THE EFFECTS OF CARDIOVASCULAR EXERCISE ON BMI IN ADOLESCENTS.

by

Erik A. Borger

An Abstract
of a thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Science
in the Department of Exercise Science
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September 2011
Obesity is linked to many health problems, including diabetes, high blood pressure and metabolic syndrome, affecting millions of Americans each year. These health problems are not found simply in adults, but are also starting to develop in children, affecting their physical and emotional well being at a younger age than ever. The lack of physical activity and poor diet must be addressed before it is too late, and too many children’s lives have been negatively altered. The study focuses on the effects of exercise on childhood obesity, concentrating on elementary aged adolescents. The study focuses upon 27 students whom researchers administer exercise towards twice weekly, examine participant’s body fat levels, and assess their overall BMI. The results were then be used for schools and researchers to gain knowledge from.
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A Thesis
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Childhood obesity is one of the most serious problems currently affecting individual and public health (Boone, Gordon-Larsen, Adair, & Popkin, 2007). Obesity is defined as a chronic condition characterized by excess body fat and often diagnosed through the use of a body mass index, where the individual’s weight in kilograms is divided by their height in meters squared (Shepherd, 2009). Obesity is caused by many factors including sedentary lifestyles, endogens, chemicals ingested during pregnancy or infancy, poor dietary habits, television, and the media (Daniels, 2006). Immediate health risks which are associated with childhood obesity include cardiovascular, metabolic, pulmonary, gastrointestinal, skeletal, neurological, and psychosocial disorders (Daniels, 2006).

In the long term obesity leads to Type 2 diabetes, metabolic syndrome, high blood pressure, heart disease, stroke, sleep apnea, breast and colon cancer, depression, osteoarthritis, and sudden cardiac death. Over four hundred million people are obese in the United States, twenty two million of those being children under five years of age (Green & Reese, 2006). This statistic means that obesity claims three hundred thousand lives every year, making it one of the leading causes of deaths in America. Children, on the average, spend up to five or six hours a day involved in sedentary activities, including excessive time watching television, using the computer, and playing video games (Green & Reese, 2006). With statistics like these, almost anyone could agree that something must be done.
Purpose of the Study

The purpose of this study is mainly to incorporate exercise into the participant’s life, while also determining whether or not the relationship between moderate exercise and BMI is statistically significant. Studies in the past such as (Hollar, et al., 2010) and (Sollerhed & Eijertsson, 2008) have successfully reduced overall BMI through major intervention. This study focuses on manageable afterschool programs allowing students who are or aren’t currently enrolled in physical education classes to be able to participate and possibly reap the benefits year round.

Significance of the Study

Teenage obesity has become all too prevalent, leaving many teens suffering from physical and emotional issues. Obesity in many teens often arises from a well-established pattern of habits stemming back many years. These patterns often include a sedentary lifestyle and showcase poor food choices, as well as a lack of motor activity. Some young people possess a sophisticated understanding of choice and consequence, while others have a myopic and distorted view of the effects of their decisions (Moir, 2006).

Developing a change in themselves is something most cognitive adults have a hard time doing, surely children with peer pressures, despite their attitudes, have a hard time as well. One of the greatest obstacles in the fight against obesity is technology. Marketing, mass media, handheld televisions and portable gaming units, along with new multifunctional cellular telephones are all factors in obesity and the reduction of teenagers overall physical activity output (Boyce, 2007). The results of this study determined if a correlation existed in regards to physical activity and BMI as it pertained to middle school aged students. The findings of the study provided useful information for parents, students, and educators as to the effects of physical activities on
Finding statistical significance between cardiovascular activity and BMI in elementary aged students provided much insight into the importance of a physical education program in schools. This information was then used to further determine the levels of activity needed to provide a benefit. This study also tested the effectiveness of a combined cardiovascular approach. By incorporating both play activities with more traditional cardiovascular exercises, some of the monotony of purely cardiovascular exercise was perhaps be lessened; increasing the students overall motivation.

**Delimitations**

This study is delimited to the following:

1. Twenty-seven students from grades five through six responded to the program by their own interests; all students were from one specific school.
2. Subjects were assessed classroom-wide in a natural setting.
3. The school’s nurse was utilized to determine age, gender, height and weight.
4. Once recorded, BMI were calculated by grade and then again as a whole, determining the levels of each individual grade as well as the entire group as a whole.
5. The male and female results were also split and again calculated by grade to determine if any patterns existed in the gender differences.
6. The study included three time trials, one at the beginning, one midway, and one at the culmination. The run was a half-mile in duration and tested for aerobic improvements.
7. Weekly activities included one day strictly for running and another day for play based activities which incorporated running.
Limitations

This study is limited to the following:

Temperatures during testing procedures proved to be a problem, affecting even the final run. There were no errors in with the testing procedure used for testing to my knowledge, yet this is a possibly unknown limitation. There were also no known errors in which the data was recorded, yet unforeseen mistakes may be possible limitations. Students, gender, ethnicities, somatotypes or unknown health conditions all may serve as other limitations as well. The BMI for overly muscular individuals would also be a factor in skewing the data, thus creating a limitation.

Assumptions

1. The testing instruments were appropriate for the target population and reliably measured body composition as well as overall body.
2. The subjects were aware of and understood all directions (consent form).
3. The subjects completed the performance tests to the best of their ability.
4. The subjects who volunteered represented average students and therefore produced accurate non-bias results.
5. Those collecting data were sufficiently trained and were capable of administering the tests.

Hypotheses

1. Subjects with a moderate to high BMI will exhibit lower initial endurance abilities (Brunt, Chaput & Tremblay, 2007).
2. Individuals from a lower grade will possess a lower body fat therefore increasing initial and improved performances (Johnson et al, 2007).
3. Body fat will decrease as the program progresses fat (Morta, Ribeiro, Carvalho, & Santos, 2010).

**Definition of Terms**

1. *BMI*. Body mass index or Quetelet index concentrates on an individual’s height and weight to determine and estimated body fat level (Stommel & Schoenborn, 2009).

2. *Obesity*. Obesity is defined by one’s subcutaneous fat level. These levels are measured by way of hydrostatic weighing, skinfold measurements, bioelectrical impedance, MRI, BMI, and Bod Pod. Each method utilizes a different procedure for determining body fat levels which then dictate the individuals overall classification (Garcia-Marcos et al., 2008)
Chapter 2
Review of Literature

Obesity is an increasing problem in our society and is starting at a younger rate each year, affecting children and even toddlers in negative physical and emotional ways. The purpose of this study was to determine the effects of exercise on individuals overall BMI. Television, video games and media are relatively new concepts, yet they have caught on with a large population of children and teens, occupying much of these kids time which was once spent playing outdoors. This review will look at four sections, covering childhood obesity, diet, physical inactivity, and media usage.

Childhood Obesity

The incidence of childhood obesity has seen a steady increase over the past few decades, allowing obesity-related effects and diseases to receive more attention than ever. There is a direct correlation between childhood obesity and adult obesity, leading to years of physical and also, potentially to emotional damage. Children ages six through eleven have seen a doubling in obesity rates, with the overall obesity rate rising from 6.5% in the 1980s to a staggering 17% in 2006, with those aged twelve through nineteen experiencing a twelve percent increase over the same period of time (Ji & Hooker, 2010).

Obesity typically is known to be caused by many factors developing differently in each individual. For some individuals, obesity may start in fetal stages, with the gestational period being a key factor, giving way to development obesity as well as hypertension, hyperlipidemia, and diabetes (Levin, 2009). One’s genetic background is also a major risk factor, putting those
who were at normal genetic risk into an advanced state when paired with high fat intake of the 
mother during pregnancy. This behavior leads to possible reorganization of central neural 
pathways which regulate one’s food intake, how energy is expended, and also how one’s energy 
is stored (Levin, 2009).

**Diet**

The diet of an individual is often seen as an important role in one’s overall health as well 
as a major contributor to obesity. In the past, food was not always readily available, with much 
of what was eaten at a dinner table coming straight from the field behind the home. Times have 
radically changed in the last century as modern technology and factories have advanced, so have 
our dinner plates. The modern meal today typically consists of foods grown hundreds, even 
thousands, of miles away, bringing a spectrum of new meal combinations to the American dinner 
(Huey, 2005). With these modern conveniences came the modern restaurant, typically 
specializing in cuisine from certain nationalities or cultures, something that made dining much 
more convenient and less labor intensive. The plethora of restaurants then gave way to a faster, 
more convenient method of precooked food delivery, in what has come to be called fast food. 
Fast food is made quickly, and cheaply, with the ability to access to most meals without even 
leaving the driver’s seat. The modern restaurant and grocery store have put large varieties and 
vast quantities at our fingertips, being so accessible that most Americans can find a food source 
less than five minutes away. This overabundance, along with around-the-corner convenience has 
left many Americans overweight and in need of medical care.

Fast food has been known to provide a high fat, sugar, and carbohydrate content, causing 
many individuals to take in an entire day’s worth of calories during one meal. In a year 2010 
study investigating the correlation between fast food restaurant distances and obesity, (Currie,
DellaVigna, Moretti, & Pathania, 2010) found conclusively that the presence of a fast food restaurant one-tenth of a mile away from a school resulted in a 5.2% increase in obesity for that school’s students. The researchers also found a 5.5% increase in the obesity of expectant mothers when fast food restaurants were located within one-tenth of a mile. The expectant mothers in this study would then correlate with the effects of Levins’s study, essentially introducing a possibility for predisposed obesity.

Research suggests a good percentage of obesity is a result of over consumption of foods rich in fat, and high in sugar. Many poor diet choices stem from environments of economic lack, producing lifestyle menus laden with addictive saturated fats, refined sugars, and starches. Obesity may be a product of under education. Many Americans, especially American youth are ignorant to proper nutritional guidelines and recommendations. This ignorance typically stems directly from the parents establishing a poor nutritional base, carried on by the school system and their lack of early education and appropriate in-school nutritional options and services. Preventing this diet-induced obesity is important, particularly for those associated with a family related link to cancer, cardiovascular disease, and diabetes (Shepherd, 2009).

Children consume one third to one half of their daily calories at school, making the school lunch an extremely important part of a child’s overall diet. Schanzenbach (2009) showed children eating school lunches consumed forty more calories a day on average than those who brought their lunches from home, producing a 2% increase on overall BMI. The school lunches in the study contained over seven hundred calories per meal and were. For many children, this is where breakfast was eaten as well. Li & Hooker (2010) found children in this study were also at a higher risk of obesity if they were a part of the free or reduced lunch program, due to reliance on school prepared lunch as opposed to bagged lunch from home. These finding are congruent
with Shepherd’s (2010) and Schanzenbach’s (2009) findings due to their predictions of obesity in economically challenged children.

**Physical Inactivity**

Poor nutrition is typically coupled with physical inactivity, increasing the risk of obesity (Kim & Lee, 2009). Kim and Lee (2009) set out to investigate the affects physical activity have on one’s overall BMI and fat levels, concentrating on factors such as waist circumference, cardiorespiratory fitness levels, and duration/intensity. Under submaximal treadmill testing procedures, it was concluded that 33.6% of 12 to 19 year olds could be classified as physically unfit, making them four times more likely to be overweight or obese than those with a high fitness level. This trend toward physical inactivity produces risks to children for such issues as metabolic syndrome and hypercholesterolemia. It was also noted simple activities such as basketball, and tag, when assessed, proved to be an effective tool for significantly reducing overall fat when a 70% to 75% maximal heart rate was maintained for five days per week at forty minutes per day.

Kim and Lee (2009) looked at the correlation between waist circumference and cardiorespiratory fitness levels, discovering that children with higher fitness levels had smaller waist circumferences, lowering their risk for several diseases. The effects of aerobic exercise without a caloric restriction was also studied, in hopes to discover if benefits did exist, even if BMI was still elevated. In the time frame of sixteen weeks, aerobic exercise alone proved to be very effective, significantly reducing total visceral, abdominal, and subcutaneous fat. The results show that 30 to 60 minutes per day of regular exercise for at least three days per week would generate significant total fat reductions in men and women without a caloric restriction,
demonstrating that regular exercise alone, when done at proper duration and intensity, is enough to reverse obesity-related health risks.

Ji and Hooker (2010) found that outside activities had the power to decrease and prevent obesity, showing that those who participated in sports or sport training were almost 6% less likely to become overweight compared to children who did not participate. In addition, the children who participated in an organized social activity had a 1% less chance of becoming overweight; parents who exercised provide another near 2% reduction in chance for obesity (Ji & Hooker, 2010).

**Media**

In our current society many children are given over seven hundred digital channels to surf with a multitude of specialized games, videos, and shows to accompany the channels. Television time went from something to do when the present options were exhausted to the ultimate present option, with many youths now seeing the outdoor activity as the last resort (Ridely & Olds, 2001). Children today spend over six hours a day focused on electronic media, with over two hours of that time focused upon video games. For many children, the video game has become high priority, taking precedence over the simplistic television program or movie. Young Americans spend over six billion dollars on video games each year, accounting for nearly 30% of the toy industry as a whole (Wack & Tantleff-Dunn, 2009). With hours of time previously spent on chores, and outdoor play activities going instead to media and video games, children are becoming more sedentary and as a result of this, obese.

Obesity among habitual virtual gamers has been a somewhat debated subject; some experts state that video games are a good way to relax and wind down, while others say they are very harmful and a potential health risk factor (Borusiak, Bouikidis, & Russell, 2008). Borusiak,
Bouikidis, and Russell looked at the effects video games have on one’s heart rate, systolic and diastolic blood pressures, oxygen production, and carbon dioxide levels. The researchers looked at seventeen German boys aged twelve to fourteen who were recruited from a local secondary school. Researchers instructed the students to participate in game play through various popular racing and action games. Heart rate, systolic and diastolic blood pressure of the children all demonstrated a significant increase comparable to that of 2-3 miles per hour treadmill walk without any physical activity present. Borusiak, Bouikidis, and Russell concluded that playing video games may cause a disproportionate elevation in blood pressure, creating a possible cardiovascular risk and hypertension.

Boone, Gordon-Larsen, Adair, and Popkin (2007) took a longitudinal approach to their study focusing on screen time and physical activity during adolescence. The study focused upon any correlation which existed between screen time and obesity, by focusing on the BMI of almost 10,000 individuals, both male and female. The first wave of the study did not collect data except basic height and weight calculations; the second wave of the study taken one year later, however, measured 13,570 adolescents’ BMI, sedentary behavior, and physical activity. The third wave of the study was five years after wave two and consisted of 14,322 adolescents focusing upon the same factors as wave two. Of the individuals tested during wave one, 11.5% of males and 10.9% of females were obese. During wave three, five years later, that number increased substantially to 21.1% for males and 23.9% for females, resulting in a total increase of 13.2%.

Males and females showed steady increases in obesity rates, independent of overall screen times and physical activity. Those who partook in the largest percentage of screen time (25 hours per week) with the least physical activity (3 or less bouts) gained the most, with those
participating in even five bouts of exercise per week following less than half a percent behind. These percentages show obesity advancing concurrently with screen time, even when aerobic exercise was performed five times weekly. These results provide evidence for the damaging effects screen time has on adolescents (Boone et al., 2007)

**Summary**

In today’s childhood obesity epidemic, diet, physical inactivity, and game play are very key components when prevention and treatment are concerned. Diets have shown to be a major factor in obesity rates, as well as other diet-related diseases (Huey, 2005). It has been discovered that one’s socioeconomic status has an effect on the type of food that is available to them as well as what they develop a taste for. These financially challenged individuals typically qualify for free or reduced lunch, which has been shown to also increase the individual’s daily calories over the typical non-free lunch student (Schanzenbach, 2009). Furthermore, fast food is also a major contributor to the obesity of children and parents alike. When fast food restaurants were within walking distance for school-children and expecting mothers, both groups gained large amounts of body fat. These heavy starch, high fat, high refined-sugar items often found at fast food restaurants are exactly what the experts direct individuals to stay away from. Listening to these experts and becoming properly educated on healthy eating habits may make a big difference in a child’s life when learned at an early age (Currie, DellaVigna, Moretti, & Pathania, 2010).

Another key component of obesity was found to be physical inactivity. Common sense tells us that the man working at an office job is going to burn fewer calories than the man working construction. This fact resonates through life; physical inactivity not only has the potential to add body fat but, it also takes away from the benefits exercise has to offer the heart, lungs, and overall metabolic system. Outdoor activities as simple as playing dodge ball or
kickball five days per week can reduce overall BMI significantly and generate a fun-filled atmosphere for children (Ji & Hooker, 2010). Simply going out and performing moderate intensity activities three days per week will make a large difference on overall body fat without restricting calories. These small activities may not seem like much, yet they have the ability to decrease one’s overall body fat as well as to decrease that individual’s chances of future obesity (Kim & Lee, 2009).

Sedentary lifestyles are usually not comprised of individuals simply sitting in corners twiddling their thumbs. Activities such as television, computers, and video games are often what motivate a child to keep indoors. It has been shown that children who partake in the most screen time with the least activity are the most obese, watching anywhere from 7-25 plus hours of media per week (Boone et al., 2007). Video games alone account for over one third of the toy industry’s overall yearly revenue, proving that children view video games as a high priority. Video games not only have been shown to increase obesity but to produce stress in adolescents as well. These children get so involved in the games that their hearts begin acting like their bodies are being walked on a treadmill at a moderate pace (Borusiak, Bouikidis, & Russell, 2008).
Chapter 3
Methodology

To determine if any statistical significance exists between increased physical activity and BMI, subjects performed supervised physical activity two days per week, lasting in duration of 45 minutes per session due to supervisory restrictions. Subjects then had their height, weight, and age recorded. BMI was calculated and factored in with all other results. The following describes the data collection plan used in acquiring the results hypothesized.

Subjects

The study was comprised of 27 elementary school students. 13 of the 27 were 5th graders and 14 were 6th graders. The fifth grade class was made up of 10 males and 3 females, with the sixth grade class being made up of 8 females and 6 males. The two groups will originate from the same school and follow the same program. Through self report, all subjects will need to be in good health with no reported health problems, disabilities, or movement issues.

Instrumentation

An Omron HBF-306C Bioelectric Impedance monitor will be used to determine body fat and BMI. Individuals’ information will then be entered into the unit by the school’s nurse. Height and weight for the BMI will also be gathered by the nurse, utilizing a Decto DR-400-750C digital medical scale and a Seca #202 Stadiometer. This procedure ensures accuracy while avoiding any possible variances which would occur if several scales were utilized.
Body Weight Scale

The Decto DR-400-750C digital medical scale was chosen for its accuracy, its lightweight movability, and to again assure the same equipment is used on all participants. Once the individuals are asked their height and weight, they then will be directed to the scale, where their shoes will be asked to be taken off and their weight then measured.

Height

A Seca #202 Stadiometer will be used to determine individual’s height and was administered directly after weight information was obtained. The individuals will then approach the stadiometer from a backward stance with their shoes still off. The stadiometer will be located flush against the wall to ensure no movement of the device occurs. Individuals will then be instructed to stand as straight as possible, while the nurse determines the final measurement.

Data Acquisition

Data will be acquired through physical testing methods. Individuals are administered three performance tests establishing a baseline, tracking progress, and producing a total improved result. By using a midway point the percentage of improvement can be seen and insight can be obtained as to what improvements were experienced at eight weeks as well as at the full sixteen weeks. The pre-test, mid-test, and post-test will all consist of the same challenge, to run 600m. Subjects will be encouraged to improve their previous time and to as always do their very best. The three tests will then be compared and correlated. All data acquisition will be performed by the school nurse, with the performance tests being administered and performed by one of the sixth grade teachers and myself. All further calculations and translation of the data will be calculated and correlated by myself as well.
Testing Protocol

The testing procedures will take place at the Zoller Elementary School and involve twenty-seven subjects all of which are either from the fifth or sixth grade. The students will be comprised of both male and female, with the gender ratio not to exceed a 60/40 split. After volunteering, the individuals will begin gathering twice weekly for a total duration of 16 weeks. Upon first meeting, the students will be informed on what to expect from the program, and explained how the logistics will be handled.

Once the actual participation is ready to be incorporated, the school nurse will gather height and weight along with age and gender. This data will then be linked to a number for that particular child. After all children have been weighed and measured, the performance segment of the research may begin by way of a simple one-mile jog test. The individuals will be grouped on the school track and begin jogging at their best pace for the duration of the mile. All individuals’ times shall be recorded and paired with their assigned numbers.

After all preliminary testing has been obtained the individuals will then begin the actual program. The 16 week program will be applied twice weekly with the individual sessions lasting a total of 45 minutes, allowing the children to use the school’s transportation methods to get home. The weekly sessions will be comprised of one running activity and one high intensity play activity such as soccer, or basketball.

Halfway through the program, the children will once again be assessed on their performance by way of the one-mile jog. Figures from the mid-test will be compared with the pre and post-tests, allowing for a possible significance to be determined. After the program has ended the individuals will again be tested by the nurse to obtain the new height and weight data.
Once all information has been obtained from both the performance tests (pre, mid, and post) and the before and after height and weight data, the statistical portion of the test may be calculated.

The statistical data will be calculated using the before and after BMI percentages. Once the BMI’s are calculated their significance can be statistically tested by way of a t-test. The performance data also will be statistically tested, by way of an ANOVA, due to the need for comparison on three levels (pre, mid, and post test). If a high rate of significance is shown to exist, a Tukey’s post hoc test will also be administered. These steps, the preliminary precautions, the data collection, and the use of proven statistically sound calculation methods will ensure that our findings, whether significant or non-significant, will be rooted in truth.
Chapter 4
Results

The BMI was significantly different between the groups before and after treatment. However, it might not have been in the preferred direction (for example, a negative result after the training). This would perhaps mean that children were not motivated enough to acquire the desired outcome, eating factors, etc. An analysis of variance showed that the effect of performance was not significant, $F = 2.420, p = 0.099$. Post hoc analyses using the Scheffé post hoc criterion for significance was therefore not necessary. In addition, the power of the study was less than the desired power meaning that it is less likely to find a significant effect and reject the null hypothesis. This may have been improved by using a larger sample size.

Table 1 summarizes the distribution of several variables assessed during the physical examination of the dual BMI observations between the before and following rates of the study. Mean BMI was slightly higher in males than in females with the males exhibiting a .78% increase in body mass over their female classmates. The average age was 10.52% with 14 students from the sixth grade and 13 students from the fifth. Females in the study comprised 44% of the total participants with the males controlling the remaining 66%.

The BMI results varied greatly within both male and female participants with the highest male body mass at 28.3396% and the lowest at 16.3582%. In contrast, the highest female body mass was 23.7621% with the lowest at 16.4816%. The average body mass for the males before the study was 21.49641% with the average before female body mass residing at 19.71597%.

Table 2 focuses on the 600m running results in order to see if performance was actually increased for the before, during and after participants. Total beginning female time was 7.520833 seconds faster than total male, total mid female time was 4.70833 seconds faster, and total end
time was 7.08333 seconds faster. The fastest female before time was 90 seconds, the fastest female mid time was 88 seconds and the fastest female end time was 92 seconds. The slowest female start time was 115 seconds, the slowest female mid time was 113 seconds, and the slowest female end time was 113 seconds. The sixth grade girls were 6.791667 seconds faster than the 5th grade girls before, 8.375 seconds faster midway, and .541667 slower at the end.

The fastest before male time was 76 seconds, with the fastest before mid-time of 73 seconds, and the fastest final time of 75 seconds, all set by the same individual. The slowest before time was 179 seconds, with the slowest midpoint of 186 seconds, and the slowest final time of 181 seconds; also set by the same individual. In the males case the 5th grade boys retained an across the board faster average with the beginning run being 11.46667 seconds faster than the sixth grade boys, the mid run 9 seconds faster, and the end run 8.966667 seconds faster.

Before BMI for 6th grade males was 22.58148 while after BMI was 21.77662; a reduction of 0.80486%. For the 5th grade boys, before BMI was 20.95388%, while the after BMI was 20.59621%; a reduction of 0.357669%. For the females in sixth grade a before percentage of 19.37653% was obtained, with an after result of 19.21797%; a reduction of 0.158567%. The fifth grade girls also started at a higher percentage with 20.73427% and finished at 20.20823%; a reduction of 0.526033%.

BMI rates for the 5th graders (20.9032) began at 0.382043% higher than the BMI for the 6th graders (20.52116%). BMI rates continued in the same manner for the 5th graders (20.50668%) ending 0.374906% higher than that of the 6th graders (20.13177%). Total BMI rates for females in both 5th and 6th grades began at 19.71597% and ended at 19.46553%. For the males in both 5th and 6th grade, they began at 21.49641% an increase of 1.780447% over the females and ended at 20.98968% an increase of 1.524147% over the females. Total reduction
over the course of the study for males resulted in a 0.506733% reduction, with the females experiencing a 0.250433% reduction.

In determining the BMI, preliminary and exit weights were obtained. The initial total weight for females at the beginning was 1,049.5lbs and the ending weight 1,045lbs, granting a total loss of 4.5 lbs. For the males, a total beginning weight of 1,669lbs was measured, with a total ending weight of 1,660lbs, granting a total loss of 9lbs.

Those collecting data were sufficiently trained and were capable of administering the tests.

**Hypotheses**

1. Performance will increase as program progresses (Iaia et al, 2007).

2. Body fat will decrease as the program progresses fat (Mota, Ribeiro, Carvalho, & Santos, 2010).
600 Meter Run/ Seconds Fig. 1

Male & Female 600M Run Results in Seconds

BMI Chart Fig. 2

Before vs After BMI Percentages
EFFECTS OF CARDIOVASCULAR EXERCISE ON BMI

600 M Run Chart Females Fig. 3

Female 600 M Run Times

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600 M Run Chart Males Fig.4

Male 600 M Run Times

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Data was then put into the context of a paired t-test which allowed comparisons to be made among the before and after groups in order to see if the results are statistically significant. The results of the paired t-test can be seen in figure 5, which state a significant change occurred p=0.002.

The change which has occurred during treatment is greater than what would be expected by chance, meaning the chance was statistically significant p=0.002. Power of performed test with alpha (=0.050: 0.905).

The 600 meter run results were also computed using one way repeated measures ANOVA. The results of the one way ANOVA can be seen in figure 6, stating that the results were not statistically significant (power < .800).
The differences within the mean values among the treatment groups were not great enough to exclude the possibility that the difference is due to random sampling variability. As a result $P=0.099$, it was not statistically significant. The power of the performed test (0.280) was below 0.800. This less desired power shows that it is less likely to find a difference when one occurs.

Results throughout this study and within the groups varied immensely through gender and grade level. 6th grade females who performed the 600 meter dash, for instance, were slower on average by 0.25%, whereas the 5th grade females were actually shown to be faster on average by 6 seconds. The males lost exactly double what the females had lost in raw pounds with males losing 9 and females losing 4.5lbs.
Chapter 5
Discussion

The object of this study was to determine the effects of cardiovascular exercise on BMI and performance. The results of this data have shown us many things to which we can possibly learn from and improve on in the future. The portion of the study which looked at BMI showed to be statistically significant at ($P = 0.002$), while the 600 meter run results were not strong enough to produce a statistical significance.

The BMI results and weight number proved to be the only statistically significant platform, with individuals reducing their weight by a total of 13.5 lbs in spite of the accelerated growth which occurred in many. The total BMI percentage was reduced by 10.60619% over the course of the study with males reducing their total amount by 7.6099% and females reducing theirs by a total of 3.0052%.

The 600 meter run results seemed to show varied improvements with many of the subjects becoming slower than their original baselines in the final test. The group total run times were reduced by 49 seconds yet were not found to be great enough to qualify for statistical significance through the ANOVA.

The differences in the age of the individuals and their performance/BMI percentages may be useful to others in predicting when obesity starts as well as when performance begins declining. The older students in both the 6th grade male and female groups, for instance, were both faster than the 5th grade groups. Females in both grades also proved to be faster than males in both grades by an average of 6.4375 seconds. Many of these statistics must be looked at in context with the male group having several obese individuals and the female group having
This study may have been limited by many factors including behavior problems, length of study, and environmental factors. The weather may have played a large role in some of the results with the testing for the initial run being conducted in cool, dry weather, and the last test being conducted on one of the hottest days of the year. The study may also be limited by the motivation of the children; children on the final run were reported to be carrying on conversations while running as well as goofing off in general.

Future studies may consider performing shorter distance runs such as a 40 yard dash which may provide the children with less distraction. Researchers also may want to incorporate additional training such as diet and nutrition talks/handouts, as well as possibly involving parents on this option. Researchers may also want to look at testing in a controlled environment such as a gymnasium or indoor track. To cut down on behavioral issues researchers may choose to have daily prizes or awards in order to help the children stay motivated and on track mentally. Possible use of interactive video game technology may also be an excellent way to keep children’s focus.

This study shows that a correlation between exercise and weight loss does exist even when implemented for 1:30 minutes weekly. The results may prove to be a good argument in regards to the need for physical education classes. The study may have proven to produce greater results had the workouts been held more than two days per week or longer in duration.
References


factor for asthma in schoolchildren: Which one to use in epidemiological studies?


8/2/2011

Erik Borger
11156 N Madison Ave
Kansas City, MO 64155

Dear Mr. Erik Borger,

Your research project, 'Effects of Cardiovascular Training on Adolescents' BMI and Endurance', was approved by the Human Subjects Review Committee on 7/28/2011. This approval is valid through 7/28/2012. Your informed consent is also approved until 7/28/2012.

Please note that you are required to notify the committee in writing of any changes in your research project and that you may not implement changes without prior approval of the committee. You must also notify the committee in writing of any change in the nature or the status of the risks of participating in this research project.

Should any adverse events occur in the course of your research (such as harm to a research participant), you must notify the committee in writing immediately. In the case of any adverse event, you are required to stop the research immediately unless stopping the research would cause more harm to the participants than continuing with it.

At the conclusion of your project, you will need to submit a completed Project Status Form to this office. You must also submit the Project Status Form if you wish to continue your research project beyond its initial expiration date.

If you have any questions, please feel free to contact me at the number above.

Sincerely,

[Signature]

Janice Putnam Ph.D., RN
Associate Dean of The Graduate School
putnam@ucmo.edu

cc: Ken Bias
CONSENT FORM

Identification of Researchers: This research is being done by Erik Borger, a graduate student, at the University of Central Missouri.

Purpose of the Study: The purpose of this study is to determine the effects of exercise on performance and body mass. BMI (body mass index) will be determined through the measurement of student’s height and weight. This measurement will be taken by the school’s nurse both before and after the program has started/ended. Performance improvements will be determined as well, through the use of a 600 meter run administered at the beginning, middle, and end of the program.

Request for Participation: We are inviting your child to participate in a study on performance and BMI. Participation is voluntary. If your child wishes to cease participation and revoke data it is his/her right to do so, and no penalization shall occur.

Exclusions: Your child must be at least 10 years of age to participate in this study. Pregnant women shall also be excluded.

Description of Research Method: This study involves a 6-12 week participation commitment (dependant of participation), where you will be subjected to exercise twice weekly at the duration of 45 min per session.

Privacy: Mr. Borger will be passing out/collating all forms, and conducting all of the after school program sessions. We will not record your child’s name, student number, or any information that could be used to identify you. All performance statistics will be kept confidential. Height, weight, and performance times will not be shared with other classmates. Data and consent forms will be kept confidential by Mr. Borger who will also be collecting and storing the data on the computer in a password protected zip file.

Explanation of Risks: The risks associated with participating in this study are similar to the risks of everyday life. Your child will be running, walking, and playing games on various surfaces in various weather conditions. All children will be under the supervision of a teacher at all times and also have access to the school nurse.

Explanation of Benefits: Your child will benefit from participating in this study through the learning of health and fitness techniques, the building of personal relationships with other classmates, and the hope for an improved body mass and exercise endurance rates.

Emergency Procedures Declaration: Testing will be done under observation of competent exercise science students that will follow emergency procedures if an untoward event were to occur. 911 will be called immediately upon observing a subject at health risk. Any costs incurred from treatment will be the responsibility of the subjects.

Questions: If you have any questions about this study, please contact Dr. Bias bias@ucmo.edu 660-543-4111 or Christian Borger borgerc@schenectady.k12.ny.us If you have any questions
about your rights as a research participant, please contact the Human Subjects Protection Program at (660) 543-4621.

If your child would like to participate, please sign a copy of this letter and return it to me. The other copy is for you to keep.

I have read this letter and agree to participate.

Parent’s Signature: ________________________________

Date: ________________________________________

Erik A. Borger