

The Effects of Weight Training and Body Fat

by

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## **Abstract**

The purpose of this study is to examine if one semester of high school weight training can significantly improve adolescence body fat percentage and Body Mass Index (BMI). Subjects in this study are all male high school students ranging in ages 14 to 18 years. Data was gathered in this study using a quasi-experimental design with a pre assessment and a post assessment of student's body fat percentage and BMI. The results of this study indicate that there is a significant difference in the male adolescent subject's body fat percentage and BMI after one semester of weight training. Evaluation of this study used a digital body fat analyzer under the supervision of the researcher. Further research would be beneficial using random selection to include both male and female subjects with varied fitness level in order to better represent the population.

## **CHAPTER I**

### **INTRODUCTION**

The rise in youth obesity from sedentary lifestyle makes it important for students to develop an appreciation for physical education. Physical education teaches students how their bodies move and how to perform a variety of physical activities. Students learn the health related benefits of regular physical activity and the skills to adopt a physically active, healthy lifestyle. In research by Anderson, Aycock, Mihalic, Kozlowski, and Detschner (2013), BMI in adolescents, and participation in physical education are examined, and determined to be an important part of school based physical education programs, and a major factor in improving adolescent BMI. A standards-based physical education program also provides an opportunity to ensure that students develop positive social skills, learn to cooperate with others, and learn to accept responsibility for their own actions. This research includes surveys, data collection, observations, and journals. The study took place in an urban public high school in Baltimore, Maryland during the 2016 school year. This particular study is of interest due to the increased number of adolescences that are considered obese in the United States, and that every student in weight training chose to be in this class.

## **Overview**

There has been a growing concern that the number of Americans that are obese is increasing. There is even more concern that the number of obese adolescents has more than quadrupled according to the Center for Disease Control (CDC). Many states have placed an educational value on physical education, by making it a graduation requirement. However, the statistics show an increase in youth obesity. Therefore it is important to track student BMI and body fat in order to make sure students are engaging in moderate to vigorous physical activity, to improve body fat and BMI.

Students in the state of Maryland are required to complete a half credit of physical education. However, students in the state of Maryland like many states may take additional physical education classes as electives. Therefore, the focus of this research is on those students who have selected weight training as an elective in addition to the state requirement. The students in this weight training class have requested to be in the class and have an interest in the subject. These students body fat during the course of one semester over a five week period will be analyzed to see if a more vigorous class such as weight training can reduce body fat and BMI.

## **Statement of Problem**

The following research will attempt to answer the question: can body fat percentage and BMI be improved during one semester of physical education weight training class?

## **Hypothesis**

One semester of high school physical education weight training will not significantly change student's body fat percentage and BMI.

## **Operational Definitions**

The operational definition for the independent variable, physical education class, would include fitness components and the activities in which students participate. The dependent variable operational definition would be the body fat percentage and what is considered normal and overweight.

## **CHAPTER II**

### **LITERATURE REVIEW**

The following literature review discusses the effects physical education will have on adolescents Body Mass Index (BMI) and body fat. The first section discusses the importance of maintaining an acceptable body fat percentage and BMI. The second section gives an overview of the importance of physical education. The third section discusses assessing body fat and BMI. This section explains how to measure BMI and body fat. It also explores ways to assess physical activity levels in students participating in physical education weight training class. The final section suggests the best ways to reduce body fat and BMI, as well as strategies used in school settings.

#### **Maintaining an Acceptable Body Fat Percentage and Body Mass Index**

Obesity affects more than one third of adults and seventeen percent of youth in the United States (National Conference of State Legislatures, 2014). Obesity is defined as having excess body fat. Due to the excess body fat, adolescents that are obese have an increased risk for cardiovascular disease, and have an increased likelihood to become pre-diabetic among other health related risk.

As adolescents become more preoccupied with the technology, television, video games, and social media, many adolescents BMI have increased due to the lack of physical activity. It is a consensus among researchers that school based physical education can play a major role in the prevention and reduction of obesity in children, adolescents, and ultimately adults, because many obese adolescents will become obese during adulthood. The research by Gao, Oh, and Sheng

(2011) examines BMI in middle school students', and physical activity levels in physical education. The study was conducted in a middle school physical education class in southern United States comprised of mainly middle class Caucasian male and female students. The focus of the investigation was on the analysis of the relationship between BMI levels and accelerometer-based physical activity among children and adolescents in physical education. Three research questions were proposed: what percentages of students are overweight and obese based on the BMI Chart; what is students' physical activity level in physical education as measured by accelerometers; and are there significant differences in students' physical activity levels across different BMI groups (normal weight vs. overweight and obese) . The finding of their research showed that 12.08% were overweight students while 10.07% of the students were obese (Gao et al., 2011). This sample of U.S. students supports the findings by the CDC that the numbers of adolescents are steadily increasing. It is alarming that a little over 22% of the students in this particular physical education class are overweight, and therefore, at risk for cardiovascular disease, diabetes, and other health related disease.

### **Importance of Physical Education**

Children, who have not been exposed to regular exercise through organized sports or through regular physical activity with their families, generally only receive moderate to vigorous exercise in school during physical education. Although the importance of physical education is well documented, many high schools do not see physical education as a priority. Maryland requires that students in high school take only one semester of physical education (Maryland State Department of Education). In the article by Anderson et al. (2013), BMI in adolescents, and the participation in physical education are examined. The study also examines obesity before and after the school wellness policy of 2006. The authors administered a biennial survey to

adolescents across the nation. The Youth Risk Behavior Surveillance System (YRBSS) survey compared the results from 2003-2006. The data from the YRBSS included BMI percentile and participation in physical education. These variables were measured by the responses students gave to questions about the number of days they participated in physical education per week, and geographic location. In 2004 the federal government reinforced the importance of the school role in addressing school nutrition, physical activity, and wellness policies (Child Nutrition and WIC Reauthorization Act [CNWICRA] PL 108-265, 2004) through legislation (as cited in Anderson, et al., 2013) These federal legislative policies have in turn led to state level wellness initiatives that focus on physical education, nutrition, and health. Anderson et al. (2013) identify school base physical education programs as a major factor in improving adolescent BMI. Several states have increased the amount of time in physical education and improved the nutritional value provided in school lunch and breakfast. Sample policies from different states were compared to see if there had been a change in the overall wellness of children according to the mandates set in the CNWICRA. The research found that while there was an increase in health and wellness, not the same could be said for the area of physical education. None of the policies assessed met best practices standards set forth in the Wellness Policy Fundamentals for physical activity (Anderson et al., 2013).

In order for improvements to be made in physical education the outcomes and implications in the 2004 mandate need to be better understood to guide future school based healthy weight programs and legislation at the state level. While legislation has mainly focused on the nutrition of school lunch and breakfast, there has not been focus on how physical education has impacted obesity.

Rhea (2009) found that school related and political issues concerning high school physical education are addressed. Having high academic test scores and graduation rates with low disciplinary problems are important in every school, but the fact that physical education can help with these areas is often over looked. With increasing popularity, many physical education classes are overcrowded, not because administrators want children to be engaged in physical education, but because of scheduling conflicts and lack of elective classes for students. Administrators often see physical education teachers as strong teachers if they have good class room management with large classes and poor teachers if they cannot manage without any emphasis on the quality of instruction. Rhea (2009) finds that by the year 2010 two of the national health objectives focuses on increasing the proportion of adolescents who participate in daily school physical education to more than 50 percent, and increasing the proportion of adolescents who spend at least half of school physical education class time being physically active to more than 50 percent.

Story, Kaphingst, and French (2006), argued that the US has made improvements to the role of the public school system concerning obesity in children. The article notes that many schools offer obesity prevention opportunities through the improvements in school breakfast and lunch programs, increasing the opportunity for physical activity, and providing obesity-related health services. Many schools had moved to selling popular non-nutritious foods, sold by chain fast food restaurants, which is a factor in the rise in obesity due to poor nutritional value. However, the trend for more nutritious foods to be sold during breakfast and lunch gives children a better choice for controlling their body fat. Also, more states are providing greater opportunities for physical activity. In the past more emphasis was placed on academic testing and physical education was made a low priority.

## **Assessing Body Fat and Body Mass Index**

Properly measuring adolescents BMI and body fat percentage is important so that accurate data can be collected. The formula for calculating BMI is dividing weight in pounds by height in inches squared and multiplying by a conversion factor of 703. This formula is lengthy and time consuming, therefore, a BMI calculator or electronic scale can be used for the calculation of both BMI and body fat. The BMI should be calculated from the average of each child's three weight and height measurements, and then charted into three different categories; underweight, normal, and overweight using a BMI chart for males and females. Morgan, Houser, Au, and Scheck (2013) demonstrate this practice in their study of high school age students. In the same study cardiorespiratory fitness was also assessed by having students perform a 6-minute 20-meter shuttle run, following the guidelines for FitnessGram. FitnessGram uses a variety of health-related physical fitness tests that are used to determine students' overall physical fitness. Many schools have begun to use FitnessGram as a tool for assessing student's fitness levels. Cardiorespiratory fitness is also a good indicator for BMI and body fat.

## **Reducing Body Fat and Body Mass Index in Public Schools**

Many people want a short cut to losing weight, but research shows that there is no fast solution to the problem of obesity and having a high BMI or body fat percentage. In fact, the only natural way of reducing BMI is exercise and nutrition. Zelasko (1995) examines the following; the amount of energy exercise uses, "Fat-burning" exercises, and the amount of energy expended for hours after exercise. By examining these three areas the author clears up some misconception about exercise. Many people want to know the answers to these questions because they want to lose weight fast and they want the easiest way to lose it, so Zelasko (1995)

suggests the use of energy charts and tables. The author gives the example of the difference between walking and running. Walking can become meaningful over time if the person engages in the higher-intensity walking (power walking) consistently, therefore increasing the estimated energy output measured in kcal/mile. There are pros and cons of high-intensity workout programs versus low to moderate intensity workout programs. The research suggest that teachers should survey there students to find what there preconceive ideas are about fitness, there past experiences in physical education, and their self-esteem level. This should be done because people that are obese due to a sedentary lifestyle before starting a regular exercise program should be convinced that the “positive results outweigh the negative expectation”, and that they will be able to successfully complete the exercises (De Feo, 2013). Educators must ensure that students understand that they may not see a significant change in their BMI or body fat percentage, but the health related benefit associated with continued daily exercise are long lasting. Swift, Johannsen, Lavie, Earnest, and Church (2014) suggest that high physical activity levels or exercise training should be an integral part of any treatment plan for obese individuals regardless of weight loss goals, and it is associated with numerous cardiovascular benefits. McMurray, Harrell, Bangdiwala, Bradley, Deng, and Levine (2002) found that educating student about health related benefits combined with a physical education program that had a strong emphasis on aerobic capacity, had the best outcome for student.

## **Summary**

Physical education plays an important role in teaching children how to maintaining an acceptable body fat percentage and BMI. This is essential in helping children understand that having a normal body fat percentage and BMI can reduce the risk of developing certain diseases associated with obesity. While there have been some improvements made to access to physical education, there is still much do to increase adolescent participation. Having adolescents engage in a meaningful physical education class that has moderate or vigorous activities that measures students body fat percentage and BMI to track activity levels are important.

## **CHAPTER III**

### **METHODS**

The purpose of this study was to investigate if high school student's body fat percentage and BMI can improve during one semester of a physical education weight training class.

#### **Design**

This is a quasi-experimental study that followed one group of male high school students in a pre/post-test design. The pretest was given to the eleven male students in the elective weight training physical education class during the first week of school. The pretest provided baseline data of each student's gender, height, weight and age, which was entered into a body fat analyzer to determine body fat percentage and BMI. This process was repeated for four weeks. The post test data was collected by entering the gender, height, weight, and age entered into a body fat analyzer to determine body fat percentage and BMI at the end of the fourth week of class. The data was used to determine if weight training improved the student's body fat percentage and BMI.

#### **Subjects**

The participants are 11 male high school age students enrolled in an urban public school in Baltimore, Maryland. The students range in age from fourteen to eighteen years of age. There are eleven male students, two ninth grade, three tenth grade, four eleventh grade, and two twelfth grade students. The racial characteristics were: 1% Caucasian, 2% Hispanic, and 97% African American. All of the participants are from low socioeconomic status families. Participants attended 70-minute physical education weight training classes daily for one semester taught by two physical education teachers' one male and one female. Students were required to change their clothes in the locker room, participate in warm-up activities, lift weights alternating upper

and lower body daily, and participate in a cool down activities. The teachers began each daily lesson by introducing skills and principles to be learned, organizing weight training lifts according to lesson objective, and ending with formal or informal assessments. Students kept a daily log of the amount of weight they used, the number of repetitions, the number of sets, and machine/exercise they completed for the day.

### **Instrument**

This study analyzed the results of one instrument used to measure student's body fat and BMI in a high school weight training class as a physical education elective. Each student was given a fitness log to track the following; what exercise they performed, how much weight they used, body weight, body fat percentage, and BMI. Every student worked out each day using the progression method and a variety of cardio exercise. At weeks end each student used the Omron Body Logic, body fat analyzer, under the supervision of the teacher to record their body fat percentage and BMI; a copy appears in Appendix A. The logs were used to track students' progress in the class to ensure students were really working out during the seventy minute class.

### **Procedures**

The teachers measured participants' height, weight, and body mass index individually during the first week of the school year and assured them of confidentiality. In the following two weeks, we measured their physical activity levels in the weight training class under physical education, testing muscle strength, muscle endurance, and cardiovascular endurance. Each student body fat was measured using Omron Body Logic, body fat analyzer model HBF-306BL under the supervision of the teachers. The teachers recorded the student's body fat and body mass index, and repeated the process at the end of each week for the next four weeks.

## CHAPTER IV

### RESULTS

The purpose of this study was to investigate if high school student's body fat can improve during one semester of a physical education weight training class. Data were gathered over a four week period on subjects in the study. To get an understanding of the greatest possible benefits accrued in the study the data for each subject concerning Body Fat Index and Body Mass Index were examined in terms of the greatest differences that occurred during the course of the study regardless of which week such differences occurred. Appendix A has a Table of these calculations.

Data indicated significant differences for both variables. Table 1 displays the measures of central tendency and Table 2 displays the t test results

Table 1

#### Measures of Central Tendency

One-Sample Statistics				
	N	Mean	Std. Deviation	Std. Error Mean
Greatest Body Fat Difference	11	0.3000%	0.15492%	0.04671%
Greatest BMI Difference	11	.309	.1578	.0476

Table 2  
Test Results

**One-Sample Test**

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Greatest Body Fat Difference	6.423	10	.000	0.30000%	0.1959%	0.4041%
Greatest BMI Difference	6.495	10	.000	.3091	.203	.415

## **CHAPTER V**

### **DISCUSSION**

The purpose of this study was to investigate if high school students' body fat can improve during one semester of a physical education weight training class. The analysis of the data indicated that there was a significant change in both Body Fat Percentage and Body Mass Index therefore, the null hypothesis was rejected.

#### **Threats to Validity**

All studies suffer from both external and internal threats to validity. External validity threats center on the sample and type of sample; whereas, internal threats to validity center on the design of the study. In terms of the external validity threats the student sample contained only high school age males that selected the class as an elective. Therefore only one gender is taken into account which creates selection bias. This class was unusually small for a physical education class which allowed for more one on one interaction with students. In addition, all of the male students were considerably athletic, either currently participating on a high school sports team or planning on trying out for one. This history effect threatens both external and internal validity.

Selection bias is an internal threat to validity in this quasi-experimental research design. Additionally, threats to internal validity in this research center on the fact that ten of the eleven male students that selected this class already had body fat percentages within a normal range for their age, height, and gender. This is a quasi-experimental study. Other possible threats to validity include students that play sports possibly had two workouts in one day. This would double the amount workout time a student receive increasing their likelihood to improve body fat percentage and BMI. The results of this study would not be applicable to a general physical

education class unless more research was done to include a more random selection that included female students and students that had no athletic interest.

### **Comparison to Previous Research**

The results of this study show that there can be a significant improvement in boy fat percentage and BMI in a high school weight training class. When students are surveyed by teachers or school councilors about what classes they feel they can be successful in, students are able to feel more comfortable in that class and are more likely to succeed. Story et al. (2006), report that the US has made improvements to the role of the public school system concerning obesity in children by offering obesity prevention opportunities through the improvements in increasing the opportunity for physical activity, and providing obesity-related health services among other advancements. More states are providing greater opportunities for physical activity. Currently there are four course offerings for physical education; team sports, individual team sports, fitness, and weight training, at this particular school. When students are given a choice, and opportunity to increase their knowledge and appreciation for fitness, students are more invested. Research shows that there are pros and cons of high-intensity workout programs versus low to moderate intensity workout programs, therefore, teachers should survey their students to find out about past experiences in physical education, their fitness and self-esteem level (De Feo, 2013). By allowing student to choose the class of interest, in this case weight training, the students that signed up for the class have a desire to increase muscle mass or they want to improve muscle strength for sports. This factor increases the likelihood of each student having positive results. If student choice is not available and all students are placed into a general team sport physical education class, physical educators should survey student to diversify instruction and to

encourage students so that “positive results outweigh the negative expectation”, and that they will be able to successfully complete the exercises (De Feo, 2013).

### **Conclusions and Directions for Future Research**

As physical educators encouraging students to stay physically active is paramount, but educators also need to ensure students understand that they may or may not see a significant change in their body fat percentage or BMI in one semester of physical education. However, tracking student growth on the weekly bases allows the teacher and the student to see if they are exercising at a level that will cause reduction in body fat or improved BMI. The health related benefits associated with continued daily exercise are long lasting. However, it is interesting that those students that choose to enroll in a high impact weight training class put in a great deal of effort, and were very focused in completing task in class. When conducting future research it would be beneficial to compare genders. This research is limited to only male high school age students that choose to take this particular class.

Swift et al. (2014) found that high physical activity levels or exercise training should be an integral part of any treatment plan for obese individuals regardless of weight loss goals, and it is associated with numerous cardiovascular benefits. Future research may compare traditional physical education classes that teach team or individual sports as opposed to physical education classes that include high physical activity levels such as weight training as a regular part of instruction.

Appendix A

Table of Greatest Differences for Analysis in the Statistical Package for the Social Sciences

Student	Current Athletic Participation	Week 1 Body Fat	Week 1 BMI	Week 1 rating	Week 2 Body Fat	Week 2 BMI	Week 2 rating	Week 3 Body Fat	Week 3 BMI	Week 3 rating	Week 4 Body Fat	Week 4 BMI	Week 4 rating	Greatest Body Fat Difference	Greatest BMI Difference
1	None	7.60%	22.7	Normal	7.60%	22.8	Normal	7.70%	23	Normal	7.50%	22.5	Normal	0.10%	0.5
2	None	17.70%	22.4	Normal	17.70%	22.4	Normal	17.80%	22.6	Normal			Normal	0.10%	0.2
3	None	19.30%	23.6	Normal	19.30%	23.6	Normal	19.00%	23.4	Normal	18.80%	22.9	Normal	0.50%	0.3
4	None	7.70%	22.9	Normal	7.60%	22.9	Normal	7.70%	22.9	Normal	7.50%	22.8	Normal	0.20%	0.1
5	None	7.10%	21.5	Normal	7.10%	21.5	Normal	7.00%	21.3	Normal	7.10%	21.4	Normal	0.10%	0.2
6	k	19.50%	25.9	High	19.50%	25.9	High	19.30%	25.7	High	19.10%	25.6	High	0.40%	0.3
7	None	18.70%	22.2	Normal	18.60%	22.2	Normal	18.30%	21.9	Normal	18.70%	22.1	Normal	0.40%	0.3
8	None	19.30%	23.8	Normal	19.40%	23.8	Normal	19.10%	23.6	Normal	18.80%	23.2	Normal	0.50%	0.6
9	Basketball	15.00%	20.7	Normal	15.30%	20.8	Normal	15.10%	20.8	Normal	14.80%	20.6	Normal	0.30%	0.2
10	None	9.20%	22.2	Normal	9.20%	22.2	Normal	9.00%	22.1	Normal	8.90%	22	Normal	0.30%	0.2
11	None	18.60%	23.1	Normal	18.50%	23.1	Normal	18.70%	23.3	Normal	18.20%	22.8	Normal	0.40%	0.5

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