The Relationship Between Resistance Training Body Composition and Self-Esteem in Adolescents

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Abstract

Introduction: Childhood obesity and mental health continue to be a growing concern. Today, children are exposed to technology and other gadgets increasing their opportunities to be sedentary thus, children's lack of physical activity, could increase negative self-esteem reports. Because of this, engaging in an active lifestyle may help improve self-esteem in adolescents. **Purpose:** The purpose of this study is to assess how body composition and physical activity relates to self-esteem within adolescents. **Methods:** The study was completed following 15 weeks. A total sample of 44 (28 boys, 16 girls) subjects gave assent and parental consent to be included in the study. Students participated in various weightlifting classes in which they completed three mesocycles of resistance training during the semester. To test pre and post variables, Bioelectrical Impedance Analyzers (BIA) were used to assess body composition (BC). Self-esteem (SE) was measured by the Rosenburg Self-esteem Scale. A Digital Hand Dynamometer was be used to assess the effect of resistance training on student's handgrip strength (HGS). **Results:** Due to unequal sample-sizes between genders, the primary statistics of this study were assessed as an independent *t*-test (collapsed across gender). Results revealed no significant difference for BC or HGS ($p = 0.171 – 0.619$), however, there was a significant difference between pre and post-test for SE ($p = 0.001$). Pre versus post SE mean was 26.68 and 30.36 respectively. Additionally independent *t*-tests were assessed per gender. For females, no significance was observed for any variables ($p = 0.059 – 0.729$). For males, no differences were seen for FM or HGS ($p = 0.161 – 0.687$), however, there was a significant difference for SE ($p = 0.004$). Lastly, a Pearson Correlation Coefficient was used to examine the relationships between FM, HGS and SE. Results from Pearson Correlation Coefficient test revealed no significant differences ($p = 0.281 – 0.455$) or effect sizes (-.116 - .100). **Conclusion:** The present findings

suggest that structured physical activity, can have a positive outcome on high-school aged self-esteem values. While no significant differences were observed for body composition, or hand grip strength, it is possible that engaging in structured physical activity can increase adolescents' self-esteem. Statistics suggest that males positive SE could be attributed to structured physical activity, however, more studies are needed to support this theory.

Chapter 1: Introduction

Background and Significance

Comparisons to one's peers could have an impact on the mental health and confidence of adolescents. Specifically, self-esteem (SE) is defined as confidence in one's own worth or abilities (Neauman, 2013). This view of one's self can be a negative or positive perspective. Once formed, this disorder can affect many thoughts creating false assumptions, and self-defeating views. SE has been linked to suicide ideation and is associated with anxiety, depression, and academic stress, all of which have a negative impact on students' quality of life (Nguyen et al., 2019). In studies that will be referenced, body composition, and physical activity are also related to the SE in college aged students, adults, and older adult populations. One cohort that has been shown to have lower SE is obese populations (Trzesniewski et al., 2006). Interestingly, in a study comparing obesity rates in adolescents from 1978 to 2016, it was shown that obesity rates rose from 5% to 18.9% (CDC, 2022). With these findings, more attention from health professionals should be given to adolescent populations, since this age group is susceptible to positive or negative health behaviors (Frech, 2012).

A lack of physical activity is considered being sedentary. During this time the body is stagnant, not engaging in any form of physical activity or movement produced by the skeletal muscle resulting in little energy expenditure (Piggin, 2020). With lower physical activity rates, increased body composition could cause negative outcomes on one's overall health, which can result in increased rates of injury, and susceptibility to early mortality. If this trend continues, it is plausible that adolescence could be setting themselves up for negative health outcomes, especially obesity, in the future.

Body composition, or the water, minerals, bone and muscles that make up the human body has been shown to be a factor that could affect SE directly (Borga et al., 2018). Specifically, it is plausible that there is a direct relationship physical activity levels and SE. Past studies have shown there is a relationship between physical activity and body composition, however few studies have looked at this relationship in adolescents while using resistance training as the form of physical activity. (Dąbrowska-Galas & Dąbrowska, 2021; Coyne & Woodruff, 2020). While the literature suggests lower physical-activity rates are related to higher body composition numbers (Dewi et al., 2021), the studies that analyzed the relationship of these variables did so using non adolescent populations (adult, older adults, and college aged populations). It is important to also note that in these previous studies, cardiovascular workout interventions were the primary workouts given. Furthermore, some did not use any physical training programs, and had their participants' rate their activity levels by answering confidential surveys. This method could lead to biased results. Lastly, it is important to note that no performance tests were performed during these said studies.

Furthermore, these previous studies had certified fitness professionals monitoring, creating, or proctoring the exercise programs, however the workouts were not extensive or progressive. Workouts generally consisted of one moderate to vigorous bout of cardiovascular exercise that was performed a one to three times a week. Changes in SE and BC were seen with this design, however an attempt should be made to provide more extensive and progressive workouts to see what effect the variety of exercise selection hason SE and BC. It may be possible that the variety of movements will allow for positive adaptions per the muscle group, or energy systems being trained.

With proper coaching, participants can gain the associated benefits of resistance training which include reduced risk of cardiovascular disease, cancer, diabetes, low density lipoproteins, cholesterol levels and improved body composition (Momma et al., 2022). These factors are relevant, specifically body composition, because it has been shown in other populations to have a relationship with SE (Borga et al., 2018). To gain these benefits adolescents must be introduced to this style of physical activity properly. Authors from *Long Term Athlete Development* state the kids should focus on having an active start by engaging in recreational sports which will then introduce them to "Learn to Train" stage (Balyi et al., 2005). During this stage, adolescent children are shown how to practice proper mechanics while keeping the activities fun to prevent boredom, or redundancy. Only then will children choose to enter the next stage, "Train to Train". By this stage children are more likely to continue to engage in physical activity, which can lead into continued physical activity rates as they get older (Balyi et al., 2005).

With the current state of obesity for children aged 2-19 at 19.7% a priority should be made to take the necessary steps to build healthy habits (specifically their physical activity) in our adolescent children (CDC, 2022). It is reported that presently, only 20% of teenagers are achieving the recommended 60 minutes of physical activity a day (CDC, 2022). Furthermore, only 15% of children walk or bike to school, and once they arrive at school, an even smaller number of children have a daily physical activity course in their school schedule (Sigelman & Rider, 2022). In summary, the literature is suggesting that physical activity rates, and one's motivation to participate or engage in physical activity continues to decline across the decades.

Adolescent children can obtain benefits from resistance training that include a potential decrease in body fat, improvement in insulin sensitivity, enhanced cardiac function and reduced

injuries during sport and recreational activities (Haff et al., 2021). Recent research shows a decrease in various cohorts of school aged children's range of muscular strength measurements (bent arm hang, handgrip strength) (Masanovic et al., 2020). Masanovic's team of researchers measured different aspects of physical fitness from 1969-2017. Results showed that adolescent physical fitness has decreased over time. The study suggests children's change in lifestyle is a cause for the decreasing trend (physical inactivity, increased screen time;(Masanovic et al., 2020). Though aspiring young student athletes may benefit from resistance training, it seems the ones who may benefit the most are the ones who begin exercise programs with no resistance training or exercise experience.

Resistance training is crucial for children due to the enhancement of bone mineral density, or the amount of minerals (mostly calcium and phosphorous) contained in a certain volume of bone (NCI, 2023). This measure can help detect the risk level of a bone breaking. This is especially important for females who are at risk for developing osteoporosis (a low bone mineral density) later in life. Though all sport related injuries are not preventable, resistance training can help load bone, muscle tissue, joints, and ligaments so they are more suited to handle the higher forces they will be placed under during daily activities (Haff et al., 2021). Thus, it is vital to teach younger aged individuals the importance of resistance training, and the positive impacts it can have on their self-esteem as they get older if they choose to manage it well.

Purpose and Hypothesis

Though previous literature has shown a relationship with body composition and SE in other populations, gaps within these studies still exist. After reviewing literature and seeing how

the relationship between SE, physical activity, and body composition can be assessed differently, the goal of this study was to assess if a controlled resistance training (using 3-different mesocycles throughout a semester), causes changes in body composition, hand grip strength, and SE in adolescents. It is hypothesized that the training program will have a positive effect on the body composition, hand grip strength, and SE in adolescents.

Limitations and Delimitations

This study has limitations that include, participants attendance, high researcher to participant ratio, and program adherence. Attendance cannot be controlled due to some students getting sick, leaving early for activities, skipping class, doctor's appointments, etc. Besides marking the participants absent, there is no ethical way to ensure the participants have perfect attendance during this study. To navigate attendance and participation, a student who accumulates seven or more absences will be removed from the study. It is understood that the variance in attendance could impact the results of the study.

The participant to researcher ratio could cause trouble depending on how many students enroll and decide to participate in the study. With higher numbers, tracking participants' progress and keeping training session organized can be difficult. Program adherence was directly affected by MSM's academic schedule (vacations, snow days, assemblies). A total of 11 days were affected causing shorter training sessions, or complete change in workout design (physical games instead of resistance training). Injured participants will be told to work opposing muscle that aren't injured. Making this adjustment will cause participants to fall behind in the program and alter results.

Furthermore, this study will not track nutritional intake (diets), nor their physical activity done outside of the training sessions. There is no registered dietitian that is a part of this study. Legally, for this reason diets cannot be tracked. This can become a factor if someone eats a healthier diet and accomplishes a more significant body composition transformation. Analyzed relationships could become biased towards the participants who had a balanced diet (a diet that contains food from all food groups (fruits, vegetables, grains, diary and protein). Tracking all physical activity is nearly impossible with one researcher. Self-reporting of physical activity requires reliance on the honesty and discipline of the high school participants to track their time and intensity. Some students may play other sports outside of school, which could impact the results of these three variables and, therefore, confound results.

Operational Definitions

- **Handheld Grip Dynamometer (HGD):** This gauge measures handgrip strength in kilograms or pounds based on the amount of tension produced in a steel spring. It has two handles, and depending on the size of the hand, the space between the handles can be changed (Lee & Gong, 2020). Although there are slightly different models of HGDs, high correlation coefficients have been in many studies (Lee & Gong, 2020). A study run by Wind demonstrated a significant relationship between overall muscle strength and grip strength (Wind et al., 2009). As a result, grip strength was employed as an all-purpose gauge of muscular strength for pre and post testing.
- **Bioelectrical Impedance Analysis (BIA):** A technique for calculating body composition is BIA. Finding the electric impedance of an electric current flowing through the body is

the basic idea behind BIA (Walter-Kroker et al., 2011). Resistance and reactance are the two halves of the electrical impedance. Resistance measures the entire amount of body water, whereas reactance measures the mass of body cells (Walter-Kroker et al., 2011). Several BIA characteristics (fat mass, body mass index, etc.) can be inferred from the determined impedance.

- **Resistance Training:** the use of external load to provide a progressive overload in order to increase muscle size and strength (Phillips & Winett, 2010).

- **Training Age:** The amount of relevant experience a person has in a particular field of expertise, or anything else requiring competence, can be thought of as training age (Pritchard, 2022). For the purpose of this article, the training age will be considered the level of expertise a student has in resistance training**.**
- **Rosenburg Self-Esteem Scale:** The 10 item RSE scale is used to assess self-esteem. The instrument was initially created to gauge high school students' self-esteem. However, since its creation, the scale has been applied to a wide range of populations, including adults, for which norms are available. (Ciarrochi et al., 2006)
- **Self-Esteem**: Confidence in ones one abilities, self-worth (Magnusson & Nermo, 2018)
- **Body Composition:** the water, minerals, bone and muscles that make up the human body has been shown to be a factor that could affect self-esteem directly (Borga et al., 2018).
- **Strength Training:** increasing the body's ability to produce force. This is notably accomplished by performing resistance training (Clayton, 2015).

- **Hypertrophy Training:** is the rise in the number and/or size of myofibrils (actin and myosin) within a certain muscle fiber that causes an increase in the size of a muscle or its cross-sectional area (Clayton, 2015).
- **Mesocycle**: is a specific training block that is intended to achieve a certain goal and is often composed of three to four microcycles (three to four weeks) (Bannister, 2015). A mesocycle is made up of several consecutive weeks (microcycles), each of which focuses on developing a particular physical adaptation, such as maximum strength, static strength, or maximum speed (Bannister, 2015).

Chapter 2: Systematic Literature Review

Introduction

Self-esteem has been a topic of interest for psychologists for many years. Today many Americans, particularly adolescents, are trying to find ways to improve their SE and find a sense of being (Magnusson & Nermo, 2018). SE, defined as a person's self-worth, has been associated with several adaptive outcomes (Du et al., 2017). One outcome linked to SE is body composition, or the amount of water, muscle, fat, bone, and minerals that make up the human body (Borga et al., 2018). Presently, adolescents are spending more time being sedentary (because of using technology), resulting in negative body composition outcomes. This negative effect can cause children to accumulate more fat mass over time, which could negatively affect their SE. It is suggested that individuals with low SE are likely to turn to negative behaviors in order to fill a void associated with their feelings. With more than 40% of middle and high school boys exercising with the goal to increase muscle mass (Quenqua, 2012), and girl's SE being more correlated to the way they view their body (Linton, 2015) it is hypothesized that body composition, and physical activity are strongly correlated to SE. Therefore, this literature review will dive deeper into the relationship between SE, physical activity, and body composition. First, the overall methods of the articles will be reviewed. Similarities, and unique differences between the studies operations will be analyzed including inclusion and exclusion criteria. Next, the discussion will follow. In this section, the review will look at the overall conclusions the articles came to concerning the relationship between body composition, physical activity, and SE. Lastly, the conclusion will discuss the take home message, inclusions, limitations, gaps found within the studies, and addressing where future studies could focus to broaden the knowledge regarding the relationships between the variables.

Methods

Inclusion Criteria

The goal was to investigate the relationship between body composition, physical activity, and self-esteem. For my thesis, all research, and relevant articles were found using the University of Central Oklahoma's (UCO) database and Google Scholar. Key search terms used included: *body composition, body image, self-esteem, adolescent, and physical activity*. Since minimal research has been done on adolescent populations my literature review incorporated all ages. This wide range helped gain a better understanding on how body composition or physical activity effected different population's self-esteem. Additionally previous literature needed to assess SE, and have form of physical activity (aerobic, resistance, Pilates, yoga etc.).

Exclusion Criteria

While reviewing studies there was criteria that needed to be filtered to help provide a clearer understanding. Articles that were published before 2016 were not used due to recent research needed for this review. Articles that used less that ten participants were excluded. This helped provide a better understanding of the study to limit bias results. Studies that looked at more than ten variables were also excluded.

Quality Criteria

All articles reviewed focused on similar variables (body composition, physical activity, and SE). Although some studies did not assess all three, SE or self-worth was assessed in all studies whether they looked at body composition and/or physical activity. Most studies used the Rosenburg Self-Esteem Survey to assess SE. (Rosenburg Self-Esteem Survey, BMI, Weight

Self-Stigma Questionnaire, and anthropometric measurements). All research ran ethical methods during their studies. All conclusions made were tide back to their research questions studying SE.

Results

Zamani, Fathirezaie, Brand, Pühse, Holsboer-Trachsler, Gerber, and Talepasand analyzed the relationship between physical activity (PA), self-esteem (SE), while body image (BI), and perceived physical fitness (PPF) in 20–60-year-old participants. The goal was to see how closely physical activity influenced self-esteem. Results indicated there were significant relationships between all the variables. Their first hypothesis stated, higher PA levels would be associated with higher SE. While the second hypothesis suggested greater PA would be associated with more positive BI, lower BMI levels.

In agreement with their first hypothesis, there was a positive correlation between PA and SE ($\beta = 0.42$, $p < 0.001$). A negative correlation between PA and BMI was discovered, supporting their second hypothesis, indicating that those who were physically active thought they were more physically fit. Support was also observed for the second hypothesis, which predicted that PA and BI would not correlate favorably. BMI was closely associated with BI ($\beta = 0.71$, $p < 0.001$), while the direct path from PA to BI was nonsignificant.

Rodgers and his team of researchers analyzed the relationships over time between media exposure, body mass index (BMI) adjusted for child age and gender, and preconceptions about body size in young girls aged 3-5. Parents of the children recorded the data of how many hours their child watch media daily over the course of 3 year. After each year the hours were averaged and labeled “Time”. Cross sectional, and descriptive statistics were used to show that media

exposure was associated with higher BMI at Time 1 (year 1) *(r = .23, p = .009)* and Time 3 (year 3) *(r = .20, p =.022)* (Rodgers et al., 2017). Girls at Time 2 and Time 3 were more likely to attribute good traits to thinner figures (positive size stereotypes; *r* = - .*21, p* = 2017). Higher BMI was predicted by more media exposure. However, this relationship was statistically significant between measures at ages 4 and 5, not between ages 3 and 4, indicating that the relationship may become stronger during this time and more obvious by age 5. This conclusion could be due to children getting older and finding a greater association with media exposure. An interesting finding from the present study was as the participants got older the relationship between media exposure and a higher BMI became more apparent in girls.

Ciccolo, Santa Barbara, Dunsiger, Busch, & Bartholomew (2016) investigated the association between maximal muscular strength and global SE. Participants included 95 men and 31 women aged 18-31 years. The Rosenberg Self-Esteem Scale, BMI, body fat percentage, and handgrip was assessed. For all individuals, the mean SE score was *33.1*. The average SE score for male participants was *33.4*, which did not statistically differ from the average SE score for female participants *(p = 0.21),* which was 32.1 (Ciccolo et al., 2016). Interestingly there was a significant association between SE score and maximal handgrip *(rho = 0.21, p = 0.02)* and SE and 1-RM squat *(rho = 0.18, p = 0.047)* among the subjects in the combined sample (Ciccolo et al., 2016). Males' SE scores significantly correlated with their maximum handgrip *(rho = 0.27, p = 0.01)* and 1-RM squats *(rho = 0.21, p = 0.04)* (Ciccolo et al., 2016). SE, however, did not significantly correspond with any of the characteristics considered among females. Comparing these findings to the previous studies it can be inferred that maximal strength is strongly correlated with SE in males, while SE and body composition may have a stronger correlation within females.

Inwoo Kim and Jihoon Ahn looked at the effect of physical self-concept changed by participation in exercise on the changes in SE and mental health in university students. Before and after the 6-week exercise program a survey was taken analyzing SE within the participants. After the program, SE *($\beta = 0.506$, $p < 0.01$)* and physical self-concept *($\beta = 0.287$, $p < 0.05$)*, respectively, it was found that the degree of change in physical self-concept (an individual's perception of themselves in areas of physical ability and appearance) strongly predicted the amount of change in SE. One of the significant aspects influencing overall SE, which is recognized as a necessary component of a happy existence, is physical self-concept. According to the researchers, exercise can result in happiness since it aids in the development of a positive physical self-concept. Additionally, it was discovered that the degree of change in SE strongly predicted the degree of improvement in mental health *($\beta = 0.565$, p 0.01)*.

Juliano Guimarães and his team aimed to assess if a yoga program was beneficial at raising seniors' SE and self-image (SI). To assess SE and SI a Steglich questionnaire was used pre and post intervention. The cut-off points for the questionnaire's SE categories were Low (41 and 163 points) and High (164 and 205 points). This was different from the Rosenburg Self-Esteem Scale as it was created in Brazil. The yoga program ran for 3 months and required the participants to attend sixty-minute classes 3 times per week. To compare the means of SE and SI a two-way ANOVA was used. In the first assessment of SE the control group scored a mean of 107 points, and the experimental group had 129 points. After the post evaluation the control group scored 117 while the experimental group score 157. Theses results show that using yoga as a form of physical activity can improve the SE in elderly *populations ($F = 48.78$; $p < 0.001$)*.

Thakur, Basu, Joshi, and Namrata aimed to investigate the differences in self-compassion and SE between adolescents who exercise physically in a gym and those who don't participate in

any such activities and lead sedentary lifestyles. Adolescents between the ages of 14 and 19 made up the two groups. One group was made up of people who worked out in the gym to get their physical activity in (n=30). Those who lived sedentary lifestyles made up the other group (n = 30). Both groups took the Rosenburg Self-Esteem Tests prior to starting the study. After completion of the study, results showed a significant difference for the SE in the groups who engaged in physical activity versus those who led sedentary lifestyles had a mean of *28.2 and 21.7*, respectively. These findings indicate great potential for the concepts of SE and self-compassion in fostering a positive self-concept in adolescent exercisers.

The Effects of Physical Activity on Self-Esteem

Based upon previous literature, it is highly suggested that increased levels of physical activity, relate to greater SE. Researchers in these studies often found that participants felt better after movement or exercise. Referencing to women, especially those who are considered middle aged, stated their SE improved after engaging in physical activity (Dąbrowska-Galas & Dąbrowska, 2021; Coyne & Woodruff, 2020). Conversely, when adolescents are sedentary, specifically time watching media, it was reported that SE went down (Rodgers et al., 2017). Similarly, when no exercise programming was allowed for Greek inmates lower SE scores was reported (Psychou et al., 2019). Thus, the direct decision to not perform exercise, or the inability perform physical activity could be a detriment to one's SE.

It is important to note there were variations of physical activity within the studies. Some participants used physical education classes, and some were a part of group led activities. It was interesting to find that other unique styles of exercise had similar effects on SE. For instance, in a study conducted by Andrade, teachers allowed students to have a choice to play video games that

required physical activity in order to participate called exergames (Nintendo Wii, dance machines) during their physical education classes or participate in the normal physical education curriculum. Both boys and girls experienced higher levels of SE in both sample groups (Andrade et al., 2020). The girls who participated in exergames had slightly higher results for SE compared to the boys. However, this could have been due to the competitive nature of the boys. Similarly, yoga was also shown to improve SE in elderly women (Guimaras et al., 2020) Although it may seem impossible to test all forms of physical activity, it can be concluded that most forms of exercise can be used to improve the SE in a wide range of populations.

The Effects of Body Composition on Self-Esteem

To see changes in body composition (BC) one must continuously participate in physical activity consistently over an extended period (Joensuu et al., 2020). In the studies that looked at BC, it was common to see studies ran over a longer period. Whether the correlation was negative or positive, BC had a strong correlation to SE. In parallel to physical activity, studies showed multiple styles of physical activity like Pilates and high intensity interval exercise can have positive effects on women's body composition while also improving SE (Auguntari et al., 2017; Levent et al., 2020). Therefore, it is suggested that the styles of physical activity do not have to be intense, however they must be consistent and given adequate time to see how changes in body composition effect SE.

It is important to note that body mass index (BMI) can be expressed as body composition in the literature. Additionally, some researchers used this to study its effect on body image acceptance. The women had more of a negative view of their body image compared to them in other studies (Laudańska-Krzemińska et al., 2020). One would expect the overweight or obese

participants to have to this implication, however it was the underweight female participants who were unsatisfied with their body image (POP, 2016). POP stated that, “46% of the underweight participants were not satisfied with their body image.”. In this study they found that body image was more correlated to SE than BMI. Therefore, analyzing these results, BMI may not cause someone to have a lower view of themself, often it is the way one sees themself in the mirror.

Furthermore, not all studies looking at body composition had the same effects on SE. A cultural difference is a variable that should gain some attention when correlating BC to SE (Alameri et al., 2017). It has been shown that even with changes in BC, SE may not change. For example, in Saudi Arabia, women might not care about their BC since they have a different standard to dress more modestly.

In conclusion, BC and physical activity are strongly correlated to SE. In some cases, physical activity can also improve physical self-concept and SE (Kim & Ahn, 2021). Generally, as one variable worsens, so does the other. With the wide range of participants, this concept can be applied to different sample type, and the same outcome could occur.

Limitation and Gaps

Physical activity has been shown to improve SE and BC, however not much research was done to see how organized resistance, and plyometric training may affect SE in adolescents. Cardiorespiratory fitness (CF) was seen to be positively correlated to SE (Petrovics et al., 2021). The better the performances were during the 20m shuttle run test the higher the SE scores were among the participants. It should be understood this test is not a valid indication of CF. The 20m shuttle run is a test for quickness and change of direction (Haff et al., 2016). This may be an indication that certified fitness professionals were not running the tests during the study. Moreover, these results show that improvements in field tests are also correlated with SE.

Continuing, some of the studies did not have their participants participate in physical activity (PA). Instead, these participants were given surveys which allowed them to report their own physical activity levels throughout the study (Sani et al., 2016; Shang et al., 2021; Reddon et al., 2017). False answers could have been a factor with the results. If participants are reporting higher PA times than what they are engaging in, then the conclusion will not hold the same meaning. To help ensure results are more valid, observation, and coaching while PA is going on may be appropriate.

Adding on, a common limitation amongst the studies was the use of cross-sectional studies. Though they are convenient for quick studies to be ran, the participants often volunteer to participate after surveys were given out asking people to join. This caused some studies to have a bias in their results. For instance, participants were gathered from a second-grade class (Russo et al., 2019). The adolescents involved in this study may have gained interest to volunteer once they found out through the survey that physical activity was going to be involved. The student who did not enjoy PA as much may have opted not to participate leaving more physically fit participants in the study.

Conclusion

Physical activity and BC have a strong correlation to SE. Based on the results in the studies presented above, these variables directly impact each other. An interesting finding revealed that overweight, obese, and female participants usually had lower SE when it came to their performance (resistance, cardiovascular), and body image (Aldhahi et al., 2022; Smith et al., 2018). It was suggested that cultural differences could have played a factor in women of eastern civilization stating they worried less about body composition, however no other studies investigated why women in western civilization are affected by their BC (Division of Adolescent and School Health, 2020).

Furthermore, though resistance training studies were harder to come by results showed that women and overweight participants had higher SE compared to BC during their pre-tests. Women's results showed that maximal strength or resistance training didn't affect their SE as much, compared to men (Ciccolo et al., 2016; Bolados et al., 2021). Overweight and obese participants often felt better about their SE while participating in resistance training.

While most of the previous literature looked at a variety of populations and ages, there are small amounts of publications relating to SE, physical activity, and adolescents. Referring to the studies who did use children, no organized exercise prescription was given by a professional. Studies had adolescents follow the lead of a teacher or had free time during a P.E. class. Resistance training used as physical activity was nonexistent in this population. Not having exercise professionals to run the physical activity may have been a factor. It takes time, and knowledge to teach young student to lift weights properly, and safely. Additionally, studies were not long enough to go through a process of adaption; therefore, results would not have been as strong if body composition was analyzed. This may lead to why nobody compositions were analyzed in studies involving children. More professional help would be needed to get accurate measurements of BC. Instead, in the studies that used adolescents, researchers just tracked the relationship between physical activity, and SE.

While each study had their own unique conclusion, a general concept remained the same, physical activity, and BC effects a wide range of different populations. Though the findings remained consist, more future studies should look to implement resistance and plyometric training on adolescents to see the effects it may cause on SE. Adolescents should be taught these concepts at their early age because it will build healthier habits for them to build on as they age (Faigenbaum, 2018).

Chapter 3: Methodology

Participants

The present study included boys and girls aged 14-18 at Mount St. Mary high school (MSM) who were recruited from various sections of weightlifting and physical education (PE) classes. The total population from all weightlifting and PE sections was 77 (57% boys, 38% girls). Students who received more than 7 absences or were not able to train due to a chronic injury were dropped from the study. Student who wanted to participate in the study had to turn in a parent consent and child assent form. After students turned in the necessary forms and granted permission for their data from the semester to be used form for the study, a total sample of 44 participants met the requirements to be included in the study (28 boys (63%), and 16 girls (36%)).

Procedures

The study followed the curriculum for physical education/weightlifting at Mount St. Mary. The study ran a total of 15 weeks. The weeks consisted of 3 weeks of testing, and 12 weeks of scheduled training. Participants trained 1-3 times per week depending on the school schedule (A/B Day schedule). A planned break took place during specific times of the semester (Martin Luther King Jr. Day, Presidents Day, Spring Break, Good Friday). During the study there were weather related breaks causing school to be out during these times, no make-up workouts were assigned. This turned out be a total of 11 missed days due to holidays, and snow days. This caused some mesocycles to be shortened to stay on track with programming. On days when weather permitted exercise outside, adjustments were made to programming. These adjustments included physical games, or shorter sprints on the basketball court instead of the football field to stay consistent with anerobic stimuluses. Games included relay races, dodgeball, and medicine ball volleyball. Lastly, the workouts done outside of school by the students were not tracked.

To start, the baseline variables of SE, (BC), hand grip strength (HGS), estimated one repetition maximums (1RM) in the barbell squat, bench press, barbell deadlift, and hex bar deadlift were assessed during the first 2 weeks of the semester. During these weeks no resistance training was done, therefore week 3 was the first week students performed structured exercises.

For the resistance training portion of the program, the mesocycle protocols consisted of hypertrophy and strength phases. The mesocycles lasted approximately four weeks each with a deload week being performed on the fourth week. The goal of the first cycle was to introduce the participants to resistance training. During this phase participants learned the "first pull" of a clean ultimately performing a deadlift. Students then learned the foundational mechanics of the bench press and barbell squat. While performing these movements (squat and bench press), a hypertrophy training stimulus was prescribed. Repetitions (rep) ranges consisted of 8-12 at 67.5%-85% 1RM. Hypertrophy style training allowed novice participants to safely exercise under moderate loads while learning how to use percentage charts, thus increasing their training age. This lowered the risk of injury, potentially allowing them to become more comfortable during the movements, allowing for an easier transition into more intense loads during the strength phase. During the second mesocycle the goal was to introduce participants to new variations of the primary movements (back squat/front squat, bench press/incline press, first pull/Romanian deadlift/hang pull). The second mesocycle used a more intense hypertrophy phase with reps consisting of 6-8 at 72.5%-85% 1RM to prescribe a progressive overload. Lastly during the third cycle subjects participated in another strength and power phase. The goal of this cycle was to peak for end of semester testing for the back squat and bench press. Another goal was to learn the hang clean, and put all the Olympic progressions they were taught throughout the semester togethers. During this cycle rep ranges consisted of 2-4 reps at 85%-90% 1RM for the strength sessions, and 75%-85% for the power sessions.

At the conclusion of the training cycles child and parental consent forms were given to the students and parents. Along with these forms, permission was given by the MSM's principal to run the

study on the MSM's campus. Students were given one week to get their forms signed and brought back to participate in the study. Participation in the student does not include any extra activity. Students and parents were simply deciding if the data accumulated from the semester could be used for the study. The student's or parent's decision to participate in the study did not negatively or positively affect the student's grade. During this week post testing was done for BC, SE, and HGS.

Testing and Assessments

Body Composition

To assess body fat percentage a handheld Bioelectrical Impedance Analyzer (BIA) was used. One by one, subjects were instructed to weigh in on a digital scale to obtain their body weight. Once weight was obtained, the subject's height was obtained using a stadiometer. Subjects were then assisted with the operation of the BIA. Once body composition was calculated, body fat percentage was taken to represent BC.

Self-Esteem

Self-esteem was measured using the Rosenberg Self-Esteem scale (RSES). This scale uses a total of ten questions to assess one's SE. Answer choices include, "strongly agree", "agree", "disagree", "strongly disagree". Scores range from 4-40. Scores below 15 are considered "low self-esteem". Scores within 15-25 are considered "normal self-esteem". A score above 25 are considered "high self-esteem. Before students separated throughout the weight room, the researcher read the purpose, and instructions for the RSES. No time limit was given to complete the questionnaire. Students were allowed to score their own questionnaire, however the researcher checked over all scores to lower the chances of invalid scores once RSES were collected.

Handgrip Strength

Handgrip strength was assessed using a handgrip dynamometer and recorded in kg. With the subject's elbow bent at a 90-degree angle, standing with the hand that was examined by their side, without moving their arm, the subjects were instructed to exert as much pressure as they could on the dynamometer. Once the force on the dynamometer became stagnant the subject was instructed to stop. The best out of 3 attempts was used for data analysis.

Statistical Analysis

All statistical tests were carried out by IBM SPSS Statistics Version 24 statistical analysis program with the level of significance measurement set at ($p<0.05$*). All descriptive statistics were used according to the study objectives. Using SPSS, an independent sample *t*-test was used to assess the difference in results for SE, BC, and HGS from pre- to post-test. Due to unequal sample-sizes between genders, the primary statistics of this study were assessed as an independent *t*-test (collapsed across gender). Additionally independent *t*-tests were assessed per gender. Lastly, a Pearson Correlation Coefficient was used to examine the relationships between FM, HGS and SE.

Chapter 4: Results

After post-testing and the collection of consent and assent forms, a sample of 44 subjects ($N = 44$) were used for the study. Of the 44 subjects, males and females accounted for 28 and 16 of the participants, respectively. Using SPSS, an independent samples *t*-test (collapsed across gender) was used to assess the pre vs post testing results for SE, BC, and HGS. SE pre vs. post $p = 0.001$, BC pre vs. post $p = 0.619$, and HGS pre vs. post $p = 0.17$. Analyzing the data, SE was the only significant variable what resulted from the study, $p = 0.001$. Physical activity/resistance training seemed to have a positive effect on participants SE values (26.68 to 30.36). Although BC and HGS changed slightly from 24.8% to 24.06% and 37.9 kg to 41.08 kg (8.4% increase) respectively, these variables were shown to be non-significant.

Additionally independent *t*-tests were assessed per gender. For females, no significance was observed for any variables ($p = 0.059 – 0.729$). For males, no differences were seen for FM or HGS ($p = 0.161 – 0.687$), however, there was a significant difference for SE ($p = 0.004$). Lastly, a Pearson Correlation Coefficient was used to examine the relationships between FM, HGS and SE. Results from Pearson Correlation Coefficient test revealed no significant differences ($p = 0.281 – 0.455$) or effect sizes (-.116 - .100).

Chapter 5: Discussion

The primary purpose of this study was to assess how structured resistance training can influence HGS, BC, and SE in adolescent high-school students. The present study observed a significant difference in SE, but no differences for BC or HGS. These results may suggest that resistance training, and the engagement of physical activity can increase one's SE, even though HGS and BC may not change.

Self-Esteem in Adolescence

The results for BC ($p = 0.619$) and HGS ($p = 0.171$) revealed there were no significant differences based upon the training intervention. Though there were raw value changes for both HGS and BC (compared to baseline), it is plausible that the minute changes in BC and HGS did influence the subjects SE since SE was significantly different post-intervention ($p = 0.001$). It is important to note that this study did not look at the effects of resistance training on boys and girls separately, however, it was clear that boys did have more subjects who increased their body weight compared to girls (22 vs. 3). This inference is common with other findings in previous studies suggesting body composition goals and/or self-image may be different for each sex (Guimarães et al., 2020). For the present study, we found that 6 boys and 13 girls managed to decrease their body weight.

The increase in training age through the semester may have had an impact on SE being significant. The results for BC ($p = 0.619$) and HGS ($p = 0.171$) were shown to be not significant. This may suggest there is an underlying variable (training age) that may have had an impact on SE. With majority of the subjects being novice toward resistance training that was a clear learning curve that the subjects had to overcome. The gain in training age may have increased their confidence thus increasing their SE.

Body Composition and Hand Grip Strength with Resistance Training

The positive changes in average HGS (37.9 kg to 41.08 kg) shows that staying on a consistent resistance training program with proper progressions can improve the strength of adolescence. The

inconsistent adherence to the NSCA's strength training protocols for the present study could have related to the non-significant findings on the student's strength gains (weather, school programs, federal holidays). One limitation to the present study, was the resistance training age of the students (novice to intermediate, with lifting experience of 6 months - 2 years). It is possible that the HGS gains could be related to the initial neural adaptations which are commonly seen in adolescent children (Haff et al., 2021). Additionally, it is suggested that twelve weeks is long enough to see notice changes in strength, however more time may be needed for significant changes in one's BC, especially if diet in not being assessed.

One interesting finding from the present study was related to BC and SE. Specifically, SE was significantly improved post-intervention even though no differences were observed for BC. These findings are dissimilar to Auguntari, Ray & Nuryadi 2017, who observed significant differences with both BC and SE after a 3-week training intervention using a cycle ergometer. While Auguntari, Ray & Nuryadi 2017 did see significant differences for both SE and BC, training duration (3-weeks vs. 15-week) and training mode (cycle ergometer vs. a variety of exercise types) could have attributed to dissimilar results for the present study compared to Auguntari, Ray & Nuryadi, (2017). For example, it is plausible that the present study's findings could be related to greater resistance training time (more exercise sessions) and the impacts RT has on SE rather than BC. Future research could look at the differences in HGs, BC and SE across a variety of time points (3, 6, 9, and 12^{+} weeks) and see if there is a threshold, or average time point, in which adolescent participants begin to have increased SE with physical activity.

Limitations

While conducting this study a few limitations were present. First, student's loads (amount of weight lifted) on the bar were not tracked. The researcher frequently checked loads to make sure students were working at the correct intensities, however it was not possible to check everyone within a training

session. It should be expected that some students worked lower and/or higher than the prescribed intensities. Student's intensities may not have been at their true 1RM at certain points during the semester because 1RMs were only tested at the beginning of the semester. If intensities looked to light/heavy the researcher adjusted the 1RMs accordingly after discussion with the student.

Next, due to the weather some training sessions had to be adjusted. For example, when subjects were scheduled to push sleds outsides, the researcher had the participants perform banded sprints to implement a similar stimulus. In parallel, there were a few days during the semester when administration needed to use the weight room for after school events. During this time the researcher had to adjust programming. The adjustment included eliminating accessory exercises and slightly increasing plyometrics before the resistance training portion of the session proceeded.

Continuing, subjects' intrinsic motivation was another limiting factor. Day to day participants' intent, and effort during workouts affected the physiological stress that was put on their body. If a participant came into class fatigued, or stressed due to factors outside of the classroom, workouts tended to be less intense. Examples included, not jumping with intent during plyometrics, taking more time in between sets during resistance training, and not using the prescribed intensities.

Lastly program adherence was a factor due to the training age of the students. Training classes with multiple training ages requires a coach to adjust a program to allow the group to train safely. A frequent change was lowering percentages for classes that had students lower training ages. For example, in the classes that contained students who were less trained during the first cycle, instead of performing 3 sets of 8 repetitions at 75%, they performed the same exercise at 70%. During the first cycle, less experienced students showed a lack of control at times allowing the path of the barbell to not travel in an efficient path. The stimulus wasn't the same as the more advanced classes, however students were able to perform the same movement in a safer and more efficient manner.

Conclusion

In conclusion, the present study suggests that participation in a structured resistance training protocol can have positive outcomes in high school students' self-esteem. Though exact NSCA resistance training protocols were missed during some training sessions, the engagement in physical activity seemed to be the biggest driver for improved self-esteem. Physical games can be used in place of resistance training sessions to continue to provide a training stimulus and negate the obstacle of monotonous training sessions with adolescents.

Though BC and HGS did not have any significant effect on SE for the sample, it could be inferred that girls and boys associate the SE differently when it comes to BC, and HGS (see gender specific *t*-test). Similar to other articles, some boys didn't see their fat mass percentage increasing as a limiting factor for their SE if they increase their body weight, or HGS. In comparison to the boys, girl's SE seemed to increase if their HGS, and/or BC improved.

While physical activity and resistance training are important for one's health, implementing healthy practices in younger populations (pre-adolescent/adolescent), could instill positive health behaviors earlier in life, which can off-set negative health rates and outcomes as one ages. Exercise programs that are programmed to work with pre-adolescent/adolescents populations need to make sure to include progressive overload; however, movements must stay consistent to allow adolescence to continue to learn resistance training exercises which might aid in increasing their SE. Future resistance training programs for high school students should implement ways to accomplish training goals while also limiting the redundancy of adhering to a training program by making training more fun. Implementing recreational games (dodgeball, kickball, basketball, etc.) in place training sessions during shortened schedules, and deload periods are a great way to keep students engaged and active. Adolescents don't seem to associate their SE with their absolute strength. Building consistent healthy habits, in this case physical activity through resistance training, has been shown to improve their SE.

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Appendix A:

Mean (SD) values for all time phases for body fat %, hand grip strength, and self-esteem in adolescent youth.

Table 1.

Mean (SD) values for all time phases for body fat %, hand grip strength, and self-esteem in adolescent youth.

Variable	Pre	Post
Body Fat (Percentage)	24.88 (8.07)	24.06 (7.36)
Hand Grip Strength (kg's)	37.90 (10.91)	41.08 (10.67)
Self-Esteem (summation)	26.68 (4.86)	30.36 (4.89)*

* Significantly different compared with Pre, $P \leq 0.05$

Appendix B:

Pre and post demographic data of the subjects

Table 2.

Mean (SD) age, grade, height, and body weight.

Variable	Pre	Post
Age	15.98	16.1
Grade	10.14	-
Height (cm)	172.7	172.7
Weight (kg)	76.2 (34.60)	75.5 (33.11)

Appendix C:

Parental Consent Form

PARENT/GUARDIAN CONSENT FOR A MINOR TO PARTICIPATE IN A RESEARCH

PROJECT

University of Central Oklahoma

Title of Project: The Effects of Resistance Training on Body Composition and Self Esteem in Adolescents

Researcher: Jay Suber CSCS

Mentor/Thesis Advisor: Eric Conchola

What is the purpose of the study? The purpose of this study is to assess how body fat percentage and physical activity are related to self-esteem within adolescents. These results will be used to help improve the department of strength and conditioning, and physical education (PE) at Mount St. Mary Catholic High School.

What procedures are involved? I will be recruiting students who have completed a PE class which focuses primarily on resistance training. During the class, students participate in resistance training 1-3 times per week (depending on the school schedule). Training was based on the current fitness level of each individual student and the class in which they are enrolled. Initial fitness level was assessed using an estimated 1-repetition maximum which was completed early in the semester. Each semester, at the beginning and the end of the class, I measure body composition, hand-grip strength, and self-esteem. This is the information I will be requesting to use for my research study. I am specifically requesting to use your child's body composition, hand-grip strength, and self-esteem which was measured two times during this class for my research project.

What are the possible benefits? Students gained many benefits from participating in the class such as knowledge about physical activity, improved quality of life, and increased strength. Participation in this research study does not add any additional benefit to your child but may benefit future students by demonstrating the importance of these types of classes.

What are the possible discomforts or risks to your child? The primary risks associated with this study are from the PE class which students have already signed up for prior to being asked to participate in the research study. Though there are a few risks while exercising the potential benefits of participation far exceed the risks of participation. Common injuries or discomforts may include muscles strains, ligament/tendon sprains, knee injuries, shin splints, fractures, dislocations, and dyspnea. To minimize these risks, the teacher (myself) is certified by the National Strength and Conditioning Association. To minimize the risk associated with the research study, your child's name and other identifying information will be removed when your child's information is transferred to the research file.

How will your child's privacy and confidentiality of their information be protected? When the information is transferred from the class files to my research file, their name and any other information

that identifies them will be removed. The personal information and survey results will not be shared and will be kept in a confidential, secure location. When referring to the study's results, and conclusions statistics will be shared, however, participant's names will remain confidential. Students will not be identifiable however, during my thesis defense students may be referred to as, "Subject 1", "Subject 2", etc. This confidential use of the student's data will help make comprehensive assessments of the data and drive home conclusions.

Voluntary Participation: Participation in this research project is completely voluntary. Your child is under no obligation to give me permission to use their class information for my research study. If you decline to participate, there will be no penalty to your child.

Researcher Contact Information:

If you have questions regarding your child's participation, or need further explanation of the study you may contact me, Jay Suber, at jsuber@mountstmary.org, or 405-631-8865 between 8:00am-3:00pm Monday-Friday, or Eric Conchola at econchola@uco.edu.

Office of Research Integrity & Compliance Contact Information:

Email: irb@uco.edu

Phone Number: 405-974-5497

Agreement

I have been informed about the study's purpose, procedures, possible benefits and risks, and protections. I have been given an opportunity to ask questions and I understand that I can

contact the researchers to ask other questions at any time. By signing this form, I am not waiving any of my legal rights. I have read and understand this form and I sign it freely and voluntarily.

I agree to allow my child _____to participate in this study.

_____

Printed name of Parent/ Guardian

_____ _____

Signature of Parent/ Guardian **Date**

I do not agree to allow my child _____to participate in this study.

_____

Printed name of Parent/ Guardian

_____ _____

Signature of Parent/ Guardian **Date**

_____ _____

Signature of Researcher **Date**

Appendix D:

Child Assent Form

Assent Form

University of Central Oklahoma

Title of Project: The Effects of Resistance Training on Body Composition and Self Esteem in Adolescents

Researcher: Jay Suber CSCS

Mentor/Thesis Advisor: Eric Conchola

What is the purpose of the study? The purpose of this study is to assess how body fat percentage and physical activity are related to self-esteem within adolescents. These results will be used to help improve the department of strength and conditioning, and physical education (PE) at Mount St. Mary Catholic High School.

What procedures are involved? I will be recruiting students who have completed a PE class which focuses primarily on resistance training. During the class, students participate in resistance training 1-3 times per week (depending on the school schedule). Training was based on the current fitness level of each individual student and the class in which they are enrolled. Initial fitness level was assessed using an estimated 1-repetition maximum which was completed early in the semester. Each semester, at the beginning and the end of the class, I measure body composition, hand-grip strength, and self-esteem. This is the information I will be requesting to use for my research study. I am specifically requesting to use your body composition, hand-grip strength, and self-esteem which was measured two times during this

class for my research project.

What are the possible benefits? You gained many benefits from participating in the class such as knowledge about physical activity, improved quality of life, and increased strength. Participation in this research study does not add any additional benefit to you but may benefit future students by demonstrating the importance of these types of classes.

What are the possible discomforts or risks? The primary risks associated with this study are from the PE class which students have already signed up for prior to being asked to participate in the research study. Though there are a few risks while exercising the potential benefits of participation far exceed the risks of participation. Common injuries or discomforts may include muscles strains, ligament/tendon sprains, knee injuries, shin splints, fractures, dislocations, and dyspnea. To minimize these risks, the teacher is certified by the National Strength and Conditioning Association. To minimize the risk associated with the research study, your name and other identifying information will be removed when your information is transferred to the research file.

How will your privacy and confidentiality of your information be protected? When your information is transferred from the class files to my research file, your name and any other information that identifies you will be removed. The personal information and survey results will not be shared and will be kept in a confidential, secure location. When referring to the study's results, and conclusions statistics will be shared, however, participant's names will remain confidential. Students will not be identifiable however, during my thesis defense students may be referred to as, "Subject 1", "Subject 2", etc. This confidential use of the

student's data will help make comprehensive assessments of the data and drive home conclusions.

Voluntary Participation: Participation in this research project is completely voluntary. You are under no obligation to give me permission to use your class information for my research study. If you decline to participate, there will be no penalty to you.

Researcher Contact Information:

If you have questions regarding your participation, or need further explanation of the study you may contact me, Jay Suber, jsuber@mountstmary.org between 8:00am-3:00pm Monday-Friday, or Eric Conchola at econchola@uco.edu.

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Agreement

I have been informed about the study's purpose, procedures, possible benefits and risks, and protections. I have been given an opportunity to ask questions and I understand that I can contact the researchers to ask other questions at any time. By signing this form, I

am not waiving any of my legal rights. I have read and understand this form and I sign it freely and voluntarily.

I agree to participate in this study.

_____ _____

Signature of Student **Date**

I do not agree to participate in this study.

_____ _____

Signature of Student **Date**

_____ _____

Signature of Researcher **Date**

Appendix E:

Data Collection Form

Spring Semester Data Collection Chart

Subject Number_____
Period _____

Pre HGS	Post HGS	Pre SE	Post SE	Pre BC	Post BC	Pre BW	Post BW

Appendix F:

Permission to Conduct Research

Permission To Conduct Research

With the permission of administration, I (the researcher) would like to use the premises of Mount St. Mary Catholic High School to conduct research regarding the effects of resistance training on body composition and self-esteem in adolescents. Below you will find a description of the study.

Researcher: Jay Suber CSCS

What is the purpose of the study? The purpose of this study is to assess how body fat percentage and physical activity are related to self-esteem within adolescents. These results will be used to help improve the department of strength and conditioning, and physical education (PE) at Mount St. Mary Catholic High School.

What procedures are involved? I will be recruiting students who have completed a PE class which focuses primarily on resistance training. During the class students participate in resistance training 1-3 times per week (depending on the school schedule). Training is based on the current fitness level of each individual student and the class in which they are enrolled. Initial fitness level is assessed using an estimated 1-repetition maximum which is completed early in the semester. Each semester, at the beginning and the end of the class, I measure body composition, hand-grip strength, and self-esteem. This is the information I will be requesting to use for my research study.

What are the possible benefits? With participation students will gain knowledge about the physiological effects of physical activity. Applied application regarding the biomechanics of lifting will be taught to reinforce safety and decrease the risk of injury while resistance training. Improved quality of life, body composition, self-esteem, blood lipid profile, energy levels, and decreased blood cholesterol.

What are the possible discomforts or risks? The primary risks associated with this study are from the PE class which students have already signed up for prior to being asked to participate in the research study. Though there are a few risks while exercising the potential benefits of participation far exceed the risks of participation. Common injuries or discomforts may include muscles strains, ligament/tendon sprains, knee injuries, shin splints, fractures, dislocations, and dyspnea. To minimize these risks, the teacher is certified by the National Strength and Conditioning Association.

Testing Instruments:

Rosenburg Self-Esteem Scale: The 10 item RSE scale is used to assess self-esteem. The instrument was initially created to gauge high school students' self-esteem. However, since its creation, the scale has been applied to a wide range of populations, including adults, for which norms are available.

Bioelectrical Impedance Analysis (BIA): A technique for calculating body composition is BIA. Finding the electric impedance of an electric current flowing through the body is the basic idea behind BIA. Resistance and reactance are the two halves of the electrical impedance. Resistance

measures the entire amount of body water, whereas reactance measures the mass of body cells. Several BIA characteristics (fat mass, body mass index, etc.) can be inferred from the determined impedance.

Handheld Grip Dynameter (HGD): This gauge measures handgrip strength in kilograms or pounds based on the amount of tension produced in a steel spring. It has two handles, and depending on the size of the hand, the space between the handles can be changed.

By signing this form, you grant the researcher permission to run this study on the campus of Mount St. Mary Catholic High School.

_____

Administrator/Principle

_____

Researcher

This project has been approved by the University of Central Oklahoma Institutional Review Board (#2023-038).

Appendix G:

This is the scale that was used to assess the subject's self-esteem

Rosenberg Self-Esteem Scale (RSE)

Author: Morris Rosenberg

The purpose of the 10 item RSE scale is to measure self-esteem. Originally the measure was designed to measure the self-esteem of high school students. However, since its development, the scale has been used with a variety of groups including adults, with norms available for many of those groups.

Scoring: As the RSE is a Guttman scale, scoring can be a little complicated. Scoring involves a method of combined ratings. Low self-esteem responses are "disagree" or "strongly disagree" on items 1, 3, 4, 7, 10, and "strongly agree" or "agree" on items 2, 5, 6, 8, 9. Two or three out of three correct responses to items 3, 7, and 9 are scored as one item. One or two out of two correct responses for items 4 and 5 are considered as a single item; items 1,8, and 10 are scored as individual items; and combined correct responses (one or two out of two) to items 2 and 6 are considered to be a single item. The scale can also be scored by totaling the individual 4 point items after reverse-scoring the negatively worded items.

Reliability: The RSE demonstrates a Guttman scale coefficient of reproducibility of .92, indicating excellent internal consistency. Test-retest reliability over a period of 2 weeks reveals correlations of .85 and .88, indicating excellent stability.

Validity: Demonstrates concurrent, predictive and construct validity using known groups. The RSE correlates significantly with other measures of self-esteem, including the Coopersmith Self-

Esteem Inventory. In addition, the RSE correlates in the predicted direction with measures of depression and anxiety.

Reference: Rosenberg, M. (1979). Conceiving the Self. New York: Basic Books. Revised date (4 October 2006) 62

Please record the appropriate answer for each item, depending on whether you Strongly agree, agree, disagree, or strongly disagree with it.

1 = Strongly agree 2 = Agree 3 = Disagree 4 = Strongly disagree _____

1. On the whole, I am satisfied with myself. _____
2. At times I think I am no good at all. _____
3. I feel that I have a number of good qualities. _____
4. I am able to do things as well as most other people. _____
5. I feel 1do not have much to be proud of. _____
6. I certainly feel useless at times. _____
7. I feel that I'm a person of worth. _____
8. I wish I could have more respect for myself. _____
9. All in all, I am inclined to think that I am a failure. _____
10. I take a positive attitude toward myself. _____