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**Morgan, Loretta Netherton**

A STUDY OF THE EFFECTS OF TWO PHYSICAL FITNESS PROGRAMS ON SECOND AND FIFTH GRADE CHILDREN IN TERMS OF ENDURANCE, ABDOMINAL STRENGTH, AND FLEXIBILITY

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# A Study of the Effects of Two Physical Fitness Programs on Second and Fifth Grade Children in Terms of Endurance, Abdominal Strength, and Flexibility

Loretta N. Morgan

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A Study of the Effects of Two Physical Fitness Programs on Second and Fifth Grade Children in Terms of Endurance, Abdominal Strength, and Flexibility

APPROVED:

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# Abstract

A Study of the Effects of Two Physical Fitness Programs on Second and Fifth Grade Children in Terms of Endurance, Abdominal Strength, and Flexibility

Loretta N. Morgan

Second and fifth grade students were involved in an 8-week, 5- or 10-minute physical fitness program. Four experimental groups (2 second and 2 fifth grades) and two control groups (1 second and 1 fifth grade) were pretested and posttested in the 9-minute run, sit-ups, and the sit-and-reach. The data were subjected to an analysis of variance to determine if there are significant differences in mean gains between experimental and control groups, between sexes within each group, between the 5- and 10-minute physical fitness program, and between second and fifth grade experimental groups. Results reveal significance for three experimental groups in the 9-minute run and one experimental group in the sit-ups test. The only group to show significant differences between sexes is the fifth grade control group in all three tests. No significance is revealed between the

5- and 10-minute program or between the second and fifth grade groups. The .05 level was utilized to determine significance.

Acknowledgments

As in this and all accomplishments the writer would first like to praise Jesus Christ.

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# Chapter 1

## Introduction

In 1979 the United States Public Health Service published a landmark document, Promoting Health/Preventing Disease: Objectives for the Nation. This document set 226 specific health objectives to be reached by the year 1990 and prompted the National Children and Youth Fitness Study (NCYFS). Much like the Kraus-Weber youth fitness study of 1966, the results showed American children lagging far behind expected physical fitness levels.

Nationally, 80.3% of students in grades 5 through 12 were enrolled in physical education classes. However, the average frequency for classes is only 3.6 times per week or 2 hours and 21 minutes per week (Pate, Ross, Dotson, & Gilbert, 1985). One of the health objectives listed in Promoting Health/Preventing Disease: Objectives for the Nation was that, by 1990, 60% of the children and youth would attend daily physical education classes.

The question in research is that even if this objective is met, how much effect can a physical fitness program within the physical education class have on children? There is disagreement within the ranks of physical educators concerning physical fitness being the primary objective of physical education classes. "Philosophically, physical educators weaken their position as a profession by lack of consensus on the primary goal of education" (Steinhardt & Stueck, 1986, p. 25). Some believe that developing appropriate skills and attitudes toward physical fitness will be more beneficial in lifetime fitness than actually developing physical fitness.

Research findings are contradictory concerning results of physical fitness programs for children. Because the life style of a child is much more active than that of an adult, improvement in physical fitness due to a training program is less likely to be significant. According to Shepherd (Stewart & Gutin, 1976), "most children are naturally active and can operate near their maximal potential for $Vo_2$ max without formal training" (p. 115).

In 1984 the President's Council on Physical Fitness and Sports conducted public hearings. The following statement is one of several that was published from those hearings.

> Children and youth respond quickly to appropriate vigorous activity when properly motivated. They are capable of substantial improvements in six to eight weeks in any one of the components of fitness, but must continue a basic program or all gains will be lost quickly. (Hayes, 1984, p. 30)

Where the stress imposed by the training program was greater than the self-imposed, active life style of the child, improvements have been more likely to result. The NCYFS reports that 5th- through 12th-grade students average 760 minutes of physical activity weekly outside the physical education class as opposed to 141 minutes per week in a physical education class. This kind of difference in terms of just quantity of time would probably require a very intense program to initiate significant improvement.

Other sources of controversy include age-related and sex-related parameters of physical fitness. Norms for the Youth Fitness Test (YFT), Health, Related Physical Fitness Test (HRPFT), and the NCYFS show continual improvement in test scores at least through the onset of puberty. Presumably, this improvement pattern would hold true in the absence of physical fitness programs, indicating a strong correlation between age and fitness. However, in the case of endurance, the $Vo_2$ max improves linearly with body weight implying that performance should remain fairly constant. Because physical fitness norms and research do not bear out this constancy of performance, researchers have looked elsewhere for the answers. Other physiological factors (economy in $O_2$ use or $Vo_2$ submax gains), learning, and motivation have been suggested as possible solutions.

It is commonly believed that at any age the typical boy is capable of outperforming the typical girl on almost any test of physical fitness. The norms from the YFT, HRPFT, and NCYFS tend to validate this belief with the exception of flexibility. The pattern of improvement from ages 10 through 18 is fairly similar for boys and girls. There is a misconception that girls peak right before puberty and then decline rapidly while boys peak shortly after puberty and then reach a plateau.

The NCYFS showed boys continue to improve through high school on flexibility, abdominal strength, body composition, and upper body strength. Girls improve continually on flexibility and abdominal strength. Upper body strength does not change much after puberty, and endurance seems to decrease slightly (Ross, Dotson, Gilbert, & Katz, 1985b).

The big difference between the sexes seems to be body composition.

> The increase in [the percent of] fat in girls that occurs following puberty is particularly important in explaining the progressive widening of the sex difference in distance running performance that develops during adolescence. The increase in body fat is regarded as the primary cause of decrease in $Vo_2$ max that occurs in girls during this time. (Cureton, 1982, p. 66)

It is important for physical educators to have accurate information about the effects of physical fitness programs on children and youth. It does not appear wise to generalize the findings of the adult population to children and youth. Researchers should attempt to make such information available and usable to the practitioner. The practitioner should make a similar effort to apply the findings to the classroom setting.

## Statement of the Problem

The purpose of this study was to determine if an 8-week physical fitness program conducted for 5 or 10 minutes, three days a week, would significantly affect the physical fitness level of either second or fifth grade students as assessed by endurance, abdominal strength and endurance, and flexibility components of the HRPFT.

## Significance of the Study

The physical education profession claims to be the caretaker of youth physical fitness. The recent NCYFS, which shows the level of youth physical fitness falling further behind, is an embarrassment to the profession. Reiff (Johnson, 1985) calls the condition of many young children today a "national tragedy." He further states that "one of every six American children is so unfit he or she is classified as 'physically underdeveloped' by the standards of the President's Council on Physical Fitness and Sports" (p. 33).

The reports are shocking to a nation in the midst of a fitness craze. But it seems that this movement has not filtered down to the youth of this nation. According to Johnson (1985), the physical education profession cannot even take credit for inspiring the adult physical fitness boom. This leaves an opening for business to try to fill the gap of where children physical fitness levels are now and where the populace would like for them to be, in much the same way business has infiltrated adult physical fitness.

Where would such a move leave physical education as a profession and where would it leave the children of this nation? Historically, physical education curricula were based purely on fitness concepts. Recently, fitness has become less of an explicit objective and, consequently, the profession may have abandoned its primary justification for inclusion in the school curriculum. If physical educators are to be the ones to fill this physical fitness gap, the profession needs more information about the specific needs of children and how they can best be met. It is hoped that this investigation will add to this field of knowledge.

## Delimitations

1. The population for this study was delimited to three second grade and three fifth grade classes.

2. The population for this study was further delimited to only those students enrolled in those selected classes, present, and able to participate in the pretest, eight-week physical fitness program, and the posttest.

3. The study was limited by not having all of the experimental and control groups at the same school,

enrolled in the same physical education program, and under the direction of the same physical educator.

4. The study was limited by using grade level instead of age to categorize experimental and control groups.

5. The study was limited by variable weather and field conditions during the testing of the nine-minute run.

Definitions of Terms

Abdominal strength--for the purpose of this study refers to the ability of the rectus abdominis muscle to contract and thus cause trunk flexion.

Appropriate physical activity--"exercise which involves large muscle groups in dynamic movement for periods of 20 minutes or longer, three or more times a week, and which is performed at an intensity requiring 60 percent or greater of an individual's cardiorespiratory capacity" (Ross, Dotson, & Gilbert, 1985, p. 83).

Endurance--the ability to sustain movement (usually involving the large muscle groups) for a considerable length of time.

Flexibility--the ability to move through a range of motion with no emphasis on speed. Flexibility is specific to a joint or area. For the purpose of this study, the specificity was to the lower back and posterior thigh (Corbin & Noble, 1980).

Sit-and-reach test--is the test described by the HRPFT Manual (1980) to evaluate the flexibility of the lower back and posterior thighs.

Sit-up test--is the test described by the HRPFT Manual (1980) to evaluate abdominal muscle strength and endurance.

9-minute run--is the test described by the HRPFT Manual (1980) to measure maximal functional capacity of the cardiorespiratory system.

$Vo_2$ max--"the maximum amount of oxygen that can be consumed per minute during maximum exercise" (Noble, 1986, p. 586).

## Basic Assumptions

1. It was assumed that students in the experimental and control groups had comparable physical education classes except for the physical fitness program.

2. It was assumed that students worked, during the physical fitness program, at an intensity of 60% or more of their maximum cardiorespiratory capacity.

3. It was assumed that the 9-minute run accurately measured endurance, the sit-up test accurately measured abdominal strength and endurance, and that the sit-and-reach test accurately measured lower back and posterior thigh flexibility.

## Hypotheses

For the purpose of this study the following hypotheses were developed:

1. There will be no significant difference in the mean gains between Experimental Group I (2nd grade, 5-min) and Control Group I (2nd grade) for each of the three test components.

2. There will be no significant difference in the mean gains between Experimental Group III (2nd grade, 10-min) and Control Group I (2nd grade) for each of the three test components.

3. There will be no significant difference in the mean gains between Experimental Group II (5th grade, 5-min) and Control Group II (5th grade) for each of the three test components.

4. There will be no significant difference in the mean gains between Experimental Group IV (5th grade, 10-min) and Control Group II (5th grade) for each of the three test components.

5. There will be no significant difference between the mean gains for boys and girls within Experimental Group I (2nd grade, 5-min) for each of the three test components.

6. There will be no significant difference between the mean gains for boys and girls within Experimental Group II (5th grade, 5-min) for each of the three test components.

7. There will be no significant difference between the mean gains for boys and girls within Experimental Group III (2nd grade, 10-min) for each of the three test components.

8. There will be no significant difference between the mean gains for boys and girls within Experimental Group IV (5th grade, 10-min) for each of the three test components.

9. There will be no significant difference between the mean gains for boys and girls within Control Group I (2nd grade) for each of the three test components.

10. There will be no significant difference between the mean gains for boys and girls within Control Group II (5th grade) for each of the three test components.

11. There will be no significant difference in the mean gains between Experimental Group I (2nd grade, 5-min) and Experimental Group III (2nd grade, 10-min) for each of the three test components.

12. There will be no significant difference in the mean gains between Experimental Group II (5th grade, 5-min) and Experimental Group IV (5th grade, 10 min) for each of the three test components.

13. There will be no significant difference in the mean gains between Experimental Group I (2nd grade, 5-min) and Experimental Group II (5th grade, 5-min) for each of the three test components.

14. There will be no significant difference in the mean gains between Experimental Group III (2nd grade, 10-min)

and Experimental Group IV (5th grade, 10 min) for each of the three test components.

## Review of Related Literature

### Introduction

In 1980 the United States Public Health Service released Promoting Health/Preventing Disease: Objectives for the Nation which specified 226 health objectives to be achieved by the year 1990. The report specified five objectives in the area of physical fitness and exercise. This prompted the establishment of the NCYFS which looked at a large sampling of 10 to 17 year-olds in relation to three of the objectives which focused on youth physical fitness:

1. 60 percent will attend physical education class daily
2. 70 percent will periodically have their fitness levels tested
3. 90 percent will participate in physical activities that are appropriate for the maintenance of an effective cardiorespiratory system. (McGinnis, 1985, p. 44)

The national government and the populace seem concerned about the fitness of youth in this country. The fitness boom that has reached American adults does not seem to have had much impact on the youth. Steinhardt and Stueck (1986) state that because the present profiles are so low, the 1990 objectives will not be met without intervention. Further discouragement comes from the omission of physical education from the 1983 report, A Nation at Risk: the Imperatives for Educational Reform. The findings of the NCYFS present a real challenge to physical educators. At the time of the study, only 36.3% of the students in grades 5 through 12 took daily physical education. Only 58.9% engaged in appropriate physical activity year around in contrast to the 90% set as an objective by 1990 (Ross & Gilbert, 1985). Steinhardt and Stueck (1986) reported that in 1984, according to the Fitness-gram project, less than 1% of the 84,000 tested in the Youth Fitness Test reached the 85th percentile.

Guy Reiff of the University of Michigan calls the condition of many young children today a "national tragedy."

> Reports indicate that one of every six American children is so unfit that he or she is classified as "physically underdeveloped" by the standards of the President's Council on Physical Fitness and Sports. In addition, from 13 to 20 percent of American children between the ages of 6 and 11 are overweight, and as many as 34 percent have high serum cholesterol levels. (Johnson, 1985, p. 33)

National studies indicate that fitness levels have not increased over the last two decades. Even with these alarming statistics the debate within the physical education profession continues. Is the major purpose of public physical education to develop physical fitness or to develop skill? Johnson (1985) states that "Physical fitness is, and always has been the primary justification for physical education in our schools" (p. 34). Proponents of this viewpoint believe fitness should be designed as the basic element of the program and all other objectives, such as skills and attitudes, secondary.

Those who view skill development as the primary objective believe that equipping students with proper skills and attitudes about fitness will prove to be more valuable in achieving lifetime fitness.

> If children achieve fitness but hate to exercise we have won the battle and lost the war. We must recognize that because fitness is transient, helping children keep their fitness and exercise dreams alive is more important than getting children fit. (Corbin, 1985, p. 83)

Many physical education programs reflect a compromise between the two views. The problem with such a compromise is that it often nullifies the fitness component because of the intensity, frequency, and duration qualifications required to meet the definition of appropriate physical activity. Jack Wilmore (1982) defines appropriate physical activity as "exercise which involves large muscle groups in dynamic movement for periods of 20 minutes or longer, three or more days per week, and which is performed at an intensity requiring 60 percent or greater of an individual's cardiorespiratory capacity" (p. 42).

The NCYFS found that the average time spent by youth in grades 5 through 12 in physical activities other than the school's physical education program was 760 minutes per week. When this is compared to 141 minutes per week for the same group in physical education class, it can be readily seen that the overwhelming majority of physical activity takes place outside physical education class (Ross, Dotson, Gilbert, & Katz, 1985a). The combined total of 901 minutes of activity weekly might cause questioning of the statistical information indicating that American youth are physically unfit. The American College of Sports Medicine addresses the concept of the normal, maximally trained state in children due to vigorous daily activity. "Most of this exercise is short-burst, high-energy in nature. Such activities are typically not sufficiently sustained to improve aerobic fitness" (Rowland, 1985, p. 493).

Youth Physical Fitness Studies

There are controversial findings in studies of aerobic fitness programs with children as subjects. The practice of generalizing the findings derived from adult populations to elementary school populations violates the basic principles of reliability and validity (Jackson & Coleman, 1976).

It was reported by Astrand (1956) that children have a relatively higher metabolic rate than adults and that they have a higher aerobic capacity than adults when compared on the basis of body weight. Children lead a more active life style than adults. This habitual level of activity is probably the reason the responses to training programs differ between children and adults.

For an adult, participation in a training program often results in a radical change in activity pattern and thus aerobic fitness gains. For training to be effective in increasing the aerobic capacity of children, it must clearly be of greater intensity than the habitual activity of which they are accustomed (Stewart & Gutin, 1976).

In a study by Stewart and Gutin (1976), 10- to 12-year-old boys were involved in an eight-week interval training program at 90% of their $Vo_2$ max. The results indicated that the training was not enough of an additional stress to improve $Vo_2$ max. They concluded that the stresses induced by the training program were probably small as compared to the overall activities of the children during the eight-week period.

The Daniels and Oldridge study (1971) of boys 10 to 15 years of age has been criticized by some because the duration of 22 months was thought to induce age-related factors into the results. They concluded from the study that "growing boys show a significant increase in $Vo_2$ max over 22 months of running training, but not greater than weight increases; the result is no change in $Vo_2$ max/Kg" (p. 164). The study did indicate a significant improvement in efficiency of running (decrease in $Vo_2$ max/KG at a submaximal running velocity). However, it was pointed out that this change seemed to be more a function of growth than training.

A study (Brown, Harrower, & Deeter, 1972) which involved the testing of girls 8 to 13 years of age after 6 and 12 weeks of cross-country running showed physiological adaptation to training to be similar to that seen in adults. After training, the $Vo_2$ max of the runners increased on the average of 18.5% at 6 weeks and 26.2% at 12 weeks. There was no reported change on the $Vo_2$ max of the control group for the same time periods.

According to Shepherd, "most children are naturally active and most can operate near their maximal potential of $Vo_2$ max without formal training" (Stewart & Gutin, 1976, p. 115). In a study by Hamilton and Andrew (Rowland, 1985), it was concluded that a lack of difference in levels of aerobic fitness between prepubescent hockey players and non-players was likely due to the high levels of activity in the control children. The American Academy of Pediatrics noted that the "preschool child who characteristically uses his large muscles during many hours of the day is continuing a self-imposed program of physical fitness" (Rowland, 1985, p. 493).

Contradictory findings were reported in several studies.

> Seliger et al. reported that minute by minute heart rates of 12 year old boys over a 24-hour period reached moderate intensity only 3 percent of the time. Saris reported that kindergarten children's heart rate exceeded 176 beats per minute only 4 to 15 minutes per day. Gilliam et al. reported that the voluntary activity patterns of 6 and 7 year old children seldom reached acceptable levels of intensity, with girls already more sedentary than boys. (Seefeldt, 1984, pp. 36-37)

The NCYFS of 5th- through 12th-grade students reported that 58.9% participate in appropriate physical activity year around. This percentages increases to 89.9% in the summer and decreases to 52.6% in the winter (Ross, Dotson, & Gilbert, 1985). All of these figures are presently short of the 1990 goal of 90%. The fluctuation in the fitness level of students based on seasonal percentages could have a substantial effect on the results of a fitness program. For example, the results of a fitness program conducted in the winter would probably show more improvement than those at the close of summer because fewer students would begin the program at an appropriate fitness level.

Rowland (1985) reports that when endurance training programs are of sufficient duration and intensity, an improvement in aerobic power in children can be elicited similar to that observed in adults. A synthesis of the literature reviewed by Rowland suggests that in studies in which there were no significant gains in aerobic power following a training program, flaws could usually be found in the experimental design. The flaw was often a failure to describe the intensity, frequency, and/or duration of the program.

"Six of eight studies in prepubescent children satisfying these standards [adult-related criteria for intensity and duration] showed significant improvement in aerobic power with training" (Rowland, 1985, p. 496). The mean $Vo_2$ max elevation of those six stuides was 14% which is comparable to the training effects of the adult programs. Reports of improved $Vo_2$ max with training in children have involved studies at least 12 weeks long and have involved intense work. The conclusion reached was that improvement in aerobic power was possible in prepubescent children but only after prolonged, vigorous training regimens.

In a study (Mosher, Rhodes, Wenger, & Filsinger, 1985) of a 12-week interval training program involving prepubertal, elite-level male soccer players, the aerobic and anaerobic fitness levels were significantly improved. The control group was from another soccer team within the same league. According to research this elite-level subject would be less likely to make a significant increase in his aerobic fitness level. "Improvement in $Vo_2$ max with endurance training in adults is inversely related to the level of aerobic fitness at the onset of the training program" (Rowland, 1985, p. 495). Stewart and Gutin (1976) concur that this is true for youth.

A study of running economy of 10-year-old children was conducted by Petray and Krahenbuhl (1985) involving three treatments: instruction on the technique of running, running training, and a combination of instruction and running training. At the conclusion of the 12-week program no significant alterations in running economy or technique were produced.

Evidence suggests that aerobic trainability before puberty is less likely and is less significant although performance can be improved. This has led some researchers to believe that there is a critical developmental age when physical trainability can be expected and that age coincides with the adolescent growth spurt (Rowland, 1985). Others (Mosher, Rhodes, Wenger, & Filsinger, 1985) have suggested 11 years of age to be the lower limit at which there is any likelihood of achieving any training effects.

$Vo_2$ max Correlation to Cardiorespiratory Fitness in Children

"$Vo_2$ max is widely accepted as an important determinant of cardiovascular-respiratory fitness and as a predictor in endurance sports" (Daniels, Oldridge, & Nagle, 1978, p. 200). "Maximal oxygen uptake [$Vo_2$ max] has generally gained acceptance as being the most accurate measure of oxygen transport system function" (Krahenbuhl, Pangrazi, Petersen, Burkett, & Schneider, 1978, p. 208). "Research conducted on adults has shown maximal aerobic capacity [$Vo_2$ max] to be the primary determinant for success in distance running" (Petray & Krahenbuhl, 1985, p. 251).

These reported high correlations between $Vo_2$ max and endurance fitness for the adult population should not be generalized to the youth populace. Krahenbuhl and Pangrazi (1983) report that although there is a relationship between a child's $Vo_2$ max and distance running performance, $Vo_2$ max appears to account for less variation in children's running performance than for adults. One study (Pangrazi, Burkett, Schneider, & Petersen, 1977) provided evidence that children use more $0_2$/Kg at submaximal running speeds than do older children or adults. "This lower efficiency may vary according to maturity, which may help explain the relatively low correlations between $Vo_2$ max and running performance of children of approximately the same age" (p. 39).

Daniels et al. (1978) studied the $Vo_2$ max of 10- to 18-year-old runners in relation to maturity and performance.

Linear increases in weight and $Vo_2$ max were r .99. This tendency was not unexpected since $Vo_2$ is related to muscle mass. While there was no significant increase in $Vo_2$ max/Kg, there was significant ($p<.01$) linear decrease in $Vo_2$ submax. Improvements in performance were dramatic which indicated that relatively large changes can occur among youth in the absence of $Vo_2$ max improvement. They concluded that both growth and training contribute to the aerobic demands of submaximal running.

Distance Runs Correlation to Cardiorespiratory Fitness in Children

Dolittle and Bigbee (1968) produced a correlation of r .62 between the 600-yard run-walk and $Vo_2$ max for junior high school boys. Vodak and Wilmore (1975), in a study of 9- to 12-year-old boys, reported a slightly lower correlation (r .50) for the same test.

The correlation between $Vo_2$ max and distance runs improves with an increase in time or distance up to a point. That point is the source of some controversy in research. Although the 600-yard run-walk is currently being used in the American Alliance for Health, Physical Education, Recreation, and Dance YFT, most studies indicate a relatively low correlation to $Vo_2$ max when compared to greater distance runs.

In an extensive study (Jackson & Coleman, 1976) of more than 1600 boys and girls, distance runs of 3, 6, 9, and 12 minutes were compared to $Vo_2$ max. The 9-minute run produced correlations to $Vo_2$ max of .82 for boys and .71 for girls. Jackson and Coleman further state that running an additional 3 minutes did not significantly improve the validity, thus giving credence to the 9-minute run. The correlations for the 3- and 6-minute runs were significantly less.

On the other hand, Cooper (Jackson & Coleman, 1976), when testing adult subjects, reported a product-moment correlation of .90 between $Vo_2$ max and the 12-minute run. Dolittle and Bigbee (1968) found a similar correlation (r .90) when 153 ninth-grade boys were tested. Krahenbuhl et al. (1978) report:

> The relationship of $Vo_2$ max/Kg with performance on the timed runs increased with distance. Both the 1200- and 1600-meter runs were found to be significantly related to $Vo_2$ max/Kg. The coefficients for the 1600-meter run were higher and were the only ones that were above r .60. (p. 211)

Cureton, Boileau, Lohman, and Misner (1977) studied 196 children, ages 7 to 12 years, investigating $Vo_2$ max correlations to distance runs. Although their data supported the claim that there was a higher correlation of $Vo_2$ max to the 1-mile run than to the 600-yard run-walk, neither showed a strong correlation. "In the present study, $Vo_2$ max was not found to be the only significant, or even the predominant determinant of either the 600-yard run-walk or the mile run" (p. 275).

Primary-aged children were involved in a study (Krahenbuhl et al., 1978) to determine the validity of using timed distance runs to predict cardiorespiratory fitness. The results were based on the assumption that "the reliability of $Vo_2$ max measurement in children is acceptable only with the presence of a plateau at maximum, therefore it was limited to subjects where leveling was achieved" (p. 210). They found that there was a relationship between $Vo_2$ max and performance on timed runs and that relationship improved with increased distance. The 1600-meter run (the longest one tested) had the highest coefficient (r .60).

In 1982 Kirk Cureton synthesized his and other studies to formulate the following statement:

> In studies that used samples of at least 25 children or adolescents and distance runs of approximately one mile or more in distance or 9 minutes or more in duration, correlations between distance running performance and $Vo_2$ max have ranged from approximately .6 to .8 indicating that, on the average, approximately one-half of the variance on distance running tests reflects variance in $Vo_2$ max. Although limited data on the relation of $Vo_2$ max and distance running

> performance in children are available, information suggests that only 25% or less of the variance in distance running performance is actually related to cardiorespiratory capacity in children. (p. 65)

If a variance of 50 to 75% between $Vo_2$ max and distance runs is not attributable to cardiorespiratory capacity, what other factors are involved? Cureton et al. (1977) lists three elements in addition to cardiorespiratory capacity: body size, body composition, and running speed. Krahenbuhl and Pangrazi (1983), in addition to the aforementioned factors included leg length, maturity, and coordination. Massicottee, Gauthier, and Markon (1985) added mechanical efficiency. Vodak and Wilmore (1975) claim that lack of experience in distance running and/or competition, and lack of motivation might supersede all of the physical factors. Krahenbuhl et al. (1977) also recognized the importance of the psychological aspects of endurance as being "the individual's willingness to accept and endure discomfort, a poorly developed concept of pacing, or a short attention span for monotonous tasks" (p. 37). It was also reported that $Vo_2$ max is influenced by genetic make-up and the state of training of the individual.

Massicottee et al. (1985) state that "the running time or distance to be covered should be sufficiently long to ensure the energy cost is derived from the aerobic metabolic source and sufficiently short, in order that motivation is not a limiting factor of performance, especially among the young" (p. 14). This might suggest that the time or distance would vary with the age of the child.

Some research (Gutin, Fogle, & Stewart, 1976; Stewart & Gutin, 1976; Daniels, Oldridge, & Nagle, 1978; Krahenbuhl & Pangrazi, 1983) suggest that measures other than $Vo_2$ max might be more appropriate for assessing children's cardiorespiratory capacity. Two studies (Gutin, Fogle, & Stewart, 1976; Stewart & Gutin, 1976) recommend testing the submaximal heart rate because most performance is submaximal and because it was more closely correlated to performance rates. Their data showed that improvements could be made in submaximal responses and performance without affecting the $Vo_2$ max. Similarly, Daniels, Oldridge, and Nagle (1978) reported significant improvement in 1-mile and 2-mile running performance and $Vo_2$ submax in the absence of improved $Vo_2$ max. Krahenbuhl and Pangrazi (1983) reported an association between blood lactate levels and differences in distance-running performance for 10-year-old males.

Children and Endurance

It is commonly believed that boys' performance on the 9-minute run peaks shortly after puberty and then plateaus for the remaining school years. The performance of girls on the same run is thought to peak at puberty and then decline rapidly. The AAHPERD YFT norms show boys constantly improve through age 15 and then level off. The HRPFT, likewise, shows improvement for boys through age 14 and then a plateau is reached. The NCYFS agrees that performance improves, but differs in placing the onset of a plateau effect at age 16 (Ross, Dotson, Gilbert, & Katz, 1985b).

For girls, the YFT norms show improvement through age 15 for the 9-minute run, although it decelerates slightly at 13. Performance after age 15 falls off slightly. The HRPFT norms show an improvement in girls' performance through age 14 and then an equal rate of decline through age 17. Norms for the NCYFS indicate gradual improvement through age 14, a slight decline, and then remaining at the same performance through age 18 (Ross, Dotson, Gilbert, & Katz, 1985b).

It has been suggested (Pate, Ross, Dotson, & Gilbert, 1985) that the difference between the sets of norms is due to the use of convenience samplings by the AAHPERD for both the YFT and the HRPFT. "Convenience samples may tend to exclude less fit and less motivated students and thereby, produce norms that are skewed toward higher performance levels" (p. 72). The NCYFS used a national random sampling to establish norms. The publishing dates might also have a significant effect on the norms; YFT published in 1976, HRPFT published in 1980, and NCYFS published in 1985.

Astrand's research (1956) has shown that younger children use more $O_2$/Kg at submaximal running than do either older children or adults, thus they are less efficient.

Both pulmonary ventilation and blood lactic acid concentration are lower in children and increase with age. Astrand also reported that untrained school children have higher aerobic capacity than adults when compared on the basis of body weight; therefore, they should be capable of doing prolonged, strenuous exercise.

"A cross-sectional study of boys revealed $Vo_2$ max among 16- to 18-year-olds to be more than double that of 7- to 9-year-olds, but when expressed in relation to body weight found no significant difference" (Daniels & Oldridge, 1971, p. 161). Krahenbuhl et al. (1978) reported significant ($p<.005$) improvements for times on three distance runs (800-, 1200-, and 1600-meter runs) with each added year of grade level for first through third graders.

> An important reason for the systematic increase in running performance during the years of growth and development appears to be an age-related improvement in running efficiency. The $Vo_2$ max required to run at various submaximal speeds decreases systematically between 5 and 17 in both boys and girls. (Cureton, 1982, pp. 65-66)

A synthesis of germane literature indicates that there is an age relationship to endurance performance in chidlren. However, an improvement in performance may not be accompanied by a similar improvement in $Vo_2$ max/Kg. Although there is usually an increase in $Vo_2$ max with age, it is most often correlated to an increase in muscle mass.

Most research indicates a significant difference between male and female endurance fitness results. While maximal pulse rate was reported to be about the same for males and females, submaximal pulse rate was reported by Astrand (1956) to be considerably higher for females. Up to the age of 12 years, the maximal pulmonary ventilation for boys and girls was the same. By adulthood the male's value was much greater than the female's. $Vo_2$ max/Kg for 4- to 9-year-old girls and boys was approximately the same in Astrand's study. By 12 years of age, females reached values 17% lower than those of boys. Astrand (1956) and Massicottee et al. (1985) suggested the differences might be partially the result of greater motivation for males and a stronger distaste for sweating among females.

> Results of a study by Macek and Vavra (1971) show lactic acid production at the beginning of exercise does not differ in boys and girls, however, there were significant differences at higher work loads. In boys, the lactic acid values were independent of body weight, but there was a direct correlation to body weight in girls. Blood lactate levels after maximal work load increased with age in children in the same proportion both in boys and girls. (p. 203)

In the Krahenbuhl et al. study (1977) of 8-year-olds, data indicate that there were no differences in height, weight, or age of males and females, and yet the males exceeded the females on $Vo_2$ max and the 1207- and 1609-meter runs. The study did report that the females possessed significantly more body fat.

> The increase in [the percent of] fat in girls that occurs following puberty is particularly important in explaining the progressive widening of the sex difference in distance running performance in body fat is regarded as the primary cause of the decrease in $Vo_2$ max that occurs in girls during this time. (Cureton, 1982, p. 66)

Massicottee et al. (1985) described the results of a 1600-meter run which included 321 girls and boys between the ages of 10 and 17 years. "The average running performance for the boys was 29% higher than those observed for girls, whereas, the difference of the $Vo_2$ max between the sexes was 21%" (p. 15).

The NCYFS included a self-report of fifth- through twelfth-grade students concerning appropriate exercise as determined by the student's awareness of sweating and breathing hard. "A much higher percentage of boys (45.0) than girls (36.8) report awareness of regular sweating and breathing hard during exercise in all four seasons. This difference between boys and girls is wide at all grade levels" (Ross, Dotson, & Gilbert, 1985, p. 84). Interestingly, girls are more acutely affected by seasonal change. In the summer and spring the rate of appropriate physical activity is virtually the same for boys and girls, but by winter there is a clear difference.

Children and Abdominal Strength

Sit-ups, or the slightly different version sometimes called curl-ups, were designed to measure abdominal strength and endurance. Some form of sit-ups is used in the YFT, HRPFT, and the NCYFS. Test protocol has been changed over the years in an attempt to isolate the abdominal muscles. The knees are bent with the heels of the feet from 12 to 18 inches from the buttocks and the hands clasped behind the head in the YFT. The curl-up is used in both the HRPFT and the NCYFS. The knees are bent in the curl-up but the arms are clasped across the chest.

The YFT norms show boys' scores improving through age 15 and then falling off slightly. Both the HRPFT and NCYFS norms have boys improving in performance at a constant rate until age 17/18. Similarly, the YFT norms present improvement in girls' scores on sit-ups through age 15, then falling off slightly. The HRPFT and NCYFS indicate continual improvement through age 17/18, although the improvement decelerates around 14 or 15 years of age (Ross, Dotson, Gilbert, & Katz, 1985b). The agreement of results of the HRPFT and NCYFS and their disagreement with the YFT may be partially explained by the difference in test protocol between sit-ups and curl-ups.

The NCYFS showed some interesting relationships between sit-up performance and physical activity:

> Students scoring in the optimal range on sit-ups report participation in significantly more physical activities both inside and outside physical education programs than acceptable and below-average performers. They also report a greater frequency of participation in high levels of activity requiring sweating and breathing hard, especially in the non-summer months. A significantly greater percentage of students scoring in the optimal range report enrollment in physical education, for a greater number of days per week and minutes per day than students scoring acceptable and below average. Especially for 5th through 9th graders, the number of community organizations through which an individual engages in physical activity correlates with sit-up performance. (Dotson & Ross, 1985, p. 88)

Krahenbuhl et al. (1978) report: "The physical work capacity of children increases approximately eightfold between 6 and 12 years of age" (p. 208). Adam (1985) found that between the ages of 6 and 20 years, the body's stature increases about 33%, but its strength increases about 80%. The sit-up norms from the HRPFT and NCYFS show about a 33%

increase in abdominal strength from age 6 to age 17 while the difference between girls and boys of the same age is less than 10%. Seefeldt (1984) claims there is abundant and irrefutable evidence that children increase in strength, flexibility, and endurance as they get older.

"At any age the typical boy is thought to be capable of out performing the typical girl on almost any test of fitness" (Ross, Dotson, Gilbert, & Katz, 1985b, p. 67). The difference between boys' and girls' fitness is thought to be the widest where strength is involved, such as in sit-ups. Although norms from YFT, HRPFT, and NCYFS add validity to this claim, the most dramatic differences in strength, according to research, is more age-related than sex-related.

## Children and Flexibility

There is agreement in research that flexibility is a valid component of health and fitness. And there is an almost unanimous agreement that flexibility is specific. The amount of range of motion is specific to each joint. "There is evidence to indicate that flexibility may be specific to the way it is measured" (Corbin & Noble, 1980, p. 24). The same research also reported that compound flexibility measures such as the sit-and-reach, which involve more than one joint, are acceptable for self-comparison, but not for interindividual comparisons which should involve direct, single joint measures.

Flexibility measurement was not addressed in the YFT but was included in both the HRPFT and NCYFS in the form of the sit-and-reach test. The sit-and-reach test measures flexibility in the lower back and hamstring region. The AAHPERD included it in the HRPFT battery because it was believed when used with the sit-up test it could predict the likelihood of an individual developing a lower back problem due to inadequate flexibility and/or poor abdominal strength (Ross & Gilbert, 1985). Both boys and girls show sharp and continuous improvement on the sit-and-reach test from ages 10 through 17/18 on both the HRPFT and NCYFS (Ross, Dotson, Gilbert, & Katz, 1985b).

The NCYFS reported that,

> Students who scored in the optimal range on the sit-and-reach test participated in a greater variety of activities outside of physical education class, had a greater energy expenditure, and more frequent participation in activities eliciting the perception of sweating and breathing hard than acceptable and below-average students. (Dotson & Ross, 1985, p. 89)

There were conflicting results in the same study of the correlation of optimal sit-and-reach performance to time in a physical education class. The investigators concluded this to mean that the quality of the physical education program was more important than the quantity of time spent in physical education class in affecting sit-and-reach performance.

Research concerning age and flexibility is contradictory. Corbin and Noble (1980) reported that flexibility increases during school years until early adolescence when a leveling off or decrease begins. Docherty and Bell (1985) found that in adolescents (10 to 14 year-olds) flexibility decreased as body surface increased. In their study of 125 boys and girls, ranging in age from 6 to 15 years, Docherty and Bell reported flexibility decreased with age for boys and remained reasonably constant for girls. Smith and Miller (1986) found no significant main effect for age and flexibility.

Evidence suggests that anatomical or regular activity differences between the sexes may account for the flexibility differences which exist (Corbin & Noble, 1980). "Changes in flexibility related to sex and age could also be correlated to differences and changes in linear proportionality. Boys generally have greater proportional limb length and stature than girls. Limb length showed a negative correlation with flexibility" (Docherty & Bell, 1985, p. 280).

A synthesis of evidence suggests that girls are generally more flexible than boys. Smith and Miller (1985) and Docherty and Bell (1985) found significantly ($p < .01$) higher results in girls' scores than boys' scores in the sit-and-reach test. The norms of both the HRPFT and NCYFS add credence to these findings, although there is no evidence of a widening of this gap with age.

Conclusion

Physical fitness levels are substandard among youth. National studies indicate that physical fitness levels have not increased over the last two decades. The physical education profession's lack of commitment to physical fitness is being cited for blame. "Current statistics suggest that the present curriculum being taught in our schools lacks a strong fitness concept (Steinhardt & Stueck, 1986, p. 24).

Research germane to children and three components of the HRPFT, endurance, abdominal strength, and flexibility, is contradictory and vague in some areas. The need for more information regarding fitness and the ability for improving fitness in children presents an endless challenge to researchers.

## Chapter 2

## Methods and Procedures

This study was conducted in the fall of 1986 and included two second and two fifth grade classes at Pittard Elementary School and one second and one fifth grade class at Bellwood Elementary School. Both Pittard and Bellwood are public schools of Murfreesboro, Tennessee. All testing and physical fitness programs were administered during each class's regularly scheduled physical education class by the investigator.

### Experimental Design

This study involved four experimental groups and two control groups (Table 1):

Experimental Group I was a class of second grade students who participated in the prescribed 8-week physical fitness program three days a week for five minutes each day.

Experimental Group II was a class of fifth grade students who participated in the prescribed 8-week physical fitness program three days a week for five minutes each day.

Experimental Group III was a class of second grade students who participated in the prescribed 8-week physical fitness program three days a week for ten minutes each day.

Table 1

Number of Subjects in Each Group

| | Males | Females | Total |
|---|---|---|---|
| Experimental Group I | 12 | 13 | 25 |
| Experimental Group II | 12 | 14 | 26 |
| Experimental Group III | 13 | 10 | 23 |
| Experimental Group IV | 11 | 15 | 26 |
| Control Group I | 10 | 11 | 21 |
| Control Group II | 11 | 13 | 24 |

Experimental Group IV was a class of fifth grade students who participated in the prescribed 8-week physical fitness program three days a week for ten minutes each day.

Control Group I was a class of second grade students who participated in regularly scheduled physical education class with no prescribed physical fitness program.

Control Group II was a class of fifth grade students who participated in regularly scheduled physical education class with no prescribed physical fitness program.

Test Instrument

Each of the experimental and control groups was pretested by the investigator on the endurance, abdominal strength, and flexibility components of the Health-Related Physical Fitness Test (HRPFT). The HRPFT Manual recommended protocol was adhered to as closely as possible in assessing each component.

The 9-minute run was used to assess the endurance component. "Students are instructed to run as far as possible in nine minutes. The students begin on the signal 'ready, start'. Walking is permitted, but the objective is to cover as much distance as possible during the nine minutes" (HRPFT Manual, 1980, p. 9).

The students were tested outside on a mostly-grassy course of either 200 or 350 yards. The temperature was in the lower 80-degree Fahrenheit range for the pretest and averaged 20 degrees cooler for the posttest. The number of laps completed was counted by a classmate for fifth grade students and by older children for the second grade students. Recording, timing, and computing laps to yardage was done by the investigator. Scores were recorded to the nearest ten yards.

The sit-ups test was used to assess the abdominal strength and endurance component.

> To assume the starting position, the student lies on his back with knees flexed, feet on floor, with heels between 12 and 18 inches from the buttocks. The arms are crossed on the chest with the hands on the opposite shoulders. The feet are held by partners to keep them touching with the testing surface. The student, by tightening his abdominal muscles, curls to the sitting position. Arm contact with the chest must be maintained. The chin should remain tucked on the chest. The sit-up is completed when the elbows touch the thighs. To complete the sit-up, the student returns to the down position until the midback makes contact with the testing surface. The number of correctly executed sit-ups performed in 60 seconds shall be the score. (HRPFT Manual, 1980, pp. 17-18)

Students were tested in a gymnasium with mats used as the testing surface. Classmates were used as partners for both second and fifth grade students. Timing and recording were done by the investigator.

The sit-and-reach test was used to assess the flexibility of the lower back and posterior thighs.

> To assume the starting position, pupils remove their shoes and sit down at the test apparatus with their knees full extended and the feet shoulder-width apart. The feet should be flat against the end board. The arms are extended forward with the hands placed on top of each other. The pupil reaches directly forward, palms down, along the measuring scale four times and holds the position of the maximum reach on the fourth trial. The position of the maximum reach must be held for one second. (HRPFT Manual, 1980, p. 20)

Students were tested in a gymnasium with a mat used as the testing surface. An improvised test apparatus consisting of a milk crate and a metric stick was used in the sit-and-reach test. Students were tested individually with the hand of the investigator placed on the knees to ensure there was no flexion at that joint. A second trial was performed when flexion was detected in the first effort. Measurement and recording were done by the investigator.

## Experimental Physical Fitness Program

The physical fitness program for all experimental groups included 60% of the allotted time for the endurance training, 20% for abdominal strength training, and the remaining 20% for flexibility training. For Experimental Groups I and III this meant a schedule of 3 minutes for endurance, 1 minute for abdominal strength, and 1 minute for flexibility. Experimental Groups II and IV performed 6 minutes of endurance, 2 minutes of abdominal strength, and 2 minutes of flexibility in their physical fitness program.

The physical fitness program was conducted either outside or inside based on weather conditions and the curricular design for the remainder of the scheduled class time. An effort was made to coordinate the physical fitness activities to the curriculum where feasible. Extremely warm weather in the first two weeks caused some slight intensity alterations in the endurance portion of the program.

Endurance fitness activities of the physical fitness program included running, rope jumping, aerobic dance, games, and sports skill activities which involved the large muscle groups for the continuous time allotted to endurance training. Random testing of the experimental groups indicated that students were performing well above 60% of their maximal aerobic capacity.

Abdominal muscular strength and endurance exercises were selected from the following suggested by the HRPFT Manual (1980):

1. Pelvic tilt--the student assumes the hook lying position (supine with the knees bent) with the feet

slightly apart. He presses the spine of the low back down on the mat by contracting the abdominal and gluteal muscles. (p 45)

2. Isometric contraction A--the student assumes the hook lying position with the feet slightly apart. To complete the exercise, the student flexes the neck, raises both arms at the sides of the body, and extends one knee while keeping both hips flexed. The exercise is repeated with the opposite knee. (p. 45)

3. Isometric contraction B--the student assumes the hook lying position with the feet slightly apart. To complete the exercise, the student flexes the neck, raises both arms at the sides of the body, and extends both knees while keeping the hips flexed. (p. 46)

4. Reverse sit-up--the student assumes the hook lying position with the feet slightly apart. To complete the exercise, the student flexes the hips and lumbar spine while keeping the knees at approximately the same angle as in the hook lying position. The buttocks should rise about two or three inches off the mat. (p. 47)

Lower back and posterior thigh flexibility exercises were selected from the following ones suggested by the HRPFT Manual (1980):

1. Supine tuck--the student is in the hook lying position. While tightening the abdominal musculature, the student draws the knees to the chest then extends the knees so that the legs are overhead and the trunk nearly parallel to the floor. The buttocks should not be allowed to go beyond the head. (p. 51).

2. Low back stretch--the student begins in the hook lying position. While tightening the abdominal musculature, the student draws the knees to the chest then extends the knees so that the legs are overhead and the trunk nearly parallel to the floor. The buttocks should not be allowed to go beyond the head. (p. 51)

3. Hook sitting stretch--the student is sitting with hips and knees flexed. In addition, the hips are laterally rotated, and the soles of the feet are touching each other. The student leans forward and holds. (p. 51)

4. Cat stand--the student assumes the squat position with palms of the hands flat on the floor. The hips, knees, and lumbar spine are flexed. The abdominal muscles are tightened while the knees are extended.

The palms of the hands should remain on the floor if possible. (p. 52)

5. Hurdler's stretch--the student sits on the floor with one leg in front and the knee extended. The other leg is abducted to the side with the knee flexed. An attempt is made to touch the head to the extended knee by grasping the ankle and pulling with the arms. The student should change leg position and repeat the exercise. (p. 52)

6. Straddle stretch--the student is sitting with both knees extended and hips abducted. The student flexes the lumbar spine and simultaneously reaches toward the left foot with the left hand. (p. 52)

7. Supine hip flexor stretch--the student, while lying flat on the back, draws one knee up to the chest and with the hands and knees pulls it tightly against the chest. An effort should be made to keep the extended leg in contact with the mat throughout the stretch. (p. 52)

## Analytical Design

The pretest data for the experimental and control groups were subjected to an analysis of variance (ANOVA) within each grade level to determine if any significant difference existed between the groups for each of the three test components. None was found to exist.

An ANOVA was used to test the null hypotheses. Where the null hypotheses were rejected, a *t* test was applied to determine where the differences were. Significance was determined at the .05 level.

## Chapter 3

## Results

Pretest and posttest scores were collected for the 9-minute run, sit-ups, and sit-and-reach for four experimental and two control groups. The Honeywell CP-6 SPSS-X system at Middle Tennessee State University Computer Center was used in the analysis of the data which included an analysis of variance (ANOVA) and _t_ test. In tables 2 through 11 comparisons are presented on the basis of mean gains between the pretest and posttest scores. Standard deviations and the level of probability are also recorded.

Table 2 reflects the results of testing the first hypothesis: There will be no significant difference in the mean gains between Experimental Group I (2nd grade, 5-min) and Control Group I (2nd grade) for each of the three test components. Significance (.013) is shown for the 9-minute run; therefore, the hypothesis is rejected. In the 9-minute run the experimental group has a mean gain of 40.00 with a standard deviation of 166.45 and the control group has a mean gain of -81.81 with a standard deviation of 149.14.

Table 3 reflects the results of testing the second hypothesis: There will be no significant difference in

Table 2

Mean Gain Comparisons of Experimental Group I (Second Grade, 5-Min) to Control Group I (Second Grade)

| | Exp. I | | Con. I | | |
|---|---|---|---|---|---|
| Test | MG | SD | MG | SD | Prob |
| 9-Min Run | 40.00 | 166.45 | -81.81 | 149.14 | .013* |
| Sit-ups | 4.20 | 7.18 | 6.63 | 6.63 | .868 |
| Sit/Reach | 2.32 | 2.32 | 2.03 | 2.03 | .480 |

*$p < .05$

Table 3

Mean Gain Comparisons of Experimental Group III (Second Grade, 10-Min) to Control Group I (Second Grade)

| | Exp. III | | Con. I | | |
|---|---|---|---|---|---|
| Test | MG | SD | MG | SD | Prob |
| 9-Min Run | -6.52 | 195.58 | -81.81 | 149.14 | .161 |
| Sit-ups | .74 | 8.81 | 3.86 | 6.63 | .195 |
| Sit/Reach | .91 | 2.89 | 1.86 | 2.03 | .221 |

the mean gains between Experimental Group III (2nd grade, 10-min) and Control Group I (2nd grade) for each of the three test components. The hypothesis is accepted.

Table 4 reflects the results of testing the third hypothesis: There will be no significant difference in the mean gains between Experimental Group II (5th grade, 5-min) and Control Group II (5th grade) for each of the three test components. The hypothesis is rejected. The 9-minute run (.026) and sit-ups (.050) show significance. For the 9-minute run, the experimental group has a mean gain of -15.39 with a standard deviation of 168.39. The control group has a mean gain of -133.63 with a standard deviation of 195.70. For the sit-ups component, the experimental group has a mean gain of 1.12 with a standard deviation of 5.34. The control group has a mean gain of 4.45 with a standard deviation of 6.39.

Table 5 reflects the results of testing the fourth hypothesis: There will be no significant difference in the mean gains between Experimental Group IV (5th grade, 10-min) and Control Group II (5th grade) for each of the three test components. The hypothesis is rejected. Significance is shown in the 9-minute run (.001). The experimental group has a mean gain of 46.15 with a standard deviation of 154.87 for the 9-minute run. The control group has a mean gain of -133.63 with a standard deviation of 195.70 for the same test.

Table 4

Mean Gain Comparisons of Experimental Group II (Fifth Grade, 5-Min) to Control Group II (Fifth Grade)

| | Exp. II | | Con. II | | |
|---|---|---|---|---|---|
| Test | MG | SD | MG | SD | Prob |
| 9-Min Run | -15.39 | 168.39 | -133.63 | 195.70 | .026* |
| Sit-ups | 1.12 | 5.34 | 4.45 | 6.39 | .050* |
| Sit/Reach | 1.58 | 2.04 | 1.25 | 3.08 | .658 |

*$p < .05$

Table 5

Mean Gain Comparisons of Experimental Group IV (Fifth Grade, 10-Min) to Control Group II (Fifth Grade)

| | Exp. IV | | Con. II | | |
|---|---|---|---|---|---|
| Test | MG | SD | MG | SD | Prob |
| 9-Min Run | 46.15 | 154.87 | -133.63 | 195.70 | .001* |
| Sit-ups | 1.50 | 5.40 | 4.45 | 6.40 | .083 |
| Sit/Reach | .69 | 2.20 | 1.25 | 3.08 | .463 |

*$p < .05$

Tables 6 and 7 reflect the results of testing hypotheses 5 through 10 which state that there will be no significant difference between the mean gains for boys and the mean gains for girls within each of the experimental and control groups for each of the three test components. Table 6 reveals there are no significant differences for the second grade groups. Therefore, hypotheses 5, 7, and 9 are accepted. Table 7 reveals there are no significant differences for the two fifth grade experimental groups; therefore, hypotheses 6 and 8 are accepted. However significant differences for the fifth grade control group are present. Hypothesis 10 is rejected.

The fifth grade control group (Control Group II) shows significance in all three test components. In the 9-minute run boys show a mean gain of -225.55 with a standard deviation of 141.93, whereas girls show a mean gain of -55.85 with a standard deviation of 205.73 which is significant at the .05 level. In the sit-ups component boys show a mean gain of 1.36 with a standard deviation of 4.06, whereas girls show a mean gain of 7.08 with a standard deviation of 6.97 which is significant at the .05 level. In the sit-and-reach component boys show a mean gain of .09 with a standard deviation of 2.84, whereas girls show a mean gain of 2.38 with a standard deviation of 2.90 which is significant at the .05 level.

Table 6

Mean Gain Comparisons of Boys and Girls for Second Grade Groups

| | Boys | | Girls | | |
|---|---|---|---|---|---|
| Test | MG | SD | MG | SD | Prob |
| | Experimental Group I (2nd Grade, 5-Min) | | | | |
| 9-Min Run | 41.67 | 181.95 | 28.46 | 158.32 | .963 |
| Sit-ups | 3.17 | 7.41 | 5.15 | 7.12 | .501 |
| Sit/Reach | 2.17 | 2.44 | 2.46 | 2.30 | .758 |
| | Experimental Group III (2nd Grade, 10-Min) | | | | |
| 9-Min Run | 19.23 | 168.99 | -40.00 | 230.70 | .484 |
| Sit-ups | 2.54 | 7.75 | -1.60 | 9.94 | .274 |
| Sit/Reach | 1.69 | 3.04 | -.10 | 2.47 | .144 |
| | Control Group I (2nd Grade) | | | | |
| 9-Min Run | -127.10 | 175.93 | -40.64 | 112.75 | .192 |
| Sit-ups | 4.70 | 6.46 | 3.09 | 6.99 | .298 |
| Sit/Reach | 1.80 | 1.32 | 1.91 | 2.59 | .906 |

Table 7

Mean Gain Comparisons of Boys and Girls for Fifth Grade Groups

| Test | Boys MG | Boys SD | Girls MG | Girls SD | Prob |
|---|---|---|---|---|---|
| | Experimental Group II (5th Grade, 5-Min) | | | | |
| 9-Min Run | -54.17 | 203.89 | 17.85 | 129.51 | .286 |
| Sit-ups | 1.50 | 6.26 | .79 | 4.64 | .742 |
| Sit/Reach | 1.83 | 1.95 | 1.36 | 2.17 | .565 |
| | Experimental Group IV, (5th Grade, 10-Min) | | | | |
| 9-Min Run | 31.82 | 95.58 | 56.67 | 189.80 | .695 |
| Sit-ups | .91 | 5.97 | 1.93 | 5.11 | .642 |
| Sit/Reach | 1.09 | 2.47 | .40 | 2.03 | .441 |
| | Control Group II (5th Grade) | | | | |
| 9-Min Run | -225.55 | 141.93 | -55.85 | 205.73 | .031* |
| Sit-ups | 1.36 | 4.06 | 7.08 | 6.97 | .026* |
| Sit/Reach | .09 | 2.84 | 2.38 | 2.90 | .047* |

*$p < .05$

Table 8 reflects the results of testing the eleventh hypothesis: There will be no significant difference in the mean gains between Experimental Group I (2nd grade, 5-min) and Experimental Group III (2nd grade, 10-min) for each of the three test components. The hypothesis is accepted.

Table 9 reflects the results of testing the twelfth hypothesis: There will be no significant difference in the mean gains between Experimental Group II (5th grade, 5-min) and Experimental Group IV (5th grade, 10-min) for each of the three test components. The hypothesis is accepted.

Table 10 reflects the results of testing the thirteenth hypothesis: There will be no significant difference in the mean gains between Experimental Group I (2nd grade, 5 min) and Experimental Group II (5th grade, 5-min) for each of the three test components. The hypothesis is accepted.

Table 11 reflects the results of testing the fourteenth hypothesis: There will be no significant difference in the mean gains between Experimental Group III (2nd grade, 10-min) and Experimental Group IV (5th grade, 10-min) for each of the three test components. The hypothesis is accepted.

A summary of the results of this study show that:

1. When the three experimental groups (2nd grade, 5-min; 5th grade, 5-min; and 5th grade, 10-min) are compared to their respective control group, significant mean gains in the 9-minute run are shown. When the fifth grade, 10-minute

Table 8

Mean Gain Comparisons of the 5-Minute (Exp. I) and the 10-Minute (Exp. III) Fitness Programs for Second Grade

| | Exp. I | | Exp. III | | |
|---|---|---|---|---|---|
| Test | MG | SD | MG | SD | Prob |
| 9-Min Run | 40.00 | 166.46 | 66.52 | 195.58 | .378 |
| Sit-ups | 4.20 | 7.18 | .74 | 8.81 | .141 |
| Sit/Reach | 2.32 | 2.32 | .91 | 2.89 | .068 |

Table 9

Mean Gain Comparisons of the 5-Minute (Exp. II) and the 10-Minute (Exp. IV) Fitness Programs for Fifth Grade

| | Exp. II | | Exp. IV | | |
|---|---|---|---|---|---|
| Test | MG | SD | MG | SD | Prob |
| 9-Min Run | -15.38 | 168.39 | 46.15 | 154.87 | .176 |
| Sit-ups | 1.12 | 5.35 | 1.50 | 5.40 | .797 |
| Sit/Reach | 1.58 | 2.04 | .69 | 2.20 | .140 |

Table 10

Mean Gain Comparisons of the Second Grade (Exp. I) to the Fifth Grade (Exp. II) for the 5-Minute Fitness Program

| | Exp. I | | Exp. II | | |
|---|---|---|---|---|---|
| Test | MG | SD | MG | SD | Prob |
| 9-Min Run | 40.00 | 166.46 | -15.38 | 168.39 | .243 |
| Sit-ups | 4.20 | 7.18 | 1.12 | 5.35 | .087 |
| Sit/Reach | 2.32 | 2.32 | 1.58 | 2.04 | .230 |

Table 11

Mean Gain Comparisons of the Second Grade (Exp. III) to the Fifth Grade (Exp. IV) for the 10-Minute Fitness Program

| | Exp. III | | Exp. IV | | |
|---|---|---|---|---|---|
| Test | MG | SD | MG | SD | Prob |
| 9-Min Run | -6.52 | 195.58 | 46.15 | 154.87 | .299 |
| Sit-ups | .74 | 8.81 | 1.50 | 5.40 | .714 |
| Sit/Reach | .91 | 2.89 | .69 | 2.20 | .764 |

experimental group is compared to the fifth grade control group, significant mean gain in sit-ups is shown.

2. A significant difference in mean gains between sexes exists for all three test components in the fifth grade control group.

3. When comparing the mean gains for each of the three test components for the second grade, 5-minute program with the second grade, 10-minute program, there were no significant differences. When comparing the mean gains for each of the three test components for the fifth grade, 5-minute program, with the fifth grade, 10-minute program, there were no significant differences.

2. When comparing the mean gains for each of the three test components for the second grade, 5-minute group, with the fifth grade, 5-minute group, there were no significant differences. When comparing the mean gains for each of the three test components for the second grade, 10-minute group, with the fifth grade, 10-minute group, there were no significant differences.

## Discussion

The results of this study indicate that the component most affected by the 8-week physical fitness program is endurance. However, it should be noted that 60% of the programs was devoted to this area and only 20% to abdominal strength and 20% to flexibility. It might also be noted that the 9-minute run is the only component to show any negative mean gains for the entire group. These negative scores have a big impact on the computation of differences between groups.

Both control groups show substantial decreases in the mean distance covered in the 9-minute run (-81.81 and -133.63 yards) while only one experimental group (5th grade, 5-min) shows a decrease of 6.52 yards in the mean distance covered. Considering this study was conducted in the fall, the results appear to support the claim of the National Children and Youth Fitness Study (NCYFS) that about 90% of the children in this country engage in appropriate physical activity in the summer and that percentage drops off sharply for fall and winter (Ross, Dotson, & Gilbert, 1985, p. 42).

The more sedentary life style that seems to coincide with returning to school may have affected this study. The physical fitness program may not have produced great gains for the experimental groups in terms of increased yardage in the 9-minute run, but it may have offset the loss of yardage experienced by the control groups.

Sex-related differences are not as significant or apparent among groups when observing the mean gain tables. The actual means from the pretest and posttest scores are more informative in eliciting patterns. In every group the boys have greater scores on both pretest and posttest means for the 9-minute run and sit-ups. The greatest differences between sexes exist in the two control groups. The mean gains are significant only for Control Group II (fifth grade) where girls show greater improvement in all three tests. The information does not reveal a widening of those differences from the second to the fifth grade.

Again, by observing the actual pretest and posttest means, every group shows girls' performance greater than boys' in the sit-and-reach. This supports most research that girls are generally more flexible than boys. The pretest means show that the differences between sexes is greater for second grade and narrows slightly for fifth grade.

There does not appear to be any significant advantage of the 10-minute physical fitness program over the 5-minute program. According to the NCYFS, dynamic movement should be continued for at least 20 minutes in order to be considered appropriate physical activity (Ross, Dotson, & Gilbert, 1985, p. 83). The findings of this study generally support this statement of the NCYFS. However, significance in mean gains is shown for Experimental Group I (5-minute program) and Experimental Groups II and IV (10-minute programs) for the 9-minute run. The time factor did not appear to have a bearing on the results in sit-ups and sit-and-reach for either second or fifth grade groups.

Age-related differences reflect greater mean gains for the second grade group over the fifth grade group for the 5-minute program, but the reverse is true for the 10-minute program. Although the differences are not significant, the results may suggest that the time spent in physical fitness vary with the age of the child. A shorter attention span for second grade children may have affected these findings. Actual mean scores of the pretest and posttest show fifth grade groups have greater scores in all components. However, the lack of significant mean gains may suggest that the physical fitness program neither widened nor narrowed the differences between second and fifth grade groups.

Observations

The second grade classes appeared to be more motivated in the testing and the physical fitness program than the fifth grade classes. All groups seemed to experience an anxiety factor in the posttest, but it was more noticeable in the control groups. This was the initial experience with the 9-minute run for all groups and seemed to be the focal point of anxiety. It might be assumed that motivation, anxiety, and lack of testing experience could have affected test scores.

Although there was no formal testing of the premise, the writer observed a general label of masculinity attached to the 9-minute run and sit-ups and femininity to the sit-and-reach. The data collected for this study support this premise, but the point may be raised concerning cause and effect.

## Recommendations

Based on the findings of this study, it is recommended that further research include:

1. Extending the physical fitness program to all grade levels through junior high school.

2. Varying the frequency, duration, and intensity components of the physical fitness program.

3. Adding body composition as one of the test components.

4. Extending the physical fitness program to public as well as private institutions.

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