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COMPARISON OF CARDIOVASCULAR FITNESS IN HOME SCHOOL AND PUBLIC SCHOOL CHILDREN

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ABSTRACT

Neuville AL, Mohr CE, Pierquet MF Comparison of Cardiovascular Fitness in Home School and Public School Children. *Journal of Undergraduate Kinesiology Research*. 2006; 2(1):32-40. **Purpose:** The purpose of this study was to compare the difference in cardiovascular fitness between home school and public school children by using the mile run. **Methods:** Twenty six healthy subjects (14 boys, 12 girls) ages 10-14 years participated in the mile run. Each participant was asked to run or walk the mile giving their greatest effort. There were significant differences ($P \leq 0.05$) in VO_2 max levels between home school and public school children. **Results:** The home school children's mean VO_2 max was 48.7 $ml*kg^{-1}*min^{-1}$ and the public school children's mean VO_2 max was 42.2 $ml*kg^{-1}*min^{-1}$. The mean mile run time for the home school students was 9.0 minutes and 11.3 minutes for the public school students. **Conclusion:** The findings in our study are significant to physical educators and parents with middle school children. These findings suggest that home school children are aerobically fit than public school children.

Key Words: Aerobic Capacity, Body Composition, Obese, Overweight, Body Mass Index (BMI), Aerobic Fitness.

INTRODUCTION

Aerobic capacity (VO_2 max) reflects the maximum rate that oxygen can be taken up and utilized by the body during exercise (1). The magnitude of VO_2max depends on the capacity of the lungs to exchange oxygen between the air and blood in lung capillaries, the capacity of the cardiovascular system to transport oxygen to the muscles, and the muscles' capacity to use oxygen (1). Aerobic capacity is an important component of physical fitness because it reflects the overall capacity of the cardiovascular and respiratory systems and the ability to carry out prolonged strenuous exercise (1). The one-mile run test is one such field test that can be used to calculate aerobic capacity in children. The rate of oxygen uptake is related in part to the pace sustained, it is possible to estimate the highest rate of oxygen uptake possible from the average pace sustained (1). Aerobic capacity is

predicted from mile time, age, gender and body mass index using this equation: *VO_2 max = .21 (Age x Sex) - .84 (BMI) - 8.41 (Time) + .34 (Time^$_2$) + 108.94* based off a research project completed by Cureton et al (1).

According to the research project from Cureton and colleagues the mean VO_2 peak for males aged 8-11 and 12-17 years is 48.1 ml*kg^{-1}*min^{-1} and 52.4 ml*kg^{-1}*min^{-1} respectively. The mean VO_2 peak fore females aged 8-11 and 12-17 years is 44.1 ml*kg^{-1}*min^{-1} and 47.2 ml*kg^{-1}*min^{-1} respectively. The research also stated that the mean mile run/walk time for males 8-11 and 12-17 years is 9.1 minutes and 7.6 minutes respectively and for females 8-11 minutes and 12-17 years is 10.8 minutes and 8.5 minutes respectively (2).

Based on a research project to generate an equation to predict VO_{2peak} from 1-mile run/walk, researchers from the University of Georgia gathered demographic variables (age, height, weight, BMI, mile run/walk time, and calculated VO2peak scores) (2). According to the research their findings are:

MRW Time (min)	BMI = 15		BMI = 20		BMI = 25		BMI = 30	
	F	M	F	M	F	M	F	
Age = 10								
6	60	58	56	54	52	50	48	46
8	53	51	49	47	44	42	40	38
10	48	46	44	42	40	38	36	34
12	46	44	42	40	38	36	34	32
Age = 15								
6	61	58	57	54	53	50	49	46
8	54	51	50	47	46	42	41	38
10	49	46	45	42	41	38	37	34
12	48	44	43	40	39	36	35	32

Table 1 – VO_2 peak estimated by multiple regression analysis for different values of age, gender, BMI, and 1 mile run/walk time. (2)

According to a research study conducted by Oregon State University and Wichita State University in which they explored the relationship between cardiovascular fitness levels and body mass index status among an ethnically diverse sample of youth (3). This study included fifth, seventh, and ninth graders from California. Table 2 shows that there was a total of 767,809 youth (M = 389,925, F = 377,884). There was a variety of different ethnic backgrounds that participated in this study such as Asians, Filipinos, Hispanics, Pacific Islanders and White Non-Hispanics. All of the subjects ran/walked one. The results that were observed in this study were that there as a significant difference between White Non-Hispanic and their ethnic peers for each age – sex strata for mile run/walk (3). For the males, the mile run/walk differences among the ethnic groups minimized with increasing age while differences MRW increased for females with increasing age (3).

Age (yrs)	White Non-Hispanic (mean ± SD)	African American (mean)	Asian (mean)
Males 10-15	579.7 ± 139.6	553.0	564.2
Females 10-15	650.7 ± 135.3	603.4	650.1

Table 2. Mean Scores of the Mile/Run (in seconds)

The number of overweight students in the United States has been rising since the 1960s (4). In 2000, it was estimated that 15.3 percent of American youths, ages 6-11, are overweight (4). Overweight is defined as a body weight that exceeds some average for stature and perhaps age (5). Currently in today's society, children are engrossed in television viewing and computer activities which negatively influences their overall physical fitness. A common dilemma that physical education teachers are dealing with is that the average child watches 26 hours of television each week (6).

There is little data about the activity patterns on young children due to the challenges associated with assessing physical activity in children (1). A number of studies have sought to characterize activity patterns in children but the results vary by the methods that are used, which may be attributed to different definition of what it means for a child to be "active" (1). According to a self-reported survey, the percent of 5th and 6th grade students participating in regular activity were 49% for girls and 56% for boys (1). There was an older evaluation (1989) completed from the National Child and Youth Fitness Survey (NCYFS) that used the FITNESSGRAM standards to determine students' passing rates for the mile run. The results indicated that 69% of the boys and 63% of the girls passed (1).

There is a general belief in society that children today are considerably less fit today than children in previous generations but there is little objective data to indicate that this is true (1). This is actually not true, because children are as fit today as they were in previous decades on most tests of fitness (1). The exception is body fat (1). There are many influences that play a role in determining a students physical fitness level, such as heredity, maturation (age), environment, nutrition, adequate amount of sleep, and motivation.

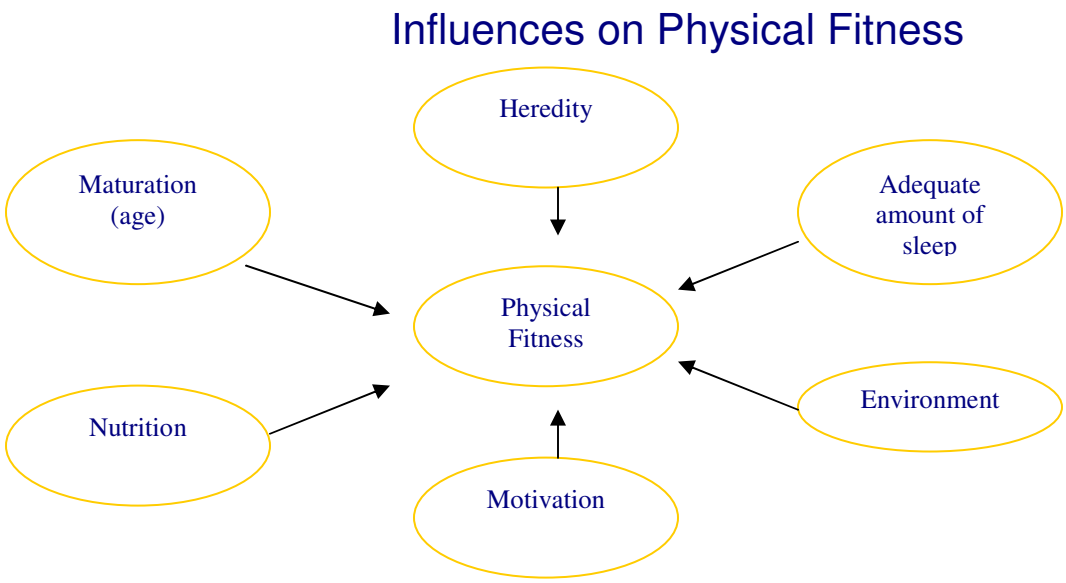

Figure 1. Influences on Physical Fitness

According to the 1999 Youth Risk Behavior Survey, two thirds (64.7%) of students nationwide participated in vigorous activities for at least 20 minutes on 3 or more days of the past week (1). Approximately one quarter (26.7%) of students nationwide reported participating in at least 30 minutes of moderate activity on five or more days of the week (1).

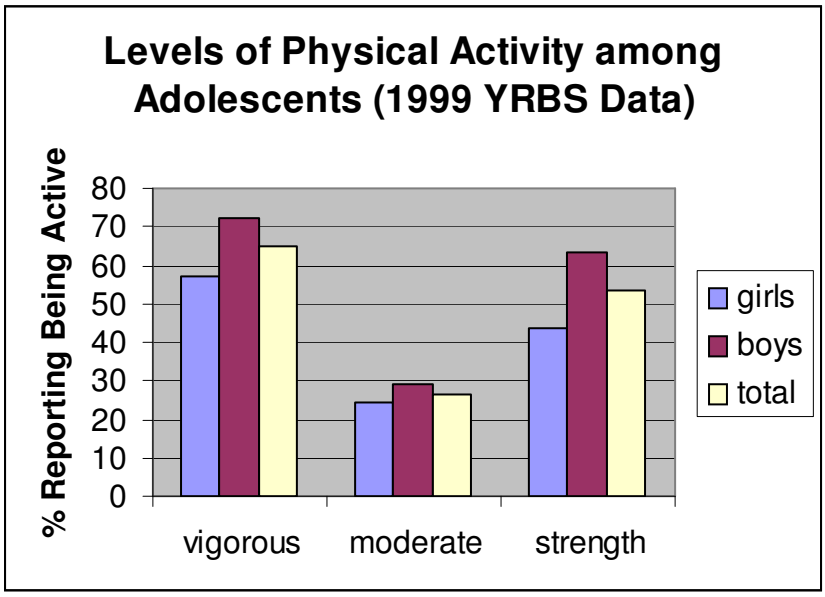

Table 3. Levels of Physical Activity among Adolescents (1999 YRBS Data)

The Council for Physical Education for Children (COPEC) of the National Association for Sport and Physical Activity (NASPE) recently developed physical activity guidelines for children, which are referred to as the NASPE Physical Activity Guidelines for Children (1). The major guidelines are summarized in Table 4.

- **Elementary school aged children should accumulate at least 30 to 60 minutes of age and developmentally appropriate physical activity from a variety of physical activities on all, or most days of the week.**
- **An accumulation of more than 60 minutes, and up to several hours per day, of age and developmentally appropriate physical activity is encouraged for elementary school aged children.**
- **Some of the child's activity each day should be in periods lasting 10 to 15 minutes or more and include moderate to vigorous activity. This activity will typically be intermittent in nature involving alternating moderate to vigorous activity with brief periods of rest and recovery.**
- **Extended periods of inactivity are inappropriate for children.**
- **A variety of physical activities selected from the Physical Activity Pyramid is recommended for elementary school aged children.**

Table 4: NASPE Physical Activity Guidelines for Children

Students that develop a habit of being physically active when they are young are more likely to remain active throughout their entire life (6). Many experts agree that obesity does not just appear in adults, but that it has its roots in childhood. According to the textbook Exercise Physiology, there is no one set definition for obesity but a common defining factor is a body mass index (BMI) greater than 30 kg/m^2(7). The relationship between physical activity and obesity is not as high as would be expected, especially among children (1). Even if a relationship is present, it is not clear that it is a "causal" factor because physical inactivity can lead to obesity but it is equally plausible that obesity leads to inactivity (1).

Body composition assessments are an important component of a physical education curriculum that is centered on the development of skills, lifetime physical activity and health behaviors (8). Body

composition is the proportion of fat, muscle, and bone of an individual's body (9). Within this study, we will be calculating body mass index (BMI) of all the individuals. BMI is measured by taking a height-weight ratio (7).

It seems that there are not many resources that study the cardiovascular fitness level of students involved in home school programs. From observations, it has been noted that there is a difference between the cardiovascular fitness levels between home school students and public school students. The purpose of this study is to compare the aerobic fitness values of home school and public school students. The independent variables will be the home school and public school students. The dependent variable is aerobic fitness values. It was hypothesized that there would be differences in aerobic fitness between home school and public school children.

METHODS

Subjects

Twenty six subjects (14 boys, 12 girls; ages 10 to 14 years) from a home school program and public school program were recruited to perform in this study. Five boys and four girls were from the home school program and 9 boys and 8 girls were from the public school program. The subjects were chosen on a voluntary basis and were random. The mean age, height, weight, and body composition are reported in Table 5.

Home School	Age (yrs)	Wt (kg)	Ht (m)	BMI (m/h^2)	Mile Run Time (min)
Mean	11.4	43.3	1.6	17.7	9.0
Standard Deviation	1.6	8.2	0.1	2.2	1.3

Public School	Age (yrs)	Wt (kg)	Ht (m)	BMI (m/kg^2)	Mile Run Time (min)
Mean	11.6	50.1	1.5	22.7	11.3
Standard Deviation	0.5	14.7	0.2	6.0	2.9

Table 5. Demographics

All subjects signed a written informed consent before volunteering for the study, and the University Human Subjects Institutional Review Board approved all procedures. The independent variables are the home school and public school children and the dependent variable is aerobic fitness values.

Instrumentation

The instruments involved were a stop watch, scale, and a tape measure. Measurement for weight was measured in pounds and then converted into kilograms. Height was measured in inches and later converted into meters. Time was measured in minutes and seconds. Prior to the study the instruments were calibrated correctly and test trials were practiced.

Procedures

The procedure included measuring the height and weight of each individual participating in the study. Height was taken by using an Ace Hardware meter stick model number 11158 produced in Eau Claire

Wisconsin for the home school students and a Champion tape measure for the students at both the home school and public school. Weight was measured by using a Detecto scale at both locations. Both measurements were taken before the student actually ran the mile. The public school students were then timed running four laps outside around a soccer field and on the track. The home school children were timed running eight laps on an indoor track. Time was recorded using a Seiko System S149 stop watch model number 5129. There were no prior requirements to participating in the study and students were asked participate as volunteers. The students were told to give their best effort in running the mile and could also walk if they had to. It was recommended that the participants walked a few warm up laps and stretched before running the mile. The participants were also told to walk a cool down lap and stretch again once they completed their mile. The only time recorded was the time it took to run the actual mile. Prior to the study, the running course was walked and looked over for safety considerations. Orange cones were places in hazardous locations to help keep participates safe. The procedure took about an hour and half to complete.

Statistical Analysis

Independent t- test was performed to find the differences between the VO_2 max of home school and public school children. Aerobic capacity is predicted from mile time, age, gender and body mass index using this equation: VO_2 max = .21(Age x sex) .84(BMI)-8.41(Time) + .34 (Timeˆ2) + 108.94 based off a research project completed by Cureton et al. (1). Level of significance was set at $p < 0.05$.

RESULTS

In our research project, there was significant difference in cardiovascular fitness between home school ($M=48.7$ ml*kg^{-1}*min^{-1}) and public school children ($M=42.2$ ml*kg^{-1}*min^{-1}), $t(24) = 2.636$, $p<0.05$. Students participating in the home school program have a higher VO_2 max value than public school students.

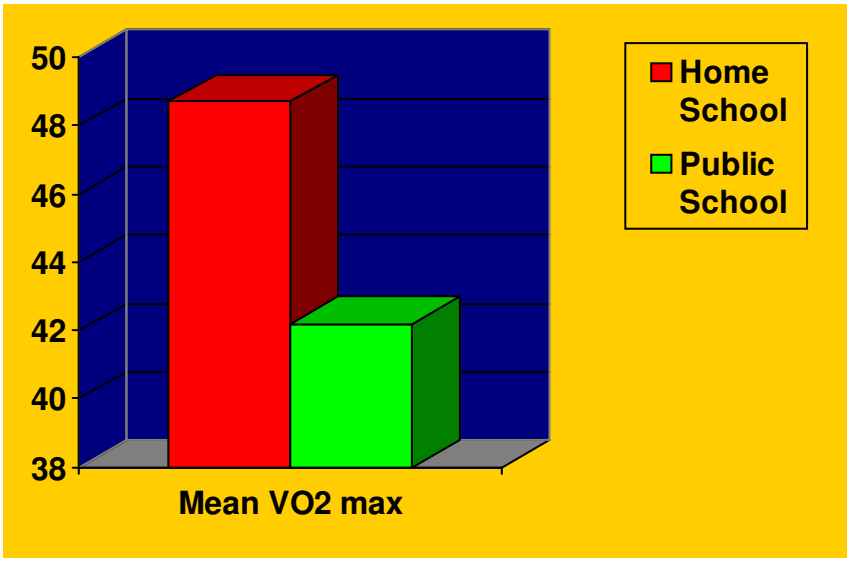

Figure 2. Mean VO_2 max

	t-value	Degree of Freedom	Sig. (2-tailed)	Mean Difference	Standard Error Difference
Mile	**2.6**	**24**	**.014**	**2.7**	**1.0**

Table 6. Independent t-test for the mile run

DISCUSSION

The results of our study led us to reject the null hypothesis and our research hypothesis. There *was* significant difference between the cardiovascular fitness values for home school student when compared to public school students. The relevance of these findings was that home school students have a higher aerobic fitness values according to our predicted calculations through the mile run/walk.

In our research project the mean VO_2 max scores for the home school and public school students were 48.7 $ml*kg^{-1}*min^{-1}$ and 42.2 $ml*kg^{-1}*min^{-1}$ respectively. According to the past research conducted by Cureton and colleagues, see figure 3, our subjects from home school, scored above average for their age. Public school students scored below average for their VO_2 peak. With the same research all the home school students, male and female, ran/walked the mile within the mean time allotted for their age. A total of four public school students, 2 males and 2 females, ran/walked the mile within the mean time allotted for their age.

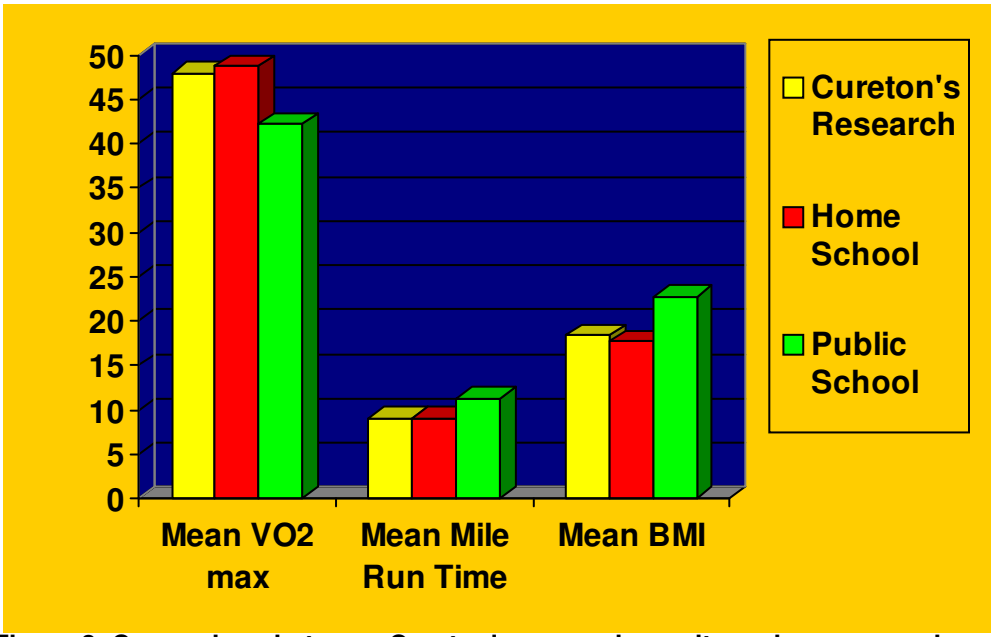

Figure 3. Comparison between Cureton's research results and our research results

Limitations

The major limitation within our study was that we had a low number of subjects from both groups. Due to the fact that home school students were allowed to discuss whether or not they wished to run/walk the mile for our research project. The public school students were required as part of their physical education class to partake in the mile run/walk, but then volunteered their mile run/walk time, height, weight, and age afterwards to be part of the study.

Lifestyle choices may also play a role in our research project due to the fact that we used two independent groups. Areas that may be included in lifestyle choices are the amount of physical

activity the student is involved in outside of the physical education classroom, nutrition factors, and the amount of television that is viewed during the day.

Another factor that may have influenced the results was that the home school students knew about the research study before they ran the mile. Therefore they may have been more motivated to do their best, whereas the public school students were unaware of the motives. Public school students ran/walked their mile in a large group which may lead to the possibility of running with a friend instead of doing their personal best effort. The home school students ran/walked the mile run in a small group setting which may have motivated them to run faster when another subject was in the lead. The home school students ran/walked their mile on an indoor track whereas the public school students were on an outdoor course (partial track and soccer field) irregardless of the weather. The location of the mile run is a limitation because the subjects were wearing more clothing since temperatures were beginning to cool. Environmental issues may be a factor in the two subject groups due to temperature and wind. Surfaces between the two test courses may also be a limitation due to different surfaces outside.

Applications for Findings

The findings of this study could be applied towards creating the basis for a physical education curriculum for either home school or public school setting. Cardiovascular fitness is important in every child's education therefore the physical education teacher should incorporate this into their daily lesson plans. Techniques to incorporate this into the classroom is limiting teacher talk time, set routines for the students, and have the equipment set up prior to the students arriving. These techniques are important to consider because it will allow for more activity time for the students. These results could also be applied to physical education teachers who may encounter home school students transferring into public school or parents if they choose to educate their child elsewhere.

Recommendations

Our study demonstrated that home school students have a higher predicted VO_2 max score than public school students. With this in mind, our recommendation is that public school physical education curriculum includes more cardiovascular fit activities. Another recommendation is that it is important to educate students on the importance of fitness and promote activities outside of the classroom.

Future Research

In conducting this research problem we noticed that there a limited amount of research dealing with younger childrens' cardiovascular fitness levels. There has been no published research concerning home school students or comparing them with public school students. Other recommended areas of research could include actual measurement of VO_2 max levels between home school and public school students and/or gender considerations. We recommend that there be additional general research conducted between these two groups in a range of areas including sport related skills and other fitness categories.

CONCLUSIONS

Aerobic capacity is an important component of physical fitness because it reflects the overall capacity of the cardiovascular and respiratory systems and the ability to carry out prolonged strenuous exercise (1). After conducting our statistical analysis on the aerobic fitness values of home school and public school children, we have found that home school students have a significantly higher VO_2 max value compared to public school students. Physical activity is the base of a person's cardiovascular fitness therefore, we recommend the importance of physical activity at a young age, so they are more likely to continue physical activity through adulthood. The groups that this recommendation may be applicable to include parents, physical education teachers, and any group involved with children's recreational activities. This research project studies just one such topic of interest comparing home school and public school students, but there are further areas of research that may be discovered.

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