECTS OF A MENTOR-LED EXERCISE INTERVENTION ON PHYSICAL SELF-PERCEPTIONS, FITNESS, BODY COMPOSITION, AND PHYSICAL ACTIVITY OF OVERWEIGHT ADOLESCENTS.

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Chapter 1: Introduction

Self-esteem is believed to be an important indicator of mental health (Fox, 2000). Self-esteem, as an overall representation of an individual's self-worth, encompasses views and attitudes about oneself, as well as an emotional response to those views (McClure, Tanski, Kingsbury, Gerrard, & Sargent, 2010). Self-esteem is particularly important in adolescent mental health and development as it represents the ability to feel worthy of happiness and facilitates the ability to face life challenges as they transition to adulthood (Mann, Hosman, Schaalma, & de Vries, 2004; Wang & Veugelers, 2008). Furthermore, low self-esteem has been associated with multiple physical, psychological, and social consequences such as depression, anxiety, substance abuse, and disordered eating (Bosacki, Dane, & Marini, 2007; Mann, Hosman, Schaalma, & de Vries, 2004; Strauss, 2000). Identification of modifiable risk factors and preventing factors for low self-esteem is of utter importance to prevent low-self esteem and enhance self-esteem development in adolescents.

Many risk and protective factors have been studied to evaluate the development of self-esteem during adolescence. Studied risk factors include low socioeconomic status, exposure to school violence, family stress, and higher television viewing (Birndorf, Ryan, Auinger, & Aten, 2005; Carlson, Uppal, & Prosser, 2000; Goldfield, et al., 2007; Youngblade et al., 2007). These factors appear to negatively impact self-esteem development in adolescent years. Additional social-environmental risk factors associated with self-esteem include low-perceived teacher support and lack of family communication and closeness (Carlson, Uppal, & Prosser, 2000; Goldfield et al., 2007). While risk factors negatively impact the development of self-esteem, there are factors that appear to protect self-esteem development. Health related behaviors such as low sedentary time, positive overall health, and high physical activity have been described as protective factors for adolescent self-esteem (Carlson, Uppal, & Prosser, 2000; Goldfield, et al., 2007; Wang & Veugelers, 2008; Youngblade et al., 2007). While many factors, both risk and protective, affect self-esteem, low-self esteem and weight status (overweight and obesity) are also related (Hesketh, Wake & Waters, 2004; O'Dea, 2006; Strauss, 2000). Because low-self esteem is associated with the development of multiple mental health disorders, it is important to reduce risk factors associated with low self-esteem during adolescence and promote protective factors to elevate self-esteem (Falkner et al., 2001; Ryff, 1989).

Self-esteem and obesity

Obesity prevalence has been on the rise for the past several decades for adults, adolescents, and children. Currently, 16% of children and adolescents are obese and 34% are overweight (Ogden, Carroll, Curtin, Lamb, & Flegal, 2010; Ogden, Carroll, Kit, & Flegal, 2012; Wang & Beydoun, 2007). North Carolina is the 11th most obese state for adolescents and furthermore, eastern North Carolina has the highest BMI average in the state (CDC, 2010). If the 29 counties of eastern North Carolina were it's own state, it would rank 51st when compared to obesity prevalence for the rest of the states in the nation (CDC, 2006). Obesity in youth is particularly important to recognize due to evidence suggesting obesity in youth tracks to obesity in adulthood. Data indicate that 40% of children who were obese at age seven become obese adults and more than 70% of obese adolescents become obese adults (Guo, Roche, Chumlea, Gardner, & Siervogel, 1994; Guo & Chumlea, 1999). The links between obesity and physical health are well known and established, however, the relationship between obesity and mental health is complex and not well understood (Hill & Williams 1998; Tuthill, Slawik, O'Rahilly & Finer, 2006).

Self-esteem is an important measure of psychological well being, and for individuals with excess adiposity, low self-esteem is evident, along with an association with interpersonal anguish and distress (Blaine, Rodman & Newman, 2006; Lee & Shapiro, 2003). In an attempt to synthesize multiple reviews focused on physical activity, obesity, and mental health, Biddle (2011) found poor self-perceptions to be a predominant mental issue in overweight and obese adolescents. While reviews indicate poor self-perceptions are an apparent problem in overweight youth, more research is needed to determine why overweight and obese adolescents have lower self-esteem than normal weight counterparts.

Several studies have aimed to understand various psychological characteristics, experienced by overweight adolescents, which may contribute to lower levels of self-esteem. In an epidemiological study, Mond, Berg, Boutelle, Hannan, & Neumark-Sztainer (2011) reported obese adolescents experience weight-related body dissatisfaction and body image issues, which attribute to poor emotional well being and lower overall self-esteem for both males and females. While the previous study relied on questionnaires, Serrano, Vasconcelos, Silva, Cerqueira, & Pontes (2009) used qualitative interviews with 15 overweight and obese adolescents to determine collective weight-related themes, among participants. Common themes found from responses in the interviews were those such as feelings of isolation, denial, lack of control, poor body image, shame, and overall, low self-esteem (Serrano, Vasconcelos, Silva, Cerqueira, & Pontes 2009). Both Mond et al (2011) and Serrano et al (2009) aimed to address common psychological traits associated with adolescent obesity and self-esteem that result in negative mental consequences. Additionally, recent research has suggested that low-self esteem in adolescence may serve as an indication for poor negative behaviors such as smoking, drinking, and delinquency, while influencing other negative psychological condition such as depression, anxiety, and suicidal behavior (McGee, Williams, & Nada-Raja, 2001; Trzesniewski et al., 2006; Wang & Veugelers 2008).

Much like the trend seen in obesity throughout a lifetime, trends in low self-esteem throughout a lifetime follow a similar pattern. If an overweight adolescent has low self-esteem, their behaviors, beliefs, and weight status will most likely transcend into adulthood. Therefore, targeting obese adolescents' self-esteem is important to prevent further mental negativity often triggered by weight and treat their current mental state.

Self-esteem model

Understanding the nature of self-perceptions, including self-esteem and self-concept, is important to prevent interchangeably using key definitions that have distinct meanings. Often, individuals are under the impression that self-concept, self-esteem and self-efficacy are one in the same, however, this is untrue. Self-concept is defined as awareness or perception of one's self, created through environmental experiences, interactions with others, and acknowledgement of their own behaviors (Shavelson, Hubner, & Stanton, 1976). It does not include an evaluative component and is simply descriptive of how one views him/herself. Fox (1988) also describes self-concept as descriptive and dynamic, meaning it constantly changes over time. In comparison, self-esteem is defined as an evaluative component of self-concept relatable to feeling valued by others, feeling successful in achieving and reaching goals, and feeling important and competent (Fox, 1997). Because self-esteem is evaluative, many different things influence these perceptions of self.

The self-esteem model, displayed as Figure 1, is a multidimensional, hierarchical concept according to Fox's model, and ranges from very general self-perceptions to more specific self-perceptions (Fox, 1988). Global self-esteem is at the top tier and it is made up of self-perceptions from many different domains such as physical, scholastic competence, social competence, relationships, and morality. The physical domain is of interest for the current study and the model includes a physical self-worth (tier two), with four subdomains in tier three (sport or physical competence, physical condition, body attractiveness, and physical strength). Physical self-worth is described as feelings of pride, satisfaction, happiness, and confidence in the physical self (Fox, 1997). Sport or physical competence is described as athletic ability, ability to learn sport, and confidence in sport (Fox, 1997). Physical condition describes stamina, fitness, ability to maintain exercise, and confidence in an exercise setting (Fox, 1997). Body attractiveness is described as physique, ability to maintain an attractive body, and confidence in appearance (Fox, 1997). Lastly, physical strength is described as perceived strength, muscle development, and confidence in situations requiring strength (Fox, 1997). Underlying physical self-perceptions is self-efficacy, which is more domain-specific and transient. Self-efficacies are sub-domain specific and deal with the confidence an individual has in their ability to perform specific behaviors, while facing internal and external challenges (Bandura, 1986). The model shown in Figure 1, adapted from Fox's model, allows focus on the influence of elements of physical self-worth (1988). Fox's adapted model (Figure 1) suggests that targeting the four subdomains within interventions will result in overall increases in physical self-worth and global self-esteem, essentially working from "bottom-up" (Fox, 1988).

Figure 1. Self-Esteem Model

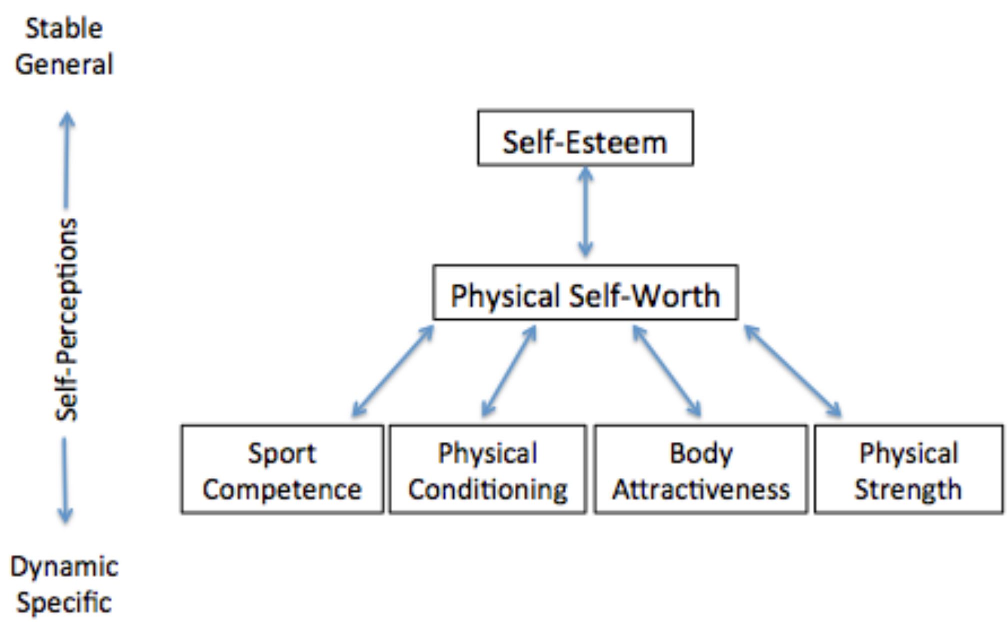


Figure 1. Adapted from "The self-esteem complex and youth fitness," by Fox, K. R., 1988, *Quest, 40*, 230-246.

Self-esteem and Physical Activity

Physical activity is an important strategy to become healthier and has potential to influence weight-related outcomes, as well as self-esteem. Several studies have shown that physical activity is associated with increases in self-esteem when increases of physical activity are reported. In other words, changes in physical activity may influence changes in self-esteem.

Researchers have found that physical activity contexts can act as a vehicle for improved self-perceptions (Fraser-Thomas, Cote & Deakin, 2005) especially in youth (Crocker, Kowalski & Hadd, 2008; Eccles, 2005). While the relationship between physical activity and self-esteem seems logical, it is more complex than it appears. The impact of physical activity on physical self-worth (PSW) may be influenced by the degree to which participating in physical activity impacts the more specific self-perceptions (Sonstroem, Harlow, & Josephs, 1994). Fox (1997) reports the self-perception variables most responsive to physical activity and exercise are perceived physical conditioning, perceived physical strength, and overall PSW, with body attractiveness being the most resistant to change. This literature suggests the subdomain level to be more variable and easily changeable with exercise, while GSE is not as transient, due to influences with other domains (scholastic, emotional, social).

Researchers have used multiple methods to examine the relationship between physical activity and self-esteem. Ullrich-French, McDonough, & Smith (2012) used correlations and effect sizes to understand the relationship between activity and physical self-worth, global self-worth, and physical competence, and to evaluate the effect the four-week physical activity camp had on these variables. Participants completed questionnaires, based on Harter's (1985) Self-Perception Profile for Children, before and after participating in the physical activity program that included a variety of sports, games, and activities. Upon completion of the program, significant increases were found for all psychological variables, which suggest that increases in physical activity also caused increases in physical competence, physical self-worth, and global self worth. Although effect sizes were modest and correlations were moderate to high, the study suggests physical activity programs have potential to promote positive psychological outcomes.

Using a similar questionnaire described in the previous study, Morgan, Saunders, & Lubans (2011) evaluated all the domains described in Fox's model (physical self-worth, sports competence, perceived physical condition, body attractiveness, and perceived physical strength) during a three-month, school-based program. While the setting varied between these two studies, results did not. Like the results from the previous study, significant intervention effects were found for physical self-worth and perceived physical condition. With promising results from both studies, the difference in program setting implies changes in self-esteem can occur in multiple program settings.

The previous studies suggested a promising relationship between self-esteem and physical activity, but it is also important to look at youth self-perceptions over time and understand the relationship between self-perceptions and physical activity in youth. A longitudinal study by Inchley, Kirby, and Currie (2011) examined physical self-perception changes and associations with physical activity during adolescence. The study examined changes in exercise self-efficacy, perceived sport competence, self-esteem, and physical self-worth. More importantly, they also examined how those domains were associated with physical activity participation. The sample included 641 Scottish schoolchildren who were in their last year of primary school when the study began. When the study was complete, participants were in their final year of secondary school. This time period was pointed out to be an important transitional stage for young people because of the physical and psychological changes that come with puberty and the move from primary to secondary school. Questionnaires assessing physical activity, self-perceptions, exercise self-efficacy, sport competence, and global self-esteem were given three times over a period of five years. Physical activity decreased significantly from ages 11 to 13 in boys (82% to 62%) and girls (61% to 30%) and even more from 13 to 15 year old boys (62% to 41%) and girls (30% to 16%). Results determined the most important indicators of physical activity were perceived sport competence and physical self worth. These two domains indicated a steady decrease, along with physical activity, as age increased. The study suggests that domain-specific self-esteem is more important than overall, global self-esteem in relation to physical activity among adolescents. Furthermore, adolescent physical activity interventions should promote competence, which will directly increase physical self-worth (Inchley et al., 2011).

It seems that adolescence is an important time during youth years psychologically and physically. Physical self-perceptions appear to decrease with increasing age and a similar pattern is seen with participation in physical activity during adolescence (Pate et al., 2002). To further examine the relationship between self-esteem and physical activity, Kitzman-Ulrich, Wilson, VanHorn, and Lawman (2010), compared BMI, self-efficacy, and physical activity of adolescent boys and girls. They sampled 314 normal weight and 355 overweight/obese adolescents for comparison. The relationship between self-efficacy and physical activity was recognized as significant ($p < .0001$). Regression models determined that when adolescents had higher self-efficacy, they engaged in higher levels of moderate-to-vigorous activity (MVPA) than adolescents with lower levels of self-efficacy. With a relationship established between physical activity and self-esteem, Wood and colleagues (2012) set out to increase physical activity and self-esteem because of environment changes. Researchers hypothesized that being active while being shown scenes of an outside environment would yield larger increases in self-esteem, when compared to being shown scenes of traditional, indoor gym settings. Contrary to their hypothesis, they determined the environment had no effect on the increases seen in self-esteem, concluding that just participating in exercise or activity alone was responsible to the significant increases in self-esteem (Wood, Angus, Pretty, Sandercock & Barton, 2012). These results support our notion that physical activity participation can increase self-esteem.

Mentioned studies highlighted relationships between physical activity and self-esteem in obese adolescents. With physical activity steadily decreasing as adolescent years progress, the need for interventions is apparent. Interventions should target physical activity, which will in turn promote self-esteem increases, as well as its subdomains.

Peer mentoring approach

Evidence suggests a relationship between self-esteem and obesity, as well as self-esteem and physical activity in obese populations. However, obesity interventions have demonstrated a wide range of success rates and methods used to deliver such interventions (Annesi, Unruh, Marti, Gorjala & Tennant, 2011; Annesi, Walsh, & Smith, 2010; Newnham-Kanas, Irwin & Morrow, 2008; Pearson, Irwin, Morrow, & Hall, 2012)

A potential method of intervention delivery is the peer mentoring approach. Peer mentoring is the process of a more experienced individual providing encouragement and training for an inexperienced individual within a common interest (Selwa, 2003). Peer mentors provide education, recreation, and support opportunities to individuals. The peer mentor may challenge the mentee with new ideas, and encourage the mentee to move beyond the things that are the most familiar or the most comfortable. The use of peer mentors is an accepted, economical approach to provide support and education to a wide range of populations that range from older adults to low-income minorities in health-related studies. (Black et al., 2010; Buman, 2009; Dorgo 2009).

Specifically evaluating mentoring in youth, a school-based mentor program by King and colleagues (2002) aimed to increase self-esteem, academic achievement, as well as school, peer, and family connectedness in youth, over a four-month timespan. Mentors met with participants twice a week to promote goal-setting, assist with academics, and provide emotional and social support. Post program analyses indicated significant increases in all measures assessed.

Exploratory in nature, this study showed a promising utilization of the mentoring approach in youth. Since peer mentoring has been effective at promoting health-related behaviors with varied populations, specifically in youth, using the this approach could potentially be effective in promoting physical activity and increasing self-esteem in overweight and obese adolescents. While using mentors in an exercise setting has not been thoroughly documented, it seems that a mentor may be capable of challenging a mentee with new exercise and healthy lifestyle modifications, while supporting their need for exercise success and enjoyment.

The current focus

Increasing self-esteem among overweight individuals is vital for long-term mental health and while increasing physical activity is important for weight control, many other factors play a role in weight management. Recent literature has focused on lifestyle interventions that target physical activity, behavior modification, and diet, to promote weight maintenance (Wilfley et al., 2007). These interventions aim to increase daily physical activity and exercise, promote healthy eating habits, and introduce self-regulatory skills to manage current behaviors (Jelalian et al., 2010; Jelalian, Sato, & Hart, 2011; Lloyd-Richardson et al., 2012; Lubans, Morgan, Aguiar, & Callister, 2011). All of these interventions demonstrate positive results and infer lifestyle interventions are essential to target all aspects of weight management. Other lifestyle interventions have also focused on an additional psychological component and demonstrated positive results, particularly in self-esteem (Daley, Copeland, Wright, Roalfe, & Wales, 2013; Huang, Norman, Zabinski, Calfas, & Patrick, 2007; Morgan, Saunders, & Lubans, 2012). None of the mentioned studies used mentoring as the method of intervention delivery. However, from success in other settings and populations, a lifestyle-based exercise intervention, utilizing mentors, should be effective in promoting increases in self-esteem, as well as physical activity.

Purpose

Our purpose is to evaluate the impact of a 12-week mentor-based, lifestyle, exercise intervention on the self-perceptions, physical activity patterns, body composition, and aerobic fitness levels of overweight adolescents. A secondary purpose of this study is to evaluate if changes made by the treatment group were maintained 12-weeks later.

Hypotheses

We hypothesize at the end of the study, the intervention group will demonstrate a positive increase in self-esteem, and the control group will remain unchanged. We also anticipate improvements in physical activity, body composition, and aerobic fitness levels in the treatment group, while the control group will remain unchanged. Furthermore, we expect the intervention group to maintain improvements in all variables at follow-up, while the control group will experience decreases in all outcome variables or remain unchanged.

Chapter 2: Methods

Participants

The study included 40 male and female adolescents aged 12-18 years old. To be eligible, participants had to be considered overweight based on a BMI ≥ 85th percentile referenced by age and gender, and have no medical contraindications to exercise, and if so, had physician approval (CDC, 2012). Additional inclusionary criteria included willingness to participate in health/fitness assessments and complete a survey at baseline, post-intervention, and follow-up. They also had to have expressed interest in exercising at the FITT building three times per week with their assigned mentor for the duration of three months, with access to transportation to and from the FITT building. Exclusionary criteria included: not being within the appropriate age range, less than the 85th percentile for weight and height, severe medical condition, physical or mental disability, inability to walk, learning disabilities that prevented lifestyle counseling sessions, and lack of transportation.

Participants were recruited through advertisements in the local newspaper, an email distribution list to university faculty and staff, local pediatric clinics, and word of mouth in the local area. Recruitment sites were not well documented for first and second semesters, however, recruitment of third semester participants indicated that 6/13 (46%) participants were recruited through an email announcement to ECU faculty, 4/13 (31%) participants were recruited through a local pediatric clinic, and 3/13 (23%) participants were recruited from word of mouth in the area. Interested individuals were directed to call or email the program coordinator, where they received information on the study and answered eligibility questions. If potential participants qualified in regard to weight status, the child and their parent were then given a brief medical history questionnaire over the phone. If any conditions arose, in which one would caution exercise, (dizziness, trouble breathing, heart issues) their medical doctor was contacted for clearance to exercise. If eligible, adolescents and their legal guardians were scheduled to attend a meeting with the program coordinator to learn more about the program in detail and to sign both assent and consent forms. Upon completion of assent and consent forms, participants were scheduled for pretesting.

Participants varied in race, gender, and ethnic background to provide generalizability of the results of the study. Table 1 displays participants' demographics.

Table 1
Sample Demographics by Condition M (SD)

	Intervention (n= 28)	Control (n= 12)	Total Sample (n= 40)
Age	14	13.75	14
Sex	65.5% Female	50.0% Female	57.5% Female
Race			
Caucasian	48.3%	41.7%	47.5%
African American	48.3%	58.3%	50.0%
Multi-racial	3.4%	0%	2.5%
BMI	31.86 (7.05)	35.67 (6.95)	33.00 (7.15)
BMI Z-score	2.00 (.48)	2.29 (.34)	2.09 (.46)

Design

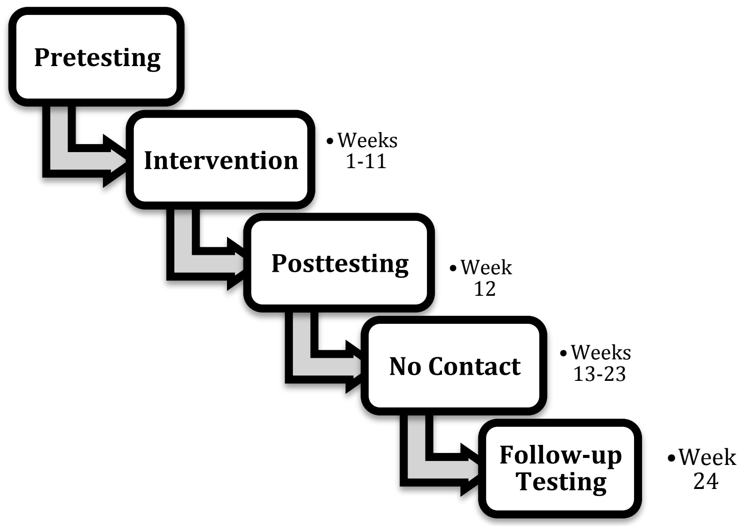
The study had a quasi-experimental design with data from three consecutive semesters. Participants from semester one (n=23) were randomly assigned to the experimental group (n=11) or a wait-list control group (n=12). The wait-list control group was informed they had the opportunity to participate in the exercise intervention the following semester. Semester two included wait-list control participants (n=9), as well as four newly recruited participants. However, to prevent using data from the same participant twice, we only used data from the new recruits from semester two (n=4). Semester three of the study included all new participants (n=13) with no control group for comparison. Each semester included three testing periods.

Testing at all three time points, in each semester, included a DEXA scan, 8-site skinfold assessment, 7-site girth measurement assessment, maximal oxygen uptake stress test (VO_2), a week of objectively measured physical activity through accelerometry, and one psychological questionnaire. For purposes of this study, we only used VO_2 data, body composition data, physical activity data, and self-perceptions. Participants who simply completed all components of the testing process, were monetarily compensated with a $20 gift card. This was completed in every semester.

Variables

The independent variable of the study was the condition, mentor exercise intervention or wait list control. The dependent variables were global self-esteem, physical self-worth, the four physical self-perception subdomains (physical competence, physical condition, body attractiveness, and physical strength), physical activity through accelerometery, percent body fat through DXA scan, and aerobic fitness changes through VO_2 max. The program was 12 weeks, followed by a 12 week no treatment follow-up. We used baseline, post-intervention, and follow-up questionnaire scores to examine self-esteem changes. We used aerobic fitness scores taken from VO_2 testing, at baseline, post-intervention, and follow up. We also used activity counts taken from accelerometers, to measure intensity, duration, and frequency of exercise at baseline, post-intervention, and follow-up.

Figure 2. Outline of Major Time Points



Procedures

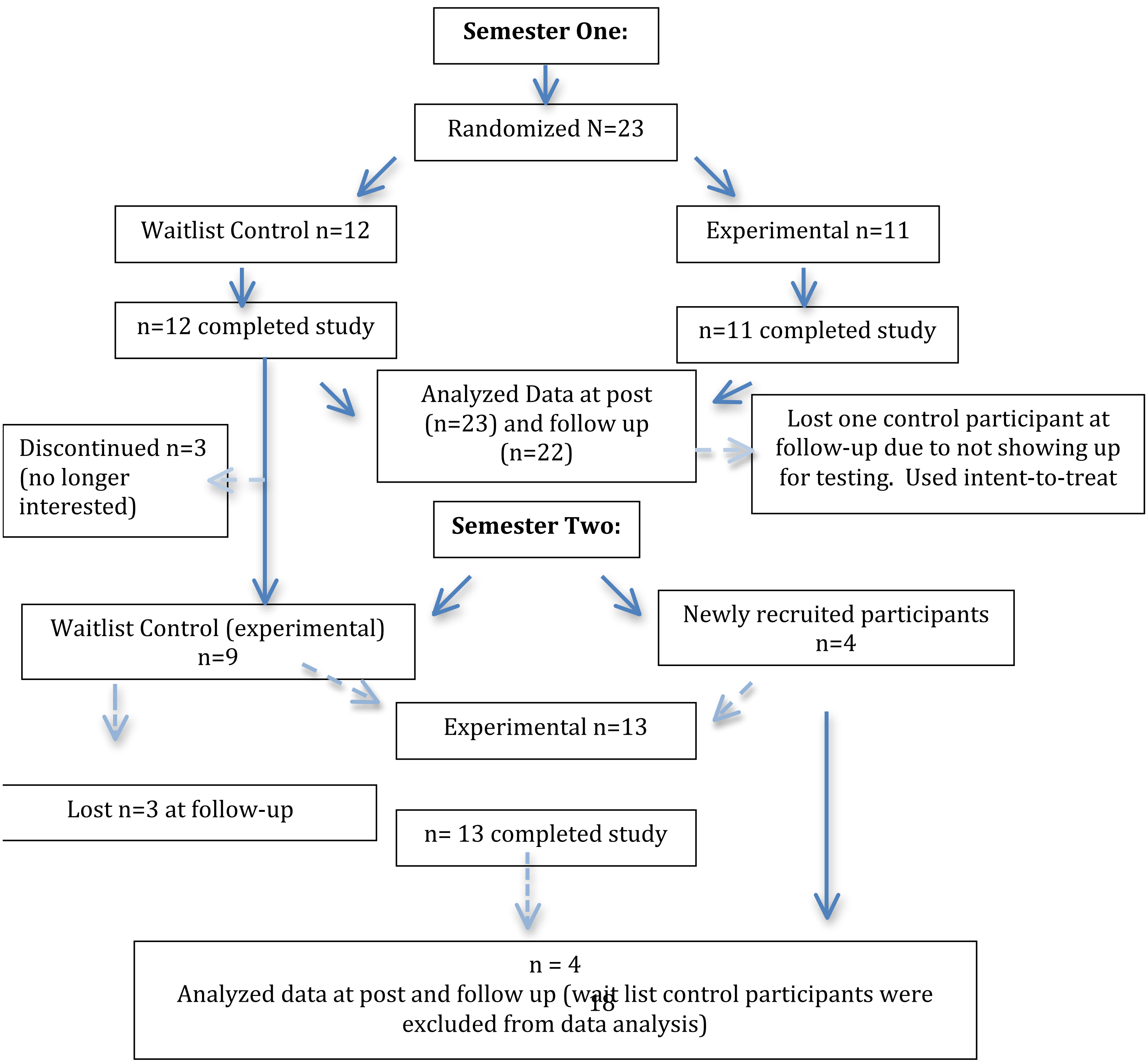
Pretesting assessments were completed before participants were randomly assigned to groups in semester one. Once assigned to groups, participants in the intervention were paired one-on-one with a college mentor based on National Mentor Guidelines. Mentors were required to be upperclassman within the Department of Kinesiology and demonstrate academic success, as well as personal responsibility. Participants met with their mentor for one hour, three times a week, engaging in a variety of physical activities designed to facilitate exercise enjoyment and success. Exercise sessions took place at Minges Coliseum and in a designated building (FITT building). Physical activities were geared toward the individual interests of each participant and were centered on filling basic psychological needs stemming from self-determination theory. While physical activities were fun and enjoyable, it was important that activity met at least a moderate intensity. Mentors were required to design activity that reached and sustained 60-85% of the participant's VO_2 max during exercise sessions, which they measured by pre-calculated target heart rate ranges. In addition, college mentors held a one-on-one 20-minute, weekly lifestyle counseling session with their participant to focus on a behavioral challenge of the week. These behavioral challenges are displayed and described in Table 2 and are based around healthy eating and physical activity.

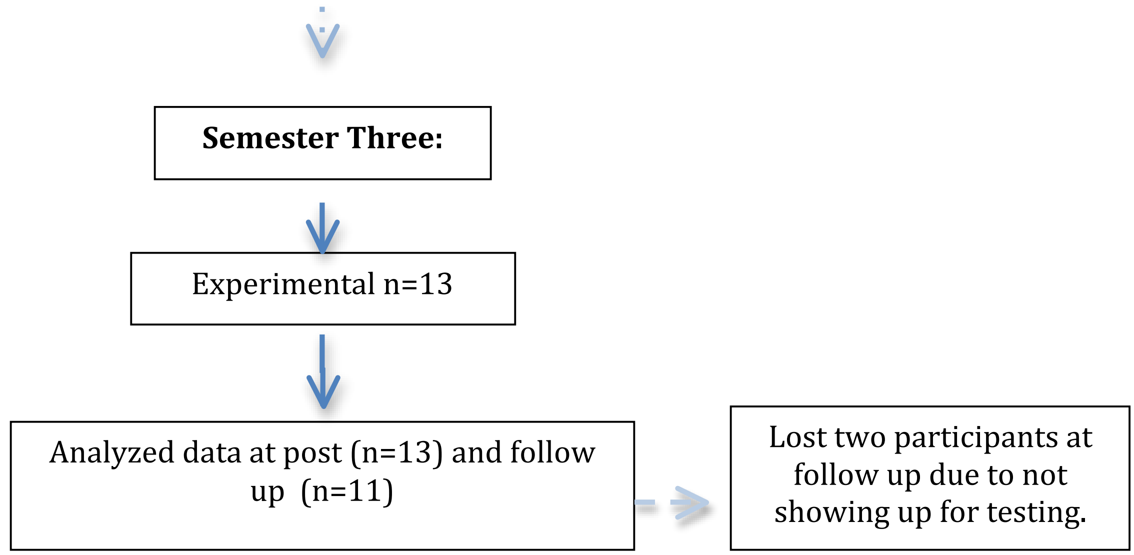
Table 2
Weekly Behavioral Challenge Descriptions

Week	Challenge	Content
Week 1	Getting to know me	About the Program
Week 2	Record keeping	Introduction of monitoring activity
Week 3	About physical activity	Moderate vs Vigorous, FITT principle, decision balance (pros and cons of being active)
Week 4	Goal setting	Long and short term; SMART goals
Week 5	Pedometers	steps counts and aerobic steps
Week 6	Problem Solving	Small Changes = Big Reward- Barriers/Problem Solving (IDEA approach)
Week 7	Weight; Eating Patterns	Discuss what makes up weight. Begin to monitor food/importance of monitoring food
Week 8	Stoplight Eating Plan	What are red, yellow, green foods/drinks, use in addition to simply monitoring
Week 9	Serving Size; QQF	Serving Size/Quality, Quantity, Frequency- Smart Eating Tips
Week 10	Eating Triggers	Internal and External cues to eat, Snacking, and Hunger Fullness Scale
Week 11	Tying it all together	Review the semester challenges, make a plan for when the program is over
Extra Week	BINGO: Get as many squares at you can	At some point in the semester, the BINGO card (during Spring Break, Fall Break, Thanksgiving Break)

Mentors received weekly training (i.e. two hours per week) in motivational interviewing and behavioral strategies for improving eating and physical activity habits. Training sessions were led by an exercise psychology or clinical health psychology graduate student. They also received weekly supervision while interacting with participants. Mentors were encouraged to maintain as much contact with their mentee outside of FITT as possible, however this was not formally tracked, due to not all participants having cell phones. The control group in semester one did not receive any contact after baseline testing until the end of the program and at follow-up to complete assessments. Post-testing took place immediately following the intervention (12-week) and follow-up testing took place three months after post-testing (24-week). At each time point, participants were compensated for completing all the testing components. Excluding the random assignment, all of these procedures were repeated for participants in semesters two and three.

The flow chart below depicts study design.





Measures

Assessments

To assess self-esteem, participants completed a Physical Self-Perception Profile questionnaire at baseline, at the end of the program (12-week), and again at the follow-up (24-week). Participants also wore accelerometers to assess physical activity patterns at each time point, along with completion of the maximal oxygen uptake stress test to assess VO_2 (indicator of aerobic fitness) and a DXA scan (to assess percent body fat). Participants completed identical assessments across all three time points to evaluate any changes made during treatment.

Children and youth physical self-perception profile. The CY-PSPP questionnaire (Whitehead, 1995) is a 40-item questionnaire used to measure global self-esteem, physical self-worth, and the four physical self-perception subdomains (sport or physical competence, physical condition, body attractiveness, and physical strength). Using a four-choice, alternatively structured design, each item presents two teenagers who are dissimilar on a given characteristic (Example: "Some teenagers are pleased with the appearance of their bodies BUT Other teenagers wish their bodies looked in better shape physically"). The participant decides which group he or she relates with most and indicates whether the description is "really true" or "sort of true" for them. Scores can be attained for each of the domains. This questionnaire was adapted from the work of Fox and Corbin (1989) and Harter (1985). Whitehead (1995) modified the PSPP, which utilized Harter's format (structured alternative to minimize social desirability), while only focusing on the physical domain (Fox and Corbin, 1989). Overall alpha reliability coefficients for the questionnaire range from .80 to .88 for males and from .86 to .90 for females (Whitehead, 1995). Whitehead (1995) demonstrated both within-network and between-network validity evidence for the PSPP through factor analysis and by examining relationships of the scale with theoretically related variables. Questionnaires were always given before any other assessment to prevent health and fitness assessments from influencing their questionnaire responses. Each item has a score from 1-4. Questionnaire scores were scored so that high scores equate to higher self-perceptions.

Accelerometery. An ActiGraph GT1M accelerometer was used to measure total minutes spent at moderate and vigorous intensity levels using a 30 second epoch interval. The Center for Disease Control (CDC, 2011) helps differentiate between the different activity-intensity levels. Light-intensity activity is defined as light daily activities that don't get your heart rate up, such as shopping, walking and talking on the phone, and putting dishes away. Moderate-intensity activity is defined as working hard enough to raise your heart rate and break a sweat. Some examples of moderate intensity activity include, walking fast, riding a bike, tennis, pushing a lawn mower, and swimming. Vigorous-intensity activity causes fast breathing and extremely elevated heart rate. Some sample activities include jogging, running, swimming laps, riding a bike fast or on hills, basketball, and many other sports. Moderate-Vigorous activity is a combination of both intensities and it is suggested that children and adolescents reach at least 60 min/day for health benefits (CDC, 2011). Freedson, as published by, Trost et al. (2002) indicated that when analyzing youth physical activity patterns, each age should be analyzed with age-specific cut-points. These cut points are used to represent a range of activity counts for each intensity level. Table 3 depicts the cut points used for categorizing activity counts.

Table 3.
Accelerometer Activity Cut Points by Age (activity counts/minute)

Ages	Sedentary	Light	Moderate	Vigorous
12	≤ 99	100-2219	2220-5093	≥ 5904
13	≤ 99	100-2392	2393-5374	≥ 5375
14	≤ 99	100-2579	2580-5678	≥ 5679
15	≤ 99	100-2780	2781-6006	≥ 6007
16	≤ 99	100-2999	3000-6362	≥ 6363
17	≤ 99	100-3238	3239-6750	≥ 6751
18	≤ 99	100-2019	2020-5998	≥ 5999

Participants were given an accelerometer and instructed to wear it for one week, as well as the appropriate way to wear the device. To help remind them to wear the accelerometers, mentors or the program coordinator sent text messages or called the participants before school on days the accelerometer was supposed to be worn. Participants also completed a hand-written log in order to indicate when they put the accelerometer on and off. Participants wore accelerometers at each of the testing time points. However, they did not wear them while the program was underway. Baseline activity levels were taken a week before the program started. Post testing activity levels were recorded the week following the program. Follow-up activity levels were recorded the week succeeding the follow-up test day. Only participants who wore accelerometers for at least 8 hours on 3 or more days were used, to ensure accurate representations of physical activity behavior. In youth, at least three days are needed to achieve a reliability of $\geq$.70 (Trost et al., 2000)

VO_2 test. Participants completed a maximal treadmill test to exhaustion to determine maximal oxygen consumption (VO_2max). Heart rate, rate of perceived exertion, and expired gases were monitored throughout the test. A Parvo Medics TrueMax 2400 metabolic cart was calibrated prior to testing according to the manufacturer's instructions. The gas tank consisted of 16% oxygen, 4% carbon dioxide, and a nitrogen balance. A 3-liter syringe was used to calibrate flow rate and flow meter prior to each test. Height (in) and weight (lbs) were taken prior to start of the treadmill test in workout clothes, excluding shoes. Seated blood pressures and heart rates were also recorded.

A standard baseline treadmill protocol was established for all participants to ensure reliability. The speed started at 2.0 mph with a grade of 0% and remained constant for the first two minutes. Starting at minute three, the grade increased by two percent while speed stayed at 3.0 mph until minute seven. At minute eight, speed was increased by .2 mph and 1% grade each minute until the participant could no longer exercise. Once the test was terminated, participants continued to walk for five minutes at a zero percent grade at 1.5 mph. Recovery heart rates were assessed each minute.

Every minute during the test and in the five-minute recovery period, the participants' heart rate was recorded, using a Polar T31 heart rate monitor. Participants wore a heart rate monitor band, which was placed snugly around their chest, and a watch to display heart rate. Fifteen seconds before each stage ended, participants were asked to point to the appropriate number on the rate of perceived exertion (RPE) scale. The scale is based on how the participant feels and ranges between 1-10, 1 being equivalent to sitting on a couch and 10 equals exhaustion. During the test, subjects wore headgear, designed to hold the mouthpiece, which was used to collect expired gases throughout the test. A nose clip was placed on the participant's nose to ensure no air was lost. Every 20 seconds, expired gases were collected and analyzed by the Parvo Medics TrueMax 2400 metabolic cart.

Participants were instructed to continue exercising until exhaustion and maximal effort was achieved to determine absolute VO_2 max. To determine whether the participant achieved maximal effort, adolescents had to meet at least two of the following criteria: a heart rate within 10-15 beats of the subject's age-predicted maximal heart rate, a rating of perceived exertion (1-10 scale) ≥ 8, a respiratory exchange ratio > 1.10, or a point of leveling off of VO_2 (<50 ml/min) with increasing workload.

Fidelity checks. Treatment integrity was assessed in multiple ways. Participants' average heart rates were recorded for each exercise session to ensure intensity levels were being met. Attendance of sessions throughout a semester was also thoroughly documented to confirm participants were coming in to exercise. Mentors were required to turn in weekly heart rate and weight sheets for their mentee to a graduate student coordinating the project. Mentors were also required to document strategies used to facilitate exercise success and enjoyment. These strategies are referred to as CARE strategies, an acronym for the psychological needs (competence, autonomy, relatedness, and enjoyment) stated in the self-determination theory (Ryan & Deci, 2000). During the weekly mentor trainings, mentors shared successes and challenges of the week. This allowed the coordinator to make sure the mentors delivered the program as intended. On the nights of exercise, there was always a graduate student present monitoring activity, providing suggestions when needed, and making sure challenges were being done. At least once in the semester, each mentor was recorded while delivering a challenge. This allowed the program coordinator to assess counseling skills of the mentor and also confirm challenges are being delivered in a non-judgmental and friendly way.

During post-testing assessments, mentees completed a questionnaire regarding whether their mentor met their needs throughout the intervention. This questionnaire provided information regarding the quality of intervention delivery and if the participant felt the mentor met or exceeded program expectations.

Data analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS for Windows, Version 18 SPSS Inc, Chicago, IL), with statistical significance set at $p < .05$. Descriptive statistics were used to describe the characteristics of the entire sample along with participants in the exercise intervention and wait list control. Changes in variables were initially compared between groups using a 2 X 2 (condition X pre/post) repeated measures ANOVA. Effect sizes were also used to examine meaningfulness of changes at the two testing time points (pre and post intervention). To examine if changes were maintained, a 2 X 3 (condition X pre/post/follow-up) repeated measures ANOVA was used, followed by measure of effect size at post and follow-up, as well as pre and follow-up. Variables measured include self-esteem (global self-esteem, physical self-worth, sport or physical competence, physical condition, body attractiveness, and physical strength), aerobic fitness, and body composition (VO_2 max, DEXA, BMI Z-scores). Physical activity was measured by comparing minutes of light, moderate, and vigorous activity, followed by a percentage of sedentary time at all three time points, between the two conditions.

Chapter 3: Results

Preliminary analysis

To test internal consistency of the instruments used, Cronbach's alpha values were computed for each scale measured in the PSPP (see Table 4). Reliability analysis for each of the PSPP variables demonstrated that all scales had above acceptable internal consistency ($\alpha \geq .70$).

Table 4.
Alpha Coefficients for Self-Perception Scales at all Three Time Points

Scale	Baseline	Post-testing	Follow-up
GSE[a]	.82	.89	.86
PSW[b]	.77	.82	.87
Physical Competence	.85	.86	.91
Physical Condition	.92	.90	.93
Body Attractiveness	.82	.91	.93
Physical Strength	.87	.86	.86

[a]Global self-esteem (GSE) [b]Physical self-worth (PSW)

There were no missing data at post-testing. However, three participants missed follow-up testing. In event of missing data at follow up, baseline values were carried forward to assume participants returned to baseline status, rather than assuming changes seen at post-testing were maintained. In addition, one participant was excluded from self-perception analysis, due to incorrectly filling out the questionnaire at pre-testing and two participants were excluded from body composition analysis (DXA) due to missing data at pre-testing. In total 23 participants had complete data sets.

There were multiple missing data points for the physical activity measure. Therefore, participants who wore the accelerometers at both pre and post testing time points were used for the 2 X 2 repeated measures ANOVA analysis, and participants who wore the devices at all three time points were used for the 2 X 3 analysis.

Descriptive statistics

On average, the sample had relatively moderate self-perception scores at baseline. The experimental group's self-perceptions fell within the moderate range. With the exception of GSE (M=2.82) and COMP (M=2.91), the self-perceptions of the control group were low to moderate. Neither group had high scores (>3.00) for any self-perception measure. Aerobic fitness (VO_2 max) for both groups is below the second percentile, for both sexes, when compared to the national average for adolescents (Eisenmann, Laurson, & Welk, 2011). BMI-Z scores are measures of relative weight adjusted for age and sex (Must & Anderson, 2006). Both the experimental and control group were at least two standard deviations above the average for their age, indicating they are heavier than 95% of other youth of the same sex and age. This interpretation also applies to body fat percentage, measured by DXA, which is another measure of obesity (Laurson, Eisenmann, & Welk, 2011). Not only are participants in the sample at or above the 95th percentile height/weight, as well as being two standard deviations above average body fat percentage, but are also at a higher risk for chronic diseases and mortality than normal weight peers.

Overall, the two groups in the study were relatively equal at baseline. Examination of mean scores at baseline, as well as an independent samples t-test, revealed non-significant p values for all variables, with the exception of GSE (see Table 5). Baseline BMI Z-score also had a nearly significant p-value, indicating that these two variables were nearly significantly different at baseline. Due to the purpose of evaluating change over time, repeated measures ANOVA was still used for data analysis.

Table 5
Examination of Baseline Mean Scores for all Variables and t-test Significance Values

Variable	Experimental		Control		t-test Significance
	M	SD	M	SD	p
GSE[a]	2.57	(.83)	2.82	(.75)	.04
PSW[b]	2.24	(.60)	2.39	(.70)	.98
COMP[c]	2.44	(.60)	2.91	(.73)	.51
COND[d]	2.19	(.47)	2.18	(.63)	.83
ATRC[e]	1.77	(.59)	1.81	(.36)	.51
STNG[f]	2.32	(.73)	2.49	(.77)	.39
VO_2 max[g]	27.78	(6.22)	24.47	(5.92)	.13
BMI Z-score[h]	2.00	(.49)	2.29	(.34)	.07
DXA[i]	43.80	(6.87)	45.50	(5.92)	.47
Age	14.00	(1.61)	13.75	(1.36)	.64

[a]Global self-esteem (GSE). [b]Physical self-worth (PSW). [c]Physical competence (COMP). [d]Physical Condition (COND). [e]Body Attractiveness (ATRC). [f]Physical Strength (STNG). [g]Maximum Oxygen Consumption- aerobic fitness. [h]Body Mass Index Z score. [i]Dual energy X-ray absorptiometry- body composition by percentage of regional body fat.

Intervention effects on self-perceptions

Participants were compared on their baseline self-perceptions, as well as their self-perceptions following the 12-week intervention using a 2 X 2 (intervention/control X (pre/post) repeated measures ANOVA (see Table 6). To examine meaningfulness of change following the intervention, Cohen's d was calculated (see Table 7). As a rule of thumb, <.3 is a small effect, .5 is a moderate effect, and >.8 is a large effect.

Table 6

2 X 2 RM ANOVA Comparing the Experimental or Control Conditions on Self-Perception Outcome Variables

	Experimental				Control					
	Pre		Post		Pre		Post		Time X condition interaction	
Scale	M	SD	M	SD	M	SD	M	SD	F	*p*
GSE[a]	2.57	(.83)	3.07	(.85)	2.82	(.75)	2.90	(.66)	2.54	.12
PSW[b]	2.24	(.60)	2.79	(.85)	2.39	(.70)	2.56	(.60)	3.65	.06
COMP[c]	2.44	(.60)	2.72	(.77)	2.91	(.73)	2.87	(.70)	1.96	.17
COND[d]	2.19	(.47)	2.64	(.63)	2.18	(.63)	2.36	(.57)	3.06	.09
ATRC[e]	1.77	(.59)	2.21	(.70)	1.81	(.36)	2.16	(.57)	.33	.57
STNG[f]	2.32	(.73)	2.69	(.90)	2.49	(.77)	2.77	(.63)	.44	.51

[a]Global self-esteem (GSE). [b]Physical self-worth (PSW). [c]Physical competence (COMP). [d]Physical Condition (COND). [e]Body Attractiveness (ATRC). [f]Physical Strength (STNG).

Table 7

Comparison of Self-Perception Effect Sizes (Cohen's d) between Groups

	Experimental			Control		
	Pre	Post		Pre	Post	
Scale	M	M	d	M	M	d
GSE[a]	2.57	3.07	.52	2.82	2.90	.11
PSW[b]	2.24	2.79	.79	2.39	2.56	.26
COMP[c]	2.44	2.72	.41	2.91	2.87	-.06
COND[d]	2.19	2.64	.82	2.18	2.36	.30
ATRC[e]	1.77	2.21	.45	1.81	2.16	.40
STNG[f]	2.32	2.69	.68	2.49	2.77	.75

[a]Global self-esteem (GSE). [b]Physical self-worth (PSW). [c]Physical competence (COMP). [d]Physical Condition (COND). [e]Body Attractiveness (ATRC). [f]Physical Strength (STNG).

Results revealed a significant time effect for global self-esteem, $F(1,37)=5.0$, $p=.03$, $\eta\varrho^2=.12$, followed by a time by condition interaction effect which approached significance, $F(1,37)=2.5$, $p=.12$, $\eta\varrho^2=.06$. Inspection of mean scores for each condition revealed that self-esteem scores improved in both groups. However, the intervention group showed a moderately large increase in GSE based on examination of effect size whereas the control group showed minimal change. Physical self-worth followed a similar pattern in that the time effect was significant, $F(1,37)=11.3$, $p=.002$, $\eta\varrho^2=.23$, while the interaction term approached significance,

$F(1,37)=3.7$, $p=.06$, $\eta\rho^2=.09$. The intervention group showed a large (d = .79) from pre to post, while the control group only showed .26 change based on Cohen's *d*.

When evaluating changes in the domain specific self-perceptions, neither time effect, nor interaction effect were significant for physical competence, $F(1,37)=1.09$, $p=.30$, $\eta\rho^2=.02$; $F(1,37)=1.97$, $p=.17$, $\eta\rho^2=.05$. This suggests that there was not a substantial difference between pre and post scores across conditions, however, effect sizes revealed a moderate positive effect (d = .41) for the intervention group and a small negative effect (d = -.06) for the control group. Physical condition yielded a strong time effect, $F(1,37)=14.5$, $p=.001$, $\eta\rho^2=.28$, superseded by interaction effect which approached significance, $F(1,37)=3.06$, $p=.06$, $\eta\rho^2=.08$). Inspection of descriptive statistics and effect sizes indicated a larger change in the intervention group from pre to post, compared to the control group. Cohen's *d* for each group revealed a positive, large effect for physical condition in the intervention group (d = .82), while the control group yielded a small effect (d = .30). Body attractiveness and physical strength yielded strong time effects, $F(1,37)=13.5$, $p=.001$, $\eta\rho^2=.26$; $F(1,37)=10.0$, $p=.003$, 33, $p=.57$, $\eta\rho^2=.21$. However, both scales resulted in a non-significant time by condition interactions, $F(1,37)= .33$, $p=.57$, $\eta\rho^2=.01$; $F(1,37)=.44$, $p=.51$, $\eta\rho^2=.01$. So, while there was a reduction in mean scores for body attractiveness and physical strength in the intervention group, they did not improve more than the control group. This is supported by similar effect sizes for each group in each scale (see Table 7).

The intervention yielded moderate to large effect sizes for all scales measured, with the exception of one (physical competence), while the control group only changed minimally in comparison. The control group displayed small or negative effect sizes, with an unexplained dramatic increase in perceived physical strength. While both groups improved body attractiveness and perceived physical condition, the intervention group showed stronger change. These data suggest the control group worsened in self-perceptions or improved, but to a lesser extent than the intervention.

Intervention effects on physiological outcomes

Participants were compared on baseline fitness levels and body composition scores, as well as identical post testing assessment scores using a 2 X 2 (intervention/control X (pre/post) repeated measures ANOVA (see Table 8). To examine meaningfulness of intervention change, scores were compared at pre and post-testing time points using Cohen's *d* (see Table 9).

Table 8
2 X 2 RM ANOVA Comparing the Experimental or Control Conditions on Physiological Outcome Variables

	Experimental				Control					
	Pre		Post		Pre		Post		Time X condition interaction	
Variable	M	SD	M	SD	M	SD	M	SD	F	*p*
VO_2 max[a]	27.78	(6.22)	30.83	(7.51)	24.47	(5.92)	24.11	(7.48)	4.46	.04
BMI Z[c]	2.00	(.49)	1.91	(.49)	2.29	(.34)	2.25	(.39)	1.33	.26
DXA[d]	43.80	(6.87)	42.23	(7.33)	45.50	(5.92)	45.47	(6.14)	5.00	.03

[a]Maximum Oxygen Consumption- aerobic fitness. [b]Body Mass Index Z score. [c]Dual energy X-ray absorptiometry- body composition by percentage of regional body fat.

Table 9
Comparison of Physiological Outcome Effect Sizes (Cohen's d) between Groups

	Experimental			Control		
	Pre	Post		Pre	Post	
Variable	M	M	d	M	M	d
VO_2 max[a]	27.78	30.83	.44	24.47	24.11	-.06
BMI Z[b]	2.00	1.91	.18	2.29	2.25	.15
DXA[c]	43.80	42.23	.22	45.50	45.47	.08

[a]Maximum Oxygen Consumption- aerobic fitness. [b]Body Mass Index Z score. [c]Dual energy X-ray absorptiometry- body composition by percentage of regional body fat.

With VO_2 max serving as the dependent variable, repeated measures ANOVA revealed a near significant time effect, $F(1,38)=2.78$, $p=.10$, $\eta\varrho^2=.06$, with a significant interaction term, $F(1,38)=4.46$, $p=.04$, $\eta\varrho^2=.11$. Inspection of mean scores at pre and post testing revealed a moderate increase, based on an effect size of .44 for the intervention group. However, mean scores for the control group decreased and resulted in a negative change in VO_2 max scores pre to post testing (d = -.06) (see Table 9). The interaction effect for DEXA was also significant, F (1,36)=5.00, p=.03, $\eta\varrho^2$=.12, with a significant time effect, F (1,36)=5.38, p=.02, $\eta\varrho^2$=.13. The intervention group showed about one and one half percent body fat reduction, while the control group remained relatively the same. Cohen's *d* revealed a small, but positive (d = .22) effect size for the intervention group, while the control group showed an even smaller effect size of d = .08. Examination of mean scores for BMI-Z scores, revealed that both groups showed a slight decrease across the two time points. The interaction term was not significant, F(1,38)=.133, p=.26, $\eta\varrho^2$=.03. Meaningfulness of these decreases were relatively identical with the intervention group indicating an effect size of .18 and an effect size of .15 in the control group. While the two groups differed substantially for VO_2 and DXA improvements, they were relatively similar in regards to decreases in BMI-Z score.

Physical activity was assessed at both time points using objective measures. Many participants did not wear the accelerometer for at least 3 days, or for at least 8 hours a day, therefore, their results are excluded. Twenty-two intervention participants and ten control participants completed pre-testing, while seventeen intervention participants and ten control participants completed post-test assessment. Pre and post-test results include participants that wore their accelerometers at both time points (See Table 10 & 11). Sixteen participants in the experimental group and nine control participants had complete accelerometer data at both time points.

Table 10
Mean Minutes/day of Physical Activity and Standard Deviations at Pre and Post

	Experimental (N=16)			
	Pre		Post	
Variable	M	SD	M	SD
Light PA[a]	203.90	(41.47)	218.09	(62.30)
Mod PA[b]	12.62	(9.02)	16.71	(10.75)
Vig PA[c]	.84	(1.00)	1.21	(1.60)
MVPA[d]	13.46	(9.82)	17.92	(12.07)
% Sed time[e]	70.09%	(5.4%)	68.82%	(8.73%)
	Control (N=9)			
	Pre		Post	
Variable	M	SD	M	SD
Light PA[a]	217.72	(45.96)	217.92	(51.31)
Mod PA[b]	19.46	(9.67)	20.67	(12.77)
Vig PA[c]	.86	(.73)	1.32	(1.87)
MVPA[d]	20.33	(9.78)	22.00	(13.34)
% Sed time[e]	68.51%	(7.07%)	69.05%	(5.89%)

[a]Light Physical Activity, [b]Moderate Physical Activity, [c]Vigorous Physical Activity, [d]Moderate-Vigorous Physical Activity, [e]Percentage of day spent at sedentary levels.

Table 11
2 x 2 RM ANOVA Interaction Terms for Physical Activity and Effect Sizes (Cohen's d) at Pre and Post Time Points

	Experimental	Control	Time X Condition Interaction	
Variable	d	d	F	p
Light PA[a]	.27	0	.41	.53
Mod PA[b]	.43	.11	.55	.47
Vig PA[c]	.28	.35	.02	.90
MVPA[d]	.41	.14	.45	.51
% Sed time[e]	.18	.08	.54	.47

[a]Light Physical Activity, [b]Moderate Physical Activity, [c]Vigorous Physical Activity, [d]Moderate-Vigorous Physical Activity, [e]Percentage of day spent at sedentary levels.

While light physical activity (LPA) intervention mean scores increased by nearly 15 minutes a day (Time 1: M= 203.90 (SD= 41.47); Time 2: M= 218.09 (SD= 62.30)), and the control group did not change from pre to post, they did not result in a significant time or interaction effect, $F(1,23)=.44$, $p=52$, $\eta\varrho^2=.02$; $F(1,23)=.41$, $p=.53$, $\eta\varrho^2=.02$. This means that neither group showed substantial change in light and activity and neither group changed more than the other group. This is supported by the small effect size (d = .27) for the intervention group and an effect size of d = 0 for the control group.

Minutes of moderate physical activity (MPA), minutes of vigorous physical activity (VPA), and minutes of combined moderate and vigorous activity (MVPA) all resulted in time effects that approached significance, $F(1,23)=1.85$, $p=.19$, $\eta\varrho^2=.07$; $F(1, 23)=1.30$, $p=.27$, $\eta\varrho^2=.05$; $F(1,23)=2.19$, $p=.15$, $\eta\varrho^2=.09$. These time effects suggest both groups showed the same positive direction of change. Therefore, no significant interactions were found for these measures, $F(1,23)=.54$, $p=.47$, $\eta\varrho^2=.02$; $F(1,23)=.01$, $p=.90$, $\eta\varrho^2=.001$; $F(1,23)=.45$, $p=.51$, $\eta\varrho^2=.02$, indicating one group did not improve more than the other for MPA, VPA, or MVPA. More specifically, mean scores for MVPA in the intervention group increased by about four minutes from pre to post-testing, however the control group also improved their MVPA by accumulating two more minutes a day. Even though the percentage of time spent being sedentary decreased by about 2% for the intervention group, and increased by about 1% for the control group, neither the time nor interaction effect was significant, $F(1,23)=.09$, $p=.77$, $\eta\varrho^2=.004$; $F(1,23)=.54$, $p=.47$, $\eta\varrho^2=.02$. When evaluating magnitude of change, the intervention showed small to moderate change, while the control group exhibited little to no change (See Table 11).

Maintenance of change on self-perception outcomes

To assess maintenance of intervention effects, participants were compared on their self-perceptions using a 2 X 3 (intervention/control X pre/post/follow-up) repeated measures ANOVA. Mean scores and standard deviations are presented in Table 12 and interaction terms and effect sizes are presented in Table 13. Cohen's d was used to calculate three effect sizes, a pre-test and post-test, posttest and follow-up, and pre-test and follow-up. Pre to post-test effect sizes are mentioned previously (See Table 7). Comparing follow-up data to post-test data allowed an analysis of behavior maintenance effectiveness at post-intervention, while comparing data at follow-up to pre-test data showed behavior change effectiveness overall.

Table 12
Mean Self-Perception Scores and Standard Deviations per Condition: Experimental or Control

	Experimental (N=27)						Control (N=12)					
	Pre		Post		Follow-up		Pre		Post		Follow-up	
Scale	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
GSE[a]	2.57	(.83)	3.07	(.83)	2.96	(.77)	2.82	(.75)	2.90	(.66)	2.95	(.55)
PSW[b]	2.24	(.60)	2.79	(.85)	2.59	(.88)	2.39	(.70)	2.56	(.60)	2.29	(.64)
COMP[c]	2.44	(.60)	2.72	(.79)	2.61	(.78)	2.91	(.72)	2.87	(.70)	2.60	(.46)
COND[d]	2.19	(.47)	2.64	(.63)	2.37	(.70]	2.18	(.63)	2.36	(.57)	2.19	(.47)
ATRC[e]	1.77	(.59)	2.21	(.70)	2.08	(.84)	1.81	(.36)	2.16	(.57)	1.00	(.65)
STNG[f]	2.32	(.73)	2.69	(.90)	2.63	(.82)	2.49	(.77)	2.77	(.63)	2.69	(.58)

[a]Global self-esteem (GSE). [b]Physical self-worth (PSW). [c]Physical competence (COMP).
[d]Physical Condition (COND). [e]Body Attractiveness (ATRC). [f]Physical Strength (STNG).

Table 13
2 x 3 RM ANOVA Interaction Terms for Self-Perceptions and Effect Sizes (Cohen's d) at all Time Points

			Experimental		Control	
	Time X condition interaction		Post-FU *d*	Pre-FU *d*	Post-FU *d*	Pre-FU *d*
Scale	F	*p*	d2	d3	d2	d3
GSE[a]	1.24	.30	-.12	.49	.08	.20
PSW[b]	2.50	.10	-.22	.47	-.43	-.15
COMP[c]	2.05	.14	-.08	.25	-.46	-.53
COND[d]	1.49	.24	-.40	.31	-.32	.02
ATRC[e]	.19	.83	-.15	.48	-.26	.38
STNG[f]	.22	.81	-.05	.41	-.12	.28

[a]Global self-esteem (GSE). [b]Physical self-worth (PSW). [c]Physical competence (COMP).
[d]Physical Condition (COND). [e]Body Attractiveness (ATRC). [f]Physical Strength (STNG).

Examining global self-esteem overtime, using Wilks' Lambda's main effect, resulted in non-significant time and interaction term effects, $F(2,36)=2.77$, $p=.08$, $\eta\varrho^2=.13$; $F(2,36)=1.24$, $p=.30$, $\eta\varrho^2=.06$ (see Table 13). Overall, there was no evidence that the change in GSE was different between groups. At follow-up, intervention means of physical self-worth revealed a significant time effect and near-significant time X condition interaction, F(2,36)=5.65, p=.007, $\eta\varrho^2=.24$; F(2,36)=2.50, p=.09, $\eta\varrho^2=.12$. The intervention group improved PSW (d = .79) during the intervention, however following the intervention, changes were not maintained (d = -.22). Still, PSW scores at the 3-month follow up for the intervention group were higher than baseline with a moderate effect size (.47). In contrast, the control group showed a large decrease in PSW from post-testing to follow-up (d = -.43) and also showed a small decrease in PSW (d = -.15), from baseline. For all four subdomain variables in the intervention group, mean scores indicated a decrease from post test to follow-up, however mean scores at follow-up were still higher than baseline scores. Conversely, the control group only had higher mean scores on three out of the six measures (GSE, COND, STNG). None of the four subdomains, physical competence, physical condition, body attractiveness, and physical strength, revealed significant time by condition interactions, F(2,36)=2.06, p=.14, $\eta\varrho^2=.10$; F(2,36)=1.49, p=.24, $\eta\varrho^2=.08$; F(2,36)=.19, p=.83, $\eta\varrho^2=.01$; F(2,36)= .22, p=.81, $\eta\varrho^2=.01$. By not revealing significant interaction terms, patterns of change did not differ across time points between groups, or one group did not change more than the other group. However, significant time effects were seen for physical condition, F(2,36)=8.19, p=.001, $\eta\varrho^2=.31$, body attractiveness, F(2,36)=6.61, p=.004, $\eta\varrho^2=.27$, and physical strength, F(2,36)=4.93, p=.01, $\eta\varrho^2=.22$. These time effects suggest groups did change significantly across time points, but since the interaction term was not significant, the groups did not vary in this change.

Even though trends seen for the intervention group in four subdomains did not significantly differ from the control group, their improvements were larger in magnitude at follow-up than the control group Cohen's *d* revealed large differences in effect sizes across conditions for perceived physical competence (COMP) and perceived physical condition

(COND) at follow-up. While the intervention group had a small, but positive effect size of .25 at follow-up for COMP, the control group had a negative, moderate effect size (d = -.53). Similarly, large differences were seen for COND, with intervention group having a positive, but small effect size of .31, and the control group with only an effect size of .02. However, effect sizes for body attractiveness (ATRC) and perceived physical strength (STNG) were similar across conditions. In the intervention group, Cohen's d revealed small to moderate effects for ATRC (d = .48) and STNG (d = .41), with the control group revealing similar effects for ATRC (d = .38) and STNG (d =.28).

Maintenance of change on physiological outcomes

To assess if post-intervention scores were maintained, all physiological variables were assessed using a 2 X 3 (intervention/control X pre/post/follow-up) repeated measures ANOVA (see Table 15).

Table 14
Mean Physiological Outcome Scores and Standard Deviations per Condition: Experimental and Control

	Experimental					
	Pre		Post		FU	
Variable	M	SD	M	SD	M	SD
VO2 max[a]	27.78	(6.22)	30.83	(7.51)	28.20	(7.49)
BMI Z[b]	2.00	(.49)	1.91	(.49)	1.92	(.56)
DXA[c]	43.80	(6.87)	42.23	(7.33)	43.20	(7.57)
	Control					
	Pre		Post		FU	
Variable	M	SD	M	SD	M	SD
VO2 max[a]	24.47	(5.92)	24.11	(7.48)	23.30	(6.48)
BMI Z[b]	2.29	(.34)	2.25	(.39)	2.27	(.37)
DXA[c]	45.50	(5.92)	45.47	(6.14)	45.38	(5.32)

[a]Maximum Oxygen Consumption- aerobic fitness. [b]Body Mass Index Z score. [c]Dual energy X-ray absorptiometry- body composition by percentage of regional body fat.

Table 15
2 x 3 RM ANOVA Interaction Terms for Physiological Outcomes and Effect Sizes (Cohen's d) at Post and Follow-up Time Points

			Experimental		Control	
	Time X condition interaction		Post-FU *d*	Pre-FU *d*	Post-FU *d*	Pre-FU *d*
Variable	F	*p*	d2	d3	d2	d3
VO_2 max[a]	2.24	.12	-.35	.06	-.11	-.19
BMI Z[b]	.66	.52	-.01	.15	-.05	.06
DXA[c]	2.58	.09	-.13	.08	.01	.02

[a]Maximum Oxygen Consumption- aerobic fitness. [b]Body Mass Index Z score. [c]Dual energy X-ray absorptiometry- body composition by percentage of regional body fat.

Results indicated that maintenance patterns for physiological variables followed the same patterns as self-perception variables. Adolescents regressed back toward baseline for all physiological variables at follow-up testing. Examination of mean scores at all three time points determined a positive change for all three variables at post testing, however all three variables demonstrated a negative change at follow-up. Because of the similarity between experimental and control groups in mean scores, VO_2 max, BMI-Z score, and DXA scores all resulted in significant or near significant time effects, $F(2,37)=3.47$, $p=.04$, $\eta\varrho^2=.12$; $F(2,37)=3.08$, $p=.06$, $\eta\varrho^2=.14$; $F(2,35)=2.67$, $p=.09$, $\eta\varrho^2=.13$. Furthermore, Cohen's *d* for VO_2 max in the experimental group revealed a small negative effect size (d =-.35), with an even smaller, yet positive effect from baseline to follow-up (d = .06). Because the size of the effect was so insignificant, it can be assumed that the intervention was not successful at helping maintain aerobic fitness. While the control group's pattern of change was comparable to the experimental group, the control group's VO_2 max mean scores decreased at all three time points (see Table 14). These differences between groups for VO_2 max determined an interaction that approached significance, $F(2,37)=2.26$, $p=.12$, $\eta\varrho^2=.11$.

Mean scores across groups indicate improvements in BMI Z-score at post-testing however, both groups reverted back to baseline at follow-up testing, resulting in a non significant interaction effect, $F(2,37)=.66, p=.52$, $\eta\varrho^2=.03$. Because the change in mean scores for both groups was so small across all time points, the magnitude of change for the intervention group (d=.15) and the control group (d=.06) showed similar results at follow-up.

As shown in Table 14 and 15, percent body fat slightly decreased (d= .08) from baseline (M=43.80, SD=6.87) to follow-up (M=43.20, SD=5.32); however, the participants started to regress back to baseline levels in the 3-month time span (d=-.13). The control group stayed relatively equal across all three time points (Time 1: M=45.50 (SD=5.92); Time 2: M=45.47 (SD=6.14); Time 3: M=45.38 (SD=5.32)) and resulted in little to no change (d=.01). Because of these differences in DEXA scores between groups, there was an interaction between groups, that approached significance, $F(2,35)=2.58$, $p=.09$, $\eta\varrho^2=.13$.

When assessing physical activity at all three time points, our sample reduced to half due to lack of compliance for the required time/days, at all three time points (See Table 16 & 17). Data included in the 2 X 3 (intervention/control X pre/post/follow-up) for physical activity, only included participants who wore the accelerometer at all three time points.

Table 16
Mean Minutes/day of Physical Activity and Standard Deviations at all Three Time Points

	Experimental (N=9)					
	Pre		Post		Follow-up	
Variable	M	SD	M	SD	M	SD
Light PA[a]	199.12	(33.62)	215.76	73.71	203.81	(41.87)
Mod PA[b]	13.20	(9.65)	17.47	(9.98)	14.34	(8.35)
Vig PA[c]	1.06	(1.08)	1.05	(1.08)	.45	(.62)
MVPA[d]	14.26	(10.50)	18.52	(10.71)	14.80	(8.72)
% Sed time[e]	71.15%	(4.68%)	70.12%	(8.73%)	71.44%	(6.53%)
	Control (N=4)					
	Pre		Post		Follow-up	
Variable	M	SD	M	SD	M	SD
Light PA[a]	234.74	(52.47)	219.18	(48.32)	184.12	(36.00)
Mod PA[b]	23.11	(9.57)	16.78	(8.13)	15.80	(11.81)
Vig PA[c]	1.28	(.77)	1.94	(2.75)	.50	(.65)
MVPA[d]	24.39	(9.05)	18.72	(10.12)	16.30	(11.77)
% Sed time[e]	65.13%	(7.47%)	70.00%	(4.86%)	70.25%	(4.21%)

[a]Light Physical Activity, [b]Moderate Physical Activity, [c]Vigorous Physical Activity, [d]Moderate-Vigorous Physical Activity, [e]Percentage of day spent at sedentary levels.

Table 17
2 x 3 RM ANOVA Interaction Terms for Physical Activity and Effect Sizes (Cohen's d) at all Three Time Points

	Experimental			Control				
	Pre-Post	Post-FU	Pre-FU	Pre-Post	Post-FU	Pre-FU	Time X Condition Interaction	
Variable	*d*1	*d*2	*d*3	*d*1	*d*2	*d*3	F	*p*
Light PA[a]	.31	-.46	.12	-.31	-.83	-1.14	1.76	.22
Mod PA[b]	.43	-.34	.13	-.72	-.10	-.68	2.19	.16
Vig PA[c]	0	-.71	-.72	.38	-.85	-1.10	.72	.51
MVPA[d]	.40	-.38	.06	-.59	-.22	-.78	1.83	.21
% Sed time[e]	.15	-.17	-.05	-.78	-.05	-.88	1.40	.29

[a]Light Physical Activity, [b]Moderate Physical Activity, [c]Vigorous Physical Activity, [d]Moderate-Vigorous Physical Activity, [e]Percentage of day spent at sedentary levels.

Overall, mean scores revealed the control group was more active than the intervention group at baseline in all variables. However, the intervention group improved in all variables at post-testing and the control group decreased in minutes of activity in all variables except VPA. Much like all other measured variables, when participants were evaluated at follow-up, the intervention group reverted back to baseline scores and the control group continued its declining pattern. LPA and MPA resulted in non significant time effects, $F(2,10)=1.66$, $p=.24$, $\eta\varrho^2=.25$; $F(2,10)=.45$, $p=.65$, $\eta\varrho^2=.08$, and both variables indicated a non significant interaction, $F(2,10)=1.76$, $p=.22$, $\eta\varrho^2=.26$; $F(2,10)=2.19$, $p=.16$, $\eta\varrho^2=.30$. While these interaction terms are insignificant, they appeared to approach significance, indicating the change in the intervention group was more substantial than the change in the control group. VPA resulted in a significant time effect, $F(2,10)=9.05$, $p=.01$, $\eta\varrho^2=.64$, but was followed by an insignificant interaction term, $F(2,10)=.72$, $p=.51$, $\eta\varrho^2=.13$. This suggested that both groups changed over the three time points, however the pattern of improvement did not significantly differ between groups. MVPA and percent of time spent in sedentary activity resulted in non significant time effects, $F(2,10)=.68$, $p=..53$, $\eta\varrho^2=.12$, $F(2,10)=1.20$, $p=.34$, $\eta\varrho^2=.19$, as well as non significant interaction effects, $F(2,10)=1.83$, $p=.21$, $\eta\varrho^2=.27$, $F(2,10)=1.40$, $p=.29$, $\eta\varrho^2=.22$. The analyses revealed that neither group significantly changed over time, and one group failed to change more than the other.

When using Cohen's *d* to determine meaningfulness of change, the intervention showed little to no effect on the experimental group's activity levels, while the control group's resulted in rapidly decreased from baseline, with large, negative effect sizes. Ultimately, with the exception of VPA, participants who received the treatment improved at post-testing, but changes were not maintained at follow-up. Conversely, physical activity of those individuals who did not receive treatment steadily declined across all three time points. Much like other variables measured in the study, changes were seen immediately following the intervention, but those changes were not sustained over the no-contact period.

Fidelity checks

Physiological data was thoroughly documented for treatment integrity of exercise sessions. Mentee's average attendance and heart rates were recorded for each session (see Table 19).

Table 18
Average Attendance and Heart Rate (bpm) Data

	M	SD	Min	Max	Range
Average Attendance (%)	87.50	(10.98)	61	100	39.00
Average Heart Rates (bpm)	160.88	(14.54)	131.28	188.96	57.69

All mentee's attended roughly 88% (SD=10.98%) of the exercise sessions. If the facilities were closed and exercise was not possible, the session was voided and an absence for any other reason was recorded as a missed session. Average heart rates were maintained within the low 130 bpm range to upper 180 bpm range. Total mean heart rate for all participants was roughly 161 bmp, which reflects a moderate physical activity level during sessions.

To assess whether mentee's program needs were being met, mentees filled out a 24-item questionnaire regarding their mentor. This questionnaire asks the participant to evaluate things such as feeling supported, feeling understood, and if they trust their mentor. Using a 7-point Likert scale (7 being the highest one could receive), mean scores (M=6.78, SD= .48) were on the upper end of the scale. The full range of scores stretched from 4.62 to 7.

Chapter 4: Discussion

The current study extends literature by evaluating a lifestyle intervention for overweight adolescents, as there is limited research examining both psychological and physiological variables in an intervention setting (Wilfley et al., 2007). Primary components of the intervention include individualized exercise and physical activity sessions, behavioral modification challenges, and the one-on-one relationship with a mentor. The combination of these components helps set this study apart from previously published studies involving adolescents and lifestyle management (Annesi, Unruh, Marti, Gorjala & Tennant, 2011; Annesi, Walsh, & Smith, 2010; Black et al., 2010; Lloyd-Richardson et al., 2012; Ullrich-French, McDonough, & Smith, 2012). The study evaluated the impact of a 12-week mentor-based, lifestyle, and exercise intervention on the self-perceptions, physical activity patterns, body composition, and aerobic fitness levels of overweight adolescents.

Due to the varied primary components of the study, a multidisciplinary approach was used to evaluate the program's efficacy. It is important to evaluate all variables, both physical and mental, because each variable plays an integral part in participant success in the intervention. Fox's (1988) hierarchical model was used to evaluate the impact of the intervention on self-perceptions (global self-esteem, physical self-worth, physical competence, physical condition, body attractiveness, and physical strength). Physiological variables were measured by physical activity (accelerometry), body composition (DXA), and aerobic fitness (VO_2 max). The study also evaluated if changes made by the treatment group were maintained 12 weeks later. The follow-up testing time point was necessary to assess if changes made during the intervention were maintained after the conclusion of the intervention.

Overall, results revealed the mentor-based exercise intervention had a strong impact on intervention participants' self-perception variables at post-testing according to effect sizes, while having minimal effect on most self-perceptions of the control group. The intervention group revealed moderate to large self-perception effect sizes, ranging from .41 to .82, while the control group demonstrated negative to small effect sizes for all but two self-perception variables. The control group did reveal an effect size that approached a moderate level (d = .40) for body attractiveness and a large effect size (d = .75) for perceived physical strength, however the intervention group increased on all self-perception variables. These results partially supported the original hypothesis, which stated that the intervention group would demonstrate a positive increase in self-perceptions, and the control group would remain unchanged. Results revealed similar findings of previous research and provided further support for the idea that physical activity contexts can lead to increases in self-perceptions of youth (Crocker, Kowalski, & Hadd, 2008; Eccles, 2005; Fraser-Thomas, Cote, & Deakin, 2005). Previous research regarding normal weight youth suggest physical activity and exercise interventions can promote increases in physical self-perceptions related to confidence in physical abilities (Crocker, Eklund, & Kowalski, 2000; Crocker et al., 2003). This finding is important because increasing physical self-perceptions may increase subsequent physical activity and exercise levels, in turn resulting in greater energy expenditure which is important in weight maintenance.

When examining the physiological variables, results indicated small, but positive improvements in body composition, aerobic fitness, and moderate-to-vigorous physical activity in the intervention group. In contrast, the control group's body composition did not change, while physical activity levels and VO_2 max decreased at post testing. Therefore, the original hypothesis, which expected improvements in physical activity levels, body composition, and aerobic fitness levels in the intervention group, with no change in the control group, was supported. However, improvements seen in the intervention group were minor and supported by small to moderate effect sizes. Further, MVPA only increased from 13 minutes/day at baseline to about 18 minutes/day at post testing, percent body fat decreased by about 1.5%, and VO_2 max only increased by about 3 ml/kg/min^{-1}. While these improvements are found to be minimal, the intervention group still showed more improvement than the control group, suggesting such interventions can promote small, but positive changes in physiological variables such as physical activity levels, body composition, and aerobic fitness.

When maintenance of all variables was examined, our hypothesis that the intervention group would sustain all improvements and the control group would decrease or show no change in all outcome variables was only partially supported. The control group's follow-up test scores were all lower than at post-test, with the exception of body composition, which showed relatively no increase or decrease. However, the intervention group did not maintain improvements seen at post-testing on any variable measured. While the intervention group did move back towards the direction of baseline, participants still demonstrated improved scores relative to baseline. The lack of maintenance associated with self-perceptions, aerobic fitness, and body composition is also consistent with previous research, in that short exercise interventions do not result in long-term maintenance (Black, et al., 2010; Morgan, Saunders, & Lubans, 2012; Wilfley, et al., 2007). It is suggested that such interventions need to focus on maintenance behaviors for long-term success (Elfhag and Rossner, 2005; Sciamanna et al, 2011) and/or incorporate a "continued care" approach (Deforche et al., 2005; Perri et al., 2008). A "continued care" approach involves maintaining contact with participants, even once the program is over. This approach is important because many youth regain weight after treatment due to abandonment of weight loss/management strategies and relapse to previous inappropriate behaviors (Deforche, De Bourdeaudhuij, Tanghe, Hills, & De Bode, 2004). Some strategies that can be used in a "continued care" approach include phone calls, text messages, letters, and emails (Deforche et al., 2005; Perri et al., 2008).

While the current study incorporates many of the suggested behavior maintenance strategies (self-monitoring, goal-setting, planning, increasing leisure time activity, and ability to face and solve barriers that may arise), perhaps more time is needed to fully grasp these concepts. One way to alleviate the time constraints of a one-semester intervention is to stretch the intervention over two semesters. By increasing the length of the intervention, participants would have more time to learn maintenance concepts, as well as have more experience with exercise, physical activity, and nutrition. As results suggest, a 12-week, lifestyle and exercise intervention is sufficient to increase self-perceptions, aerobic fitness, while decreasing body composition, in the short-term. Yet, this intervention is not adequate for long-term results, which is one of the most important indicators of weight maintenance. It is also worth mentioning that a phased transition towards the end of the intervention may help participants not feel as though the intervention has abruptly ended, help reduce feelings of abandonment, as well as help build behavior skills to help succeed and raise self-efficacy. Elfhag and Rossner (2005) emphasize the importance of social support, self-efficacy, and the ability to handle life stressors. While we tried to incorporate and enhance all of these strategies for maintenance, more time is needed to adequately cover topics such as these. Future interventions should also gear activity/exercise to be more specific and appropriate for performing at home in preparation for cessation of the structured intervention. This would allow participants to translate activities with their mentor from each structured session into their regular routines at home. Maintenance of healthy behaviors is important, especially because participants at this age are attempting to transition into adulthood and independence.

Despite previous literature (Sonstroem, Harlow, & Josephs, 1994), results of the current study demonstrated a moderate to large effect in GSE, which is the most stable self-perception, at post-testing and the largest effect of all self-perceptions at follow-up. As mentioned earlier, self-esteem is a multidimensional construct and GSE is influenced by self-perceptions in a variety of domains such as scholastic competence, social competence, emotional competence, relationships, and morality, not merely physical. In Fox's self-perception hierarchy, GSE is the top tier, followed by PSW, and four subdomains, which are more likely to change according to the model (Fox, 1998). It was interesting that the physical activity intervention did not impact the domain specific self-perceptions to a greater extent, due to the transient nature of these subdomains compared to the stability of the GSE (Fox, 1988; Fox, 1997). One interpretation is that self-perceptions were improving in more dimensions than just physical. Self-perceptions in domains such as scholastic competence, social competence and emotional competence, could have had a bigger influence on overall global self-esteem than the intervention had on the four subdomains. Because the study includes teaching a variety of behavioral skills associated with weight management, and participants exercise in group and individual-based activities, adolescents may experience increases in self-perceptions across multiple domains. Further research would be beneficial to determine whether the physical domain or one of the supplemental domains play a larger role in the increase in GSE.

While the mentees seemed to enjoy the exercise sessions, there were many challenges within the actual session. One of the main challenges was transition time between different activities within a session. Often times, the participant would want to take an extended break or talk to their friends instead of exercising and the mentor would have to come up with a way to keep them moving. To help the mentors understand the issue with transition times and the need to reduce this time, participants wore accelerometers during two or three exercise sessions throughout the semester. This allowed the mentor to see how much downtime was occurring within a single exercise session and to make them more conscious of when the downtime may be occurring. This also helped the mentor determine if their mentee was meeting at least a moderate intensity. Using accelerometers was also useful to assess intensity because using heart rate monitors alone may overestimate heart rates if the participant is deconditioned. There were also some issues with having activities prepared for each participant ahead of time, so while the mentor was setting up an activity, the participant may have just been standing there. So, to help overcome this challenge, we had mentors discuss several activities they were going to do with their mentees in the weekly trainings. One graduate student also demonstrated two to three new activities in training each week to help the mentors become more creative and prepared for activities in the sessions. While these challenges were not initially planned for, it was important to immediately assess and help teach mentors how to deal with these issues in future sessions.

Much like all studies, this study was not without limitations, one of which being a small sample size. While we tried to recruit around fifteen participants each semester, we typically were a couple short. Also, while it helped with recruitment efforts, using participants who may have known each other prior to the intervention (the word of mouth sampling procedure) reduces generalization of the study. Another limitation of the study is the lack of group equivalence on two variables at baseline (BMI-Z scores, GSE). Initially, the control group had a significantly higher baseline GSE score, while having an almost significant higher BMI-Z mean score. A final, important limitation to note is that because self-esteem is derived from both internal and external experiences, it is highly susceptible to change from variables not controlled in the study (family, friends, school, etc), therefore indicating uncontrollable potential confounding variables.

Other than the previously mentioned limitations (small sample size and confounding variables), there are other, more notable, factors to take into consideration. When measuring physical activity and intensity, objective measures, like accelerometers, provide advantages such as collecting unbiased data, improved reliability and validity, and not interfering with normal movement patterns. However, there are also disadvantages to using only objective tools, such as lack of compliance. Even though the use of accelerometers is well documented as noninvasive and simple (Dale, Welk, & Matthews, 2002), they may not be feasible in a population that relies on so heavily on social acceptance (Mann, Hosman, Schaalma, & de Vries, 2004; Wang & Veugelers, 2008). Because this population cares so much about what peers may think, they may have avoided wearing them due to the attention that could come from wearing an accelerometer. Another factor to take into consideration is that participants may have found the accelerometer uncomfortable to wear. If participants did not wear their accelerometer for either of the suggested reasons, it is important to brainstorm ways to increase compliance. Throughout the past semesters, we have tried multiple strategies to increase compliance such as text/phone calls and monetary compensation, however, data suggests compliance is still an issue for our population. Perhaps including supplemental, subjective measures to assess physical activity such as physical activity diaries, or quantitative questionnaires to supplement the accelerometers, may give a more thorough representation of activity. It would also be beneficial to explore whether other objective measures would have greater compliance for this population such as Nike FuelBands, and/or fitbits.

Another limitation was variation of intervention delivery among mentors. While mentors were provided weekly instruction, some mentors were better at weekly challenge delivery and planning physical activities than others. One of the reasons some mentees showed greater changes in self-perceptions could be perhaps attributed to quality of the mentor. To help ensure treatment fidelity, many things were done to control for mentor differences throughout semester. Strategies to help control fidelity included, sharing experiences at weekly training, recording a challenge session and giving feedback to mentor, turning in weekly activity/heart rate/weight sheets, as well as CARE tables, and having a graduate student at all exercise sessions, but mentor quality remains to be a confounding variable.

The last limitation to consider is the variability in participants' self-esteem at baseline. It is possible that participants with higher esteem would not have as much room for increase, thus attenuating the potential changes in self-esteem across the entire sample. The decision to exclude such participants with high esteem was not carried out because the purpose of the paper was to improve self-esteem and all participants had potential to improve self-perceptions at baseline testing. If those participants were excluded, our study would target solely individuals with "low" self-esteem, and our purpose was to target weight management, physical activity, and nutrition in all overweight adolescent participants.

Although the study had several limitations, it is better represented by its strengths. One of its strengths of the current study is evaluating both psychological and physiological variables. Having both kinds of variables are absolutely necessary to help provide a comprehensive understanding of changes specific to each participant and each testing time point. For example, while perceived physical condition improved for both groups from baseline to post-testing, the intervention group actually improved in levels of physical activity and aerobic fitness, and the control group showed no change in physical activity levels and had a decrease in aerobic fitness. By having both types of variables, the interpretation changes slightly by suggesting that physical self-perceptions don't always match actual physical ability. While positive physical self-perceptions are important for mental well being (Fox, 2000), positive physiological factors (aerobic fitness, body composition, physical activity) are important for physical health. Thus, having both a psychological and physiological approach is imperative.

Another strength of the study was the ease and feasibility of implementing it in various settings. Even further, the current study extends previous literature by evidencing the success of peer mentoring in an adolescent exercise intervention. Previous research has demonstrated success in health-related studies (Buman, 2009; Dorgo, 2009), but to our knowledge, there is a little research supporting adolescent peer mentoring, delivered by undergraduate college students, in an exercise setting. Black and colleagues (2010) used college students as mentors for obese adolescents, however their intervention was based in a community setting and focused heavily on nutrition, rather than splitting time between nutrition, physical activity, and behavior modification strategies. Using undergraduate college students as mentors is an economical approach to mentoring in which many universities could utilize. Because of the abundance of exercise science programs in the United States, many adolescents could benefit from a program such as the intervention described. By using college students as mentors, the students are also gaining experience that will help them in their careers as health/fitness professionals.

While the study had limitations and strengths, it is important to evaluate the next step in this growing body of research. Future directions should include utilizing a two-semester, or 28 week, intervention to assess if successes are better maintained at follow-up testing. Using a longer intervention would give participants more time to learn self-regulatory skills (goal-setting, self-monitoring physical activity and healthy eating, utilizing a social support group, and overcoming barriers to physical activity and healthy eating), how to design and implement at-home activities, and planning for how they are going to maintain success at the completion of the program.

Secondly, it may be important to evaluate if baseline self-perceptions are a predictor of intervention success and maintenance. Maintenance will be challenging if adolescents lack attractive activity options following the completion of a structured program therefore, further research should also include a family component, which would involve family members in a shared process with the participants. Because adolescents are still living at home, much of their everyday behavior reflects their home life, which includes physical activity and eating habits. In the future, it would also be important to collect qualitative data to provide supplemental support for the results. Because of the limitations of only group comparisons, the qualitative data would allow for individual results to be evaluated as well. Even though we tried to control for mentor variation with weekly sheets to turn in and recording one of their weekly challenge sessions, the qualitative data would delve deeper into the quality of mentor delivery, rather than relying on a single questionnaire at post-testing.

Chapter 5: Conclusion

This study was designed to offer insight into how exercise interventions for overweight adolescents may improve self-perceptions, body composition, aerobic fitness, and physical activity levels. Findings suggest such interventions warrant positive, short-term changes in self-perceptions, body composition, aerobic fitness, and physical activity levels. However, future interventions should pay additional attention to maintenance behaviors for long-term success. Furthermore, this program specifically, has the potential to promote growth in both the physical and psychological domains, and should justify further research.

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APPENDIX

EAST CAROLINA UNIVERSITY
University & Medical Center Institutional Review Board Office
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600 Moye Boulevard · Greenville, NC 27834
Office **252-744-2914** · Fax **252-744-2284** · www.ecu.edu/irb

Notification of Continuing Review Approval

From: Biomedical IRB
To: Thomas Raedeke
CC:
Date: 8/8/2012
Re: CR00000464
UMCIRB 10-0362
[IMPORTED] Project MENTOR: Exercise and Sport Science Students as the Agent of Change in an Adolescent Weight Management Intervention.

I am pleased to inform you that at the convened meeting of the Biomedical IRB on 8/8/2012, this research study underwent a continuing review and the committee voted to approve the study. Approval of the study and the consent form(s) is for the period of 8/8/2012 to 8/7/2013.

The Biomedical IRB deemed this study Greater than Minimal Risk.

Changes to this approved research may not be initiated without UMCIRB review except when necessary to eliminate an apparent immediate hazard to the participant. All unanticipated problems involving risks to participants and others must be promptly reported to the UMCIRB. The investigator must submit a continuing review/closure application to the UMCIRB prior to the date of study expiration. The investigator must adhere to all reporting requirements for this study.

The approval includes the following items:

Name	Description	Modified	Version
AASP grant final.doc	Study Protocol or Grant Application	7/2/2012 12:26 PM	0.01
Assent child	Consent Forms	7/2/2012 12:36 PM	0.01
Barriers to Physical Activity Questionnaire & Social Anxiety Scale for Adolescents	Surveys and Questionnaires	12/12/2011 11:49 AM	0.01
Consent 18years of age	Consent Forms	7/2/2012 12:36 PM	0.01
		7/2/2012 12:35	

Consent-Parent	Consent Forms	7/2/2012 12:55 PM	0.01
Demographics	Surveys and Questionnaires	12/8/2011 5:17 PM	0.01
Doctor letter.pdf	Additional Items	1/3/2012 10:54 AM	0.01
DXA Risk Statement and Questionnaire.pdf	Surveys and Questionnaires	1/3/2012 10:53 AM	0.01
Final Revised Flyer.pub	Recruitment Documents/Scripts	12/9/2011 4:02 PM	0.01
Flier	Recruitment Documents/Scripts	12/9/2011 4:00 PM	0.01
iMedical history.pdf	Surveys and Questionnaires	12/9/2011 4:04 PM	0.01
Mentor survey.pdf	Surveys and Questionnaires	1/3/2012 10:52 AM	0.01
Multidimensional Scale of Perceived Social Support	Surveys and Questionnaires	12/12/2011 11:50 AM	0.01
PARTS	Surveys and Questionnaires	12/8/2011 5:18 PM	0.01
RDA 2010-11 template.pdf	Study Protocol or Grant Application	12/9/2011 3:58 PM	0.01
Revised protocol Sept 29, 2010	Study Protocol or Grant Application	12/8/2011 4:52 PM	0.02
SDTneeds	Surveys and Questionnaires	12/8/2011 5:18 PM	0.01
SocialCognitive	Surveys and Questionnaires	12/8/2011 5:18 PM	0.01

The following UMCIRB members were recused for reasons of potential for Conflict of Interest on this research study: None

The following UMCIRB members with a potential Conflict of Interest did not attend this IRB meeting: None

IRB00000705 East Carolina U IRB #1 (Biomedical) IORG0000418
IRB00003781 East Carolina U IRB #2 (Behavioral/SS) IORG0000418 IRB00004973