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The effectiveness of the Remedial Physical Education Program at Foster Junior-Senior High School

Werner Leonard Neudorf
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**THE EFFECTIVENESS OF THE REMEDIAL PHYSICAL
EDUCATION PROGRAM AT FOSTER JUNIOR-
SENIOR HIGH SCHOOL**

**A Thesis
Presented to
the Graduate Faculty
Central Washington State College**

**In Partial Fulfillment
of the Requirements for the Degree
Master of Education**

**by
Werner Leonard Neudorf
July 1966**

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APPROVED FOR THE GRADUATE FACULTY

Robert N. Irving Jr., COMMITTEE CHAIRMAN

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CHAPTER I

THE PROBLEM AND DEFINITIONS OF TERMS USED

The President's Council on Youth Fitness published its Youth Physical Fitness: Suggested Elements of a School Centered Program in July 1961, following appointment and re-organization of the Council the previous spring. The preparation, publication and distribution of this manual to the schools of the United States represented a mammoth undertaking carried out quickly and efficiently. With the enthusiastic support of Superintendent Myron Colburn, South Central School District, near Seattle, Washington initiated at the beginning of the 1961 school year its district-wide physical fitness emphasis as advocated by the "Recommended Basic School Program" outlined in Youth Physical Fitness (29:7-9).

Evidence of the support given to the increased emphasis on physical fitness aspects of over-all physical education are the following actions of the South Central School District:

- (1) District-wide adoption of Youth Physical Fitness.
- (2) Provision of Youth Physical Fitness to all schools in the district.
- (3) District-wide adoption of the Youth Fitness Test published by the American Association for

Health, Physical Education and Recreation (A.A.H.P.E.R.) and suggested by the President's Council.

- (4) Annual compilation of participation and performance statistics in physical fitness transmitted to the State Superintendent of Public Instruction.
- (5) Provisions of special exercise equipment and achievement awards.
- (6) Provision of district-wide school nursing services.

In order that all youngsters may participate daily in at least fifteen minutes of vigorous activity as set forth by the President's Council, pupils should be free from all remediable physical defects. In order for students with postural defects to become physically fit, they first must have a firm foundation which includes sound, functional body mechanics. The need for identification of correctable orthopedic defects and for posture screening is specifically pointed out in Youth Physical Fitness (29:7). The writer has attempted to meet this need with the introduction of a pilot remedial physical education program for his sophomore classes. This program has a two-fold purpose: (1) to help improve the posture of those boys needing this help and (2) to raise the fitness level of well-developed as well as underdeveloped boys.

This posture training program would have been impossible without the cooperation and public-spirited dedication of Jack Morrison, M.D. Encouraged by the cooperation of the school administration and the assistance of Dr. Morrison on the posture training program, the writer decided to evaluate the effectiveness of the remedial physical education program.

I. THE PROBLEM

Statement of the Problem

The study was composed of three problems, as follows:

1. To determine the amount and significance of change in posture as a result of special posture training.
2. To determine the amount and significance of change in physical fitness as a result of systematic training.
3. To determine the effect of the order of training upon posture scores.

Scope of Study

This study involved a total of seventy-five sophomore boys enrolled at Foster Junior-Senior High School during the school year 1964-65. On the basis of posture examinations, the boys were classified into two main groups: those with defects, the posture training group; and those without defects,

the advanced body building group. The posture training group consisted of twenty-three boys who took part in eight weeks of specialized instruction designed to improve functional defects of the feet and back and eight weeks of circuit training. Eight of the twenty-three participated in posture training during the first semester only, and the remaining fifteen during second semester only. The advanced body building group consisted of fifty-two boys engaged in eight weeks of body building and resistant exercises and eight weeks of circuit training. Fifteen of the fifty-two participated during first semester only and the remaining thirty-seven during second semester only. These figures as tabulated below also reflect the order of training.

Order of Training

<u>(First Semester)</u>			<u>(Second Semester)</u>		
	<u>1st 8 weeks</u>	<u>2nd 8 weeks</u>		<u>1st 8 weeks</u>	<u>2nd 8 weeks</u>
(8)	Circ. train.	Post. train.	POSTURE GROUP	(15) Post. train.	Circ. train. = 23
(15)	Circ. train.	Resis. exerc.	ADV. BODY BUILDING (37)	Resis. train.	Circ. train. = <u>52</u>
					total = 75

In the case of the posture training group and the advanced body building group, each participated for a period of ten to twelve minutes of daily exercises in their

activities prior to the regular service program. One week was used for administration of the posture, anthropometric, and physical fitness tests at the beginning and at the end of each semester for each of the two groups. The second semester program was the same as the first except that the order of circuit training and posture training for the posture group and circuit training and body building exercises for the body building group, was reversed as noted in the preceding tabulation.

Importance of the Study

Interest in physical fitness has been greatly stimulated in the past decade. Americans were rudely awakened to the need of physical fitness by the publication of the Kraus-Weber results and the draft rejection figures of recent years. In the last decade, Presidents Eisenhower, Kennedy and Johnson have committed their respective administrations to aid the national fitness effort. President Kennedy aptly summed up the gravity of our deteriorating standards of physical fitness in the "Presidential Message" to schools when he stated: "The softening process of our civilization continues to carry on its persistent erosion" (28:1).

Currently, President Johnson has been carrying on the program of the late President Kennedy. He too stressed its significance when he described physical fitness as ". . . a matter of fundamental importance to individual well-being

and to the progress and security of our Nation" (28:9).

Despite recent improvements and interest of three presidents during the past eight years, the physical fitness job is far from finished as shown by the recent 1964 publication of Physical Fitness Facts:

1. Tests consistently show the deficiency of American boys and girls in arm and shoulder strength, endurance and flexibility. One of every four does not measure up to even minimum fitness standards.
2. More than one-half million draftees were examined in 1963; approximately every other one was disqualified. About half the disqualifications were for physical reasons.
3. According to the American Medical Association, one out of every four Americans is overweight with a correspondingly greater occurrence of chronic and degenerative diseases.
4. Slightly more than one-half of all deaths in the United States result from diseases of the heart and blood vessels (28:2).

In spite of the current emphasis on physical fitness as the most important objective in physical education, there is a continued need for program improvement in order to achieve our stated goals. However, in order to achieve physical excellence any comprehensive program should include an area not presently emphasized--provision for posture development through appropriate training to correct existing remediable defects.

II. DEFINITIONS OF TERMS USED

Advanced Body Building Group

This group is composed of students who had no physical or postural defects. This group performed a combination of partner resistant exercises and physical condition work prior to the regular service program.

Back Group

The back group is composed of pupils who had various functional and/or structural defects.

Foot Group

This group denotes those students who had various foot defects.

Anthropometric Measurements

This denotes selected girth measurements of major muscular areas of the body plus body weight.

Body Building and Resistant Exercises

Body building exercises were those in which an individual worked alone while the resistant exercises involved partners of approximately equal size. These were performed by all members of the advanced body building group.

Circuit Training

A method of physical training in which dosage is systematically governed by combinations of time and number of repetitions is defined as Circuit Training.

Posture

Posture is the balanced position of body segments.

Posture Index

Posture Index denotes a derived score for posture obtained by dividing the sums of the scores of the defects by the number of defects identified.

Good Posture

Good posture is the ability to assume a position of skeletal balance with minimum effort both at rest and when in motion.

Static Posture

This refers to the body at rest or motionless, with the body segments and muscles in a state of equilibrium.

Functional Defects

Functional defects are those physical defects which are amenable to correction.

Structural Defects

Structural defects are those physical defects which

are not correctable by means of exercises.

Physical Fitness

According to Clarke, physical fitness is:

. . . the development and maintenance of a sound physique and of soundly functioning organs, to the end that the individual realizes his capacity for physical activity, unhampered by physical drains or by a body lacking in physical strength and vitality (8:16).

He further stated:

The basic physical fitness elements are muscular strength, muscular endurance, and circulatory endurance; muscular power, agility, speed and body balance are added to compose motor fitness; then arm-eye and kinesthetic foot-eye coordinations are needed for general motor ability (8:221).

Remedial Physical Education

This refers to specialized instruction designed to correct postural defects involving the back, feet and overall posture. In addition, circuit training and advanced body building and resistant exercises were a part of this phase of physical education.

Student Assistants

Student assistants refers to the eleventh and twelfth grade physical education students used to aid the physical education teacher. These eleventh and twelfth grade boys were carefully screened and selected for their leadership, citizenship, ability and academic qualities.

Youth Fitness Test

This is a nationally normed test of the American Association for Health, Physical Education and Recreation. This test was adopted by the South Central Schools in 1961 as a representative test of the most important motor fitness elements.

III. LIMITATIONS OF THE STUDY

This study was limited by the following factors:

1. Only sophomore boys in the investigator's own physical education classes participated in the study.
2. This study was limited in time by school regulations. Sophomores were allowed to take only one semester of physical education.
3. This study was limited by the allotment of ten to twelve minutes' time at the beginning of the class period for the remedial physical education program.
4. An evaluation of the value of the program as specified above was limited to selected tests of posture, physical fitness and anthropometric measurements.

IV. HYPOTHESES

The following hypotheses were formulated for purposes of this study:

1. Boys assigned to posture training will improve in posture as a result of eight weeks of posture training and an additional eight weeks of circuit training.
2. Physical fitness of those boys assigned to advanced body building will improve as a result of eight weeks of resistant and body building exercises. By the same token physical fitness of those boys assigned to posture training will improve as a result of eight weeks of special instruction in posture and an additional eight weeks of circuit training.
3. Among those boys assigned to posture training (in either semester) the best improvement in posture and in physical fitness will be made by those who had posture training prior to circuit training, rather than by those who had circuit training prior to posture training.

V. OVERVIEW OF THE REMAINDER OF THE THESIS

Chapter II, Review of Related Research, will be organized into three parts: posture reports and tests related to physical fitness; circuit training reports related to physical fitness; and justification for the use of anthropometric measurements, resistant and body building exercises in physical fitness work.

Chapter III will contain the procedures of the study involving the initial use of the posture test, the A.A.H.P.E.R. Youth Fitness Test and anthropometric measurements taken at

the beginning of the semester. The operation of the advanced body building, posture development and circuit training programs during the semester will be discussed. Lastly, the above tests and measurements will be readministered at the end of the semester and will be charted to evaluate the effectiveness of the program.

Chapter IV will be an analysis of the data and statistical results.

Chapter V will include: (1) a brief review of the three main problems; (2) the conclusions derived from the results; and (3) recommendations resulting from the findings of the study.

CHAPTER II

REVIEW OF RELATED RESEARCH

I. POSTURE REPORTS AND TESTS RELATED TO PHYSICAL FITNESS

Posture development and adapted physical education were to some degree the outgrowth of the needs of the armed forces to have fighting men in top physical and mental condition. The early physical educators were the medical gymnasts, the true fathers of all physical medicine and auxiliary services.

Soon after World War I, more emphasis was placed on posture programs in our schools. In the late thirties, several progressive physical educators and physicians such as McCloy, Klein, Clarke, DeLorme and Stafford went along with the new evolution in medical thinking and began to turn back to the "physical" aspects of physical education. However, in the recent nationwide emphasis on physical fitness, posture training appears to have been neglected as an integral part of the total program.

Need for Posture

The following authorities were among many who offered convincing testimony and evidence for wide-spread posture training and who consider the school the most effective

agency for such a program. Irwin of Boston University remarked that relatively few school children participated in and benefitted through approved posture training programs. He believed that too much emphasis was placed on theory rather than on the actual practice of maintaining desirable functioning programs (19:470). Hardy indicated that on the basis of examining seventy-five thousand Chicago school children, 47 per cent had poor posture and 14 per cent had pronated feet (15:2154-2161). Kuhns, a physical therapist, revealed that 80 per cent of all adults and 50 per cent of the children had foot trouble (24:3:147). In his article entitled "Bodily Posture As An Indicator of Fitness," Cureton repeatedly inferred the relationship of posture to health and fitness. Cureton commented:

Posture is an important concomitant of fitness associated both as a result of ill health and low energy state, as well as a causal factor in poor circulation and nervous irritation (11:348).

Posture Reports

In his classification on the basis of posture exams of college freshmen in 1917, Brown discovered a definite correlation between student health and fitness status and postural condition. Brown's classification rated the various postural conditions as A excellent, B good, C poor and D as very poor mechanical use of the body. This survey indicated that from 80 to 85 per cent comprised the C and D groups with the greatest number of illnesses, operations and early nutritional and physiological faults being present in these groups

based on the scale (5:781).

Lee, Geer and Brown at Harvard found only about 20 per cent of the entering Harvard College freshmen with good body mechanics in 1920 (25:58-59).

In 1923, Klein and Thomas carried on an experiment with 1,700 children in the Chelsea, Massachusetts schools. Nine hundred sixty had group training in posture while the rest served as controls. Approximately 90 per cent began with poor posture. During two years observation, improvement was six times as frequent among the children who had posture training as among those who did not. It was more frequent if there was improvement in nutrition as well. Improvement in health and school work was found. The attendance of the posture-trained students improved compared to the untrained pupils. Improvement, the authors felt, could be expected in nearly all children, though some required more training than others. In evaluating posture, the authors compared silhouettes with the posture charts of the Children's Bureau, United States Department of Labor (23:41-43).

In 1937-1938, 5,573 freshmen boys and girls and new students in the nine public high schools of Seattle, Washington were examined by physicians from the School Medical Department and were classified for physical education in two specific areas: (1) ability to participate

in a physical education program and (2) need for posture development training. In the area of ability to participate in a physical education program (adapted programming) the survey revealed the following classifications:

1. General program, 68 per cent
2. Limited program, 26 per cent
3. Individual progress, 4 per cent
4. Rest, 2 per cent

In the area of posture training needs, the survey noted:

1. Excellent posture, 11 per cent
2. Good posture, 50 per cent
3. Poor posture, 35 per cent
4. Bad posture, 4 per cent (30:86-88).

Despite the above, it was surprising to note that no follow-up posture training program was mentioned in this article or subsequent articles.

According to Anderson of Yale, upon the completion of a postural examination of 861 freshmen, 497 were assigned to corrective exercises (31:38).

Through a joint cooperative effort involving four agencies, Delaware conducted a state-wide orthopedic screening program in 1962-1963. Physical examinations were made of 68,301 pupils--grades one through twelve (2:30). In lieu of a completed report to date, a statement from George W. Ayars, State Supervisor of Safety and Driver Education stated in part:

In the more than one thousand referrals who were examined, some four hundred and ninety needed surgery and correction. We had a very careful follow-up of the pupils and saw to it that they received the attention and treatment they needed. Most of the cases needed remedial corrections. These were done by the physical education teachers and nurses upon recommendations of family or other physicians (3).

Posture Grading

Subjective posture appraisal tests. One of the simplest methods of measuring anterior posterior posture consists of merely looking at the subject and assigning a value of A, B, C, or D, depending upon the standard of excellence as judged by the physician.

One of the most successful subjective posture exams was the Iowa Posture Test which provided a three point rating scale for each of five functional conditions, foot mechanics, standing position, walking, sitting and stooping to pick up a light object (8:154).

Objective posture tests. Methods of objective posture grading fall into three classes: (1) direct scoring on the basis of arbitrary scales; (2) type-fitting; and (3) measurement of relative position of selected points on profile pictures or tracings.

Bancroft's Vertical Line Test (4:6) and Triple Posture Test (4:179) were examples of the first class as these tests involved direct scoring on the basis of arbitrary scales.

Brownell introduced the type-fitting posture test in 1928 by using a posture scale in which the instructor compared the subject with each type specimen on the scale, until the sample most similar in merit was found. The subject's posture was awarded the same grade as that assigned to the chart sample (6:34).

Kellogg used a measurement of relative positions of selected points on profile pictures as a method for grading posture objectively (20:193-194).

Other worthwhile contributions in posture reading should include:

1. The schematograph devised by Dr. Mosher and Professor Lesley at Stanford University.
2. The Photo Metric posture pictures used by Wickens and Kiphuth at Yale University.
3. The Tarbell, MacEwan and Howe posture tests administered at Wellesly College.
4. Cureton's center of gravity test and conformateur technique first introduced at Springfield College.

In the final analysis the objective posture tests mentioned above were too costly, too time-consuming, too involved and too difficult to administer and therefore, impractical for school use.

II. CIRCUIT TRAINING DATA RELATED TO PHYSICAL FITNESS

In 1958 Adamson and Morgan in England published a book presenting a new idea in fitness training which they called circuit training. Although their idea was not new, they deserved credit for the formalizing of systematically and progressively presenting conditioning exercises (1:1).

The goals of circuit training were expressed by Adamson and Morgan as follows:

Circuit training aims at the simultaneous progressive development of muscular power, muscular strength, muscular endurance and circulo-respiratory fitness. The system was based on the principle of progressive loading, but of sub maximal level, on a time basis--a concept generally ignored by weight trainers (1:14).

The Circuit

To enable a large number of performers to work at the same time, but each to his own capacity, a large number of exercises (e.g. ten) were selected and numbered consecutively in the form of a circuit around the gymnasium or field. They were arranged so that an individual could proceed from one exercise to another without undue loss of time. Progression in a circuit was measured, initially by decreasing time of performance, and secondly, by increasing loads or repetitions (1:31).

Circuits have been designed to utilize an entire physical education period, or any portion of it, thus allowing enough time for both fitness training and skills training in the class period. Howell and Morford have developed a circuit to fit into the ten minutes warm-up period of the calisthenics variety and have recommended it for use for Canadian physical education in secondary schools. This circuit could be used at the start or at the end of the physical education period. The exercises selected required a minimum of equipment. The list of exercises for a ten minute circuit were outlined by Howell and Morford as follows:

1. Squat jumps - equipment none.
2. Chinning the Bar - equipment, a high bar, erected or suspended in any manner.
3. Sit Ups - equipment none.
4. Squat Thrusts - equipment none.
5. Wrist Rolling - equipment an 18 inch brook handle with 24 inch window cord attached at center and suitable 10-15 pound weight up to the handle.
6. Steps-ups - equipment, chairs 16-24 inches high or a bench or a bleacher seat.
7. Push-ups - equipment none.
8. Straight arm Pullover - equipment a bar 3-5 feet long with or without weight but weighing at least 10-15 pounds (17:5).

These eight items were arranged around the gym floor at eight different stations. These stations might be

numbered and, if necessary, labelled. For ease of administration, the class should be divided into eight equal groups, each group starting at a different station on the circuit and proceeding in a standard clockwise order to the next station (17:6).

Procedure

Administration of the circuit by the instructor followed a sequential pattern of teaching, testing, and timing as follows:

(1) Teaching - First Day of Project. Each student was taught the exercise according to the standards of the instructor with correct form emphasized. Second and Third attendance. The student performed three laps of the circuit doing the beginner's dosage at each exercise. By the end of the third attendance, he will gauge his optimum pace at each exercise station.

(2) Testing. Fourth attendance. The student was now tested to maximum on each exercise in the circuit. For heavy resistance items, e.g. bar and dumbbell work emphasizing strength, the test was for a maximum number of repetitions or maximum in half minute, whichever was less. For endurance items, such as stepping (bleacher seats), squat jumps, etc., the test was for a maximum number of repetitions or maximum in one minute, whichever was less. Next, the training dosage

was calculated. These dosages were usually half of the maximum executed in the test, although this could be varied if one wished to weight the circuit toward a particular quality. If a student has performed twenty-five situps in one minute his training dosage will be thirteen situps. The circuit would consist of three laps, each lap consisting of eight items, each performed at the training dosage.

(3) Timing. Fifth attendance. All students performed the three laps of the circuit at the training dosage working at their own rate and without rest between the items. The object was to perform the three laps of the circuit at the training dosage in ten minutes. After ten minutes had elapsed the class was stopped and each student recorded on his card the number of laps that each item was completed. When a student was able to complete the entire circuit within the stated time of ten minutes, his training dosage at each station was increased either arbitrarily or by means of a retest (17:6-8).

III. JUSTIFICATION FOR THE USE OF ANTHROPOMETRIC
MEASUREMENTS, RESISTANT AND BODY
CONDITIONING EXERCISES IN
PHYSICAL FITNESS WORK

The father of anthropometric measurements in the United States was Edward Hitchcock of Amherst College, Massachusetts. He secured body measurements and tests of every student entering Amherst College as early as 1861 (16:558).

Sargent of Harvard began the systematic measurements of Harvard students in 1879. He used anthropometric measurements to ascertain the strength and physical status of his pupils. His emphasis was placed on perfection in physical performance through selected exercises (27:284).

In the early part of the twentieth century many physical culture faddists such as Macfadden, Lederman, and Atlas introduced commercial body building and strength courses which were widely advertised and carried on by correspondence. Although this has stimulated much interest in body building, the techniques were not always founded on physiologically sound principles.

To keep our fighting men in shape, body building and physical conditioning exercises were stressed in our armed services during both World Wars. Clarke mentioned the extensive use of exercise in speeding recovery of wounded fighting men, introduced in World War II (8:59).

On the college level during the past three decades men like Kiphuth, Fradd, Bevans and Cureton have conducted outstanding body building exercise programs for their respective students in developing their physical fitness. Leighton at Eastern Washington State College has a unique program of resistant exercises consisting of individual and partner work (26:31).

According to many physical educators, LaSierra High School, Carmichael, California has the most outstanding high school physical fitness program in the country today. The secret of the LaSierra program was based on motivation and pride (22:42).

LeProtti, LaSierra's physical education director said:

We have some boys who are doing fantastic things. One of our lads does 555 extension press-ups and another can pack a man on his back for $7\frac{1}{2}$ miles (22:43).

A very unique ten year physical conditioning case study of Jolie Ray was recently completed by Cureton at the University of Illinois. Ray was a former United States

Olympic miler and National A.A.U. mile champion (1915-1923). One is never too old to improve his physical fitness as was indicated by Jolie Ray at the amazing age of seventy years. His remarkable improvement in physical fitness as a result of a vigorous physical conditioning program over a period of ten years was indicated by advantageous changes in fourteen different physical fitness tests (10:64-72).

In a recent experiment, involving ten college women students, Flint and Gadgell revealed by electromyography those exercises found to be most and least beneficial in strengthening abdominal musculature (12:29).

In order to make the most effective use of his limited time in attempting to raise the physical fitness level of his students, a physical education teacher must be aware of the most beneficial exercises.

The evidence reviewed by the investigator pointed to a dire need for posture training in physical education and physical fitness. The use of an uncomplicated, yet efficient and economical graded posture test feasible for school use was also indicated. In addition, the value of anthropometric measurements and the merits of circuit training, body conditioning and resistant exercises as methods of fitness training were revealed. In Chapter IV, the writer's results and analysis of data will be presented.

CHAPTER III

METHODS AND PROCEDURES

This chapter consists of: (1) description of test items used and procedure for their administration; (2) the methods employed in conducting the daily physical education program; and (3) the methods employed in analyzing the test information.

I. DESCRIPTION AND PROCEDURE IN TESTING

All tests were administered twice in each semester at the beginning and at the end. The foot group (as diagnosed from the posture screening test) took a standing broad jump test in order to reflect change in functional foot condition as a result of prescribed exercises. The back group (as diagnosed) took two objective back flexibility tests to reflect change as a result of prescribed exercises. Every boy was examined in the posture screening test, the anthropometric tests and in four of the seven tests of the A.A.H.P.E.R. Youth Fitness Test battery.

Posture Tests

Subjective posture screening tests. These tests consisted of a subjective examination involving primarily back and foot defects, administered by the school physician at the beginning and end of each semester, to seventy-five

sophomore boys. These boys were examined privately and were stripped to gym trunks and barefooted. The following tests were administered.

Back appraisal. Three bodily positions involving the back were examined: (a) standing position (side and rear view), (b) walking position (rear and front view) and (c) sitting-standing alignment. The rating scale used was: 0 = normal alignment, 1 = mild deviation, 2 = moderate deviation, and 3 = marked deviation. Next, the subject assumed a standing position on a chalk line where side, front and rear profiles were evaluated in regard to general back structure. The subject was then observed walking eight paces to a second chalk line with attention focused on walking gait and back alignment. Finally, the subject was observed while sitting and assuming a standing position from sitting with attention directed to weight bearing and general alignment.

Foot appraisal. In the foot mechanics test, the doctor judged the subject in heel-toe walking (rear, front, side views). While in the standing position, the subject's feet were observed as to the amount of toeing out or in, the amount of pronation, and the angle of the arches. All postural defects were recorded on the posture screening card.

Objective tests administered to posture group.

The trunk flexibility tests were objective tests which were given to the boys assigned to the back group. The measuring device, an adaptation of one described by Cureton (11:348-364), consisted of a short sliding bar indicator attached perpendicularly to a 24 inch ruler encased in a wooden frame. To illustrate these tests, they are described as follows:

Trunk extension backward. To measure the flexibility of the trunk backward, the subject, with hands clasped behind his head, from a prone position, raised his trunk and chest off the floor as high as possible. A student assistant assuming a kneeling position, straddled the subject's legs and held his body position rigid by placing his hands over the subject's buttocks. The investigator raised the sliding bar along the ruler, under the subject's chin and perpendicular to the floor and read the distance from the floor to the closest one-eighth inch. Increases in linear distance from the floor denoted increases in flexibility of the trunk and the back.

Trunk flexion forward. To measure trunk flexion forward, the subject assumed the sitting position on the floor, hands clasped behind his head and legs straight and about 18 inches apart. The student assistant held the subject's knees in complete extension. As the subject flexed his trunk forward, the investigator put the trunk flexibility indicator in an upright position on the floor between the subject's knees and moved the sliding bar along the ruler until it touched the subject's forehead. Decreases in linear distance denoted increases in trunk and back flexibility.

Physical Performance Tests

A.A.H.P.E.R. youth fitness test battery. The A.A.H.P.E.R. Youth Fitness Test was adopted by the South Central School District in 1961. It was simple, inexpensive, easy to administer and relatively free from accidents. It also had established national norms on each test item. The A.A.H.P.E.R. Youth Fitness Test Battery consisted of seven items: standing broad jump, 50 yard dash, pull ups, sit ups, softball throw, 40 yard shuttle run, and 600 yard run (27). The following three items, 50 yard dash, 40 yard shuttle run, and sit ups were eliminated from the test battery above for the following reasons:

1. In the case of both the 50 yard dash and the 40 yard shuttle run, it was felt that the magnitude of human errors in timing might very likely nullify any gain in speed and secondly, that the training program was not designed with improvement in running speed as being an important consideration.
2. In the case of the sit ups, scores are known to be truncated at the upper limit of the scale when the test is administered according to the AAHPER Youth Fitness Test directions. Boys have a tendency to score rather highly on this test and it would be difficult to differentiate significant change due to the truncation of the scores. If the administration of the test was retained, on the other hand, the time necessary to exhaust each boy would be prohibitive.

Standing broad jump. Purpose: Measurement of explosive power of the legs. The student assumed a semi-squat position and jumped forward as far as possible. The distance to the nearest inch from the take off line to the nearest heel position was measured by the writer and recorded by the student assistant.

Pull ups. Purpose: To measure the strength and endurance of the biceps and shoulder muscles. The student grasped the bar with palms facing away from the face hanging with arms and legs fully extended. His feet were to be kept free of the floor or ground. The student assistant stood to one side of the pupil who was being tested and counted each successful pull up. The experimenter recorded the number of pull ups.

600 yard run. Purpose: To measure circulatory-respiratory endurance. A 440 yard cinder track, a whistle, and a stop watch were the only equipment necessary. Three students ran in each heat, being grouped according to their height, weight and age. The students were instructed to run their best but if they felt they were becoming too tired they were allowed to alternate their running with walking. The score was the time recorded to the nearest tenth of a second. The times of the runners as they crossed the finish line were announced by the writer and recorded by a student assistant.

Anthropometric Tests

Anthropometric measurements. These tests consisted of the following girth measurements: arm tensed-flexed, chest normal, and thigh. These measurements plus height and weight were recorded on a special form by the student

assistant. This form may be referred to in the Appendix.

II. THE PHYSICAL EDUCATION PROGRAM

On the basis of the defects detected in the posture test, the seventy-five boys were classified into three categories for this study as follows: (1) advanced body building group, (2) back group and (3) foot group. The back and foot groups were collectively known as the posture training section.

The posture training section (twenty-three boys) had corrective exercises prescribed for them by the doctor. The advanced body building group (fifty-two boys) took resistant and body building exercises. Each group participated in a daily service program in addition. The boys involved in this study ranged in age from fourteen years, eleven months to seventeen years, eight months.

Circuit training for both groups was divided into two parts: (1) outdoor circuit, four weeks, and (2) indoor circuit, four weeks. Tabulated below were the exercises comprising the two circuits and opposite these were listed the fundamental physical elements each exercise was chosen to develop. This tabulation was included for clarity and convenience only. It was recognized that every exercise contributed to development of more than just the single physical element with which it has been matched below, but

in each case the physical element shown was considered to be the primary concern.

<u>EXERCISE</u>	<u>PHYSICAL ELEMENT</u>
Running ropes (similar to football agility tire drill)	Agility
Squat thrusts	"
Abdominal curl ups	Strength and muscular endurance
Triple standing broad jumps	Strength and muscular endurance of quadriceps
Vertical jumping	" "
Squat jumps	" "
Bench jumps	" "
Leg press (with barbell weights)	" "
Pull ups	Strength and muscular endurance of arm flexors
Peg board	" "
Parallel bar dips	Strength and muscular endurance of arm extensors
Running laps	Circulatory-respiratory endurance
Running up bleacher steps	" "

The exercises in both the indoor and outdoor circuits were performed at thirty-second intervals at six different consecutively numbered stations about the gymnasium or athletic field. The complete circuit was run three times

in a ten to twelve minute period. Progression was developed in most cases by increasing the number of repetitions and where the twelve minute total was not violated by increasing the length of time per exercise. After the second week, laps were also run upon the completion of the third circuit.

In conducting both the posture exercise group and the advanced body building group the writer and the student assistant rotated from group to group demonstrating the exercises and making all necessary corrections. The body building and partner resistant exercises were designed to develop the major muscle areas of the body including neck, wrists, flexors and extensors of the arms, shoulders, chest, back, abdomen, quadriceps and calves. Usually eight to ten exercises starting with five repetitions each, were performed daily by the advanced body building groups.

The exercises for the posture trainees were designed to correct the defects and faulty posture found by the physician. The procedure for both the posture trainees and the advanced body building group was an adaptation of interval training with alternate work and rest intervals. Progression was developed by increasing the work and decreasing the amount of rest systematically according to the ability of the groups to tolerate work increases as judged by the instructor. During the first two weeks, all

exercises included five repetitions with a ten second rest interval between each exercise. In succeeding weeks, the rest intervals were shortened and then eliminated and in addition all exercises were increased by two repetitions every two weeks.

The two physical education classes in the second semester followed the same routine as the first semester class except that the order of circuit training and posture training for the posture group and circuit training and body building for the body building group was reversed. The activities carried on in the regular service program during first semester were: testing, two weeks; flag football, four weeks; soccer, four weeks; basketball, four weeks; and wrestling, four weeks. Second semester service program activities consisted of: testing, two weeks; basketball, four weeks; wrestling, four weeks; badminton, three weeks; and track, five weeks.

Tests were organized according to weather conditions. In both semesters, physical fitness performance tests were scheduled in the second test week to allow for several days of conditioning.

III. METHODS OF DATA ANALYSIS

In order to test statistically the significance of change in posture scores as the result of special posture

training, the T_1 tests of the first semester were combined with the T_1 tests of the second semester and these in turn were compared with the corresponding T_2 tests of the first and second semesters. The data were analyzed according to the t ratio test for the significance of the difference between means of correlated groups. The groups are designated as correlated because the T_1 scores of each group were compared to the group's own T_2 scores. Therefore, the t ratio formula included the correlation between tests one and two, as shown by Garrett (13:226-227).

It was necessary also to test statistically the significance of changes in physical fitness scores as a result of systematic physical training. Here again, T_1 physical fitness scores from the first semester group were combined with the T_1 scores of the second semester group and these in turn compared with the corresponding T_2 scores, as described above in the case of the analysis of the significance of changes in posture scores. In the case of the physical fitness scores, both posture and advanced body building groups were analyzed.

To determine the effect of the order of training upon posture scores the T_1 mean and standard deviation for each posture variable was compared to the T_2 mean and standard deviation for the same variable, in both first and second semester posture groups. The evaluation of the effect of

order of training was done in two ways, namely: (1) it was established that both first and second semester posture groups were from the same population; and (2) a t ratio test of significance of the difference between correlated means was computed for the first semester group as well as the same for the second semester group. Due to small sample size the posture sub groups were analyzed subjectively.

CHAPTER IV

ANALYSIS OF THE DATA

Three analyses were made of the data in this study. The first purpose of this study was to determine the amount and significance of change in posture as the result of posture training, in both first and second semester posture groups. Secondly, it was the purpose of this study to determine the amount and significance of change in physical fitness as a result of training in physical fitness, for both semesters for both posture and advanced body building groups. Finally, it was the purpose of this study to determine the effect of the order of training upon the change in posture scores.

In the first two analyses above, T_1 scores of the first semester group were combined with those of the second semester group and were then compared with the corresponding T_2 scores for the two semesters. This process was followed for two reasons. First, it increased the number of cases upon which conclusions could be based and second, this allowed a greater chance for significance of differences to be established, by providing a greater number of degrees of freedom. Because the T_2 scores of a group were compared to its own T_1 scores, computation of a coefficient of correlation was necessary between the T_1 and the T_2

scores on each variable. Data analyses were made by means of the t ratio for the significance of the difference between means of correlated groups as specified by Garrett (13:226-228). This resulted in application of the following formula:

$$SE_D = \sqrt{\frac{\overbrace{M_1}^2 + \overbrace{M_2}^2 - 2r_{12} \overbrace{M_1} \overbrace{M_2}}{M_1 M_2}}$$

In the third analysis, paucity of data made some restrictions of analysis necessary as follows. The size of the N's of each of the two semesters was eight and fifteen, respectively. Each of the eight and the fifteen had a Posture Index score both at the beginning and at the end of their respective semesters. It was decided that a t ratio test of the significance of the difference between means of these two uncorrelated groups should be computed in order to determine whether these two posture groups could be considered as being from the same posture population, at least in this one respect. Secondly, the T_1 test mean was compared with the T_2 test mean for each semester posture group on the Posture Index Rating where the full size of N for both semesters was available. No other statistical tests of significance of difference between means of sub-groups (foot group or back group) was attempted.

Because this study is concerned with positive

changes in posture, physical fitness, and order of training, the one-tailed statistical test of the null hypothesis was applied as demonstrated by Garrett (13:227).

I. THE AMOUNT AND SIGNIFICANCE OF CHANGE
IN POSTURE SCORES AS A RESULT
OF SPECIAL TRAINING

The combined first and second semester T_1 scores of the two posture groups were compared to the combined first and second semester T_2 scores in order to test the statistical significance of any change in posture.

The pre-test Posture Index Rating mean score of twenty-three boys was 1.7. The post-test, Posture Index Rating mean score of the same group was .6. The correlation between the initial test and final test was .01. The difference between the mean scores was 1.1. This gave a t ratio of 14.10 which was statistically significant beyond the .01 level of confidence for 44 degrees of freedom.

The standing broad jump was used as a test of foot condition for the nine boys of the foot group, composed of four boys in first semester and five boys in second semester. The pre-test mean score for this group was 77.3 inches and the post-test score was 82.5 inches for an increase of 5.2 inches. A correlation of .87 was

found between the first and last tests. The t ratio obtained by the foot group in this test was 2.33 which exceeded the .05 level of confidence. The difference of 5.2 inches between the objective pre-test and post-test broad jump scores was great enough to be considered beyond the realm of chance and therefore supports the adequacy of the doctor's subjective Posture Index Rating.

The Trunk Flexion Forward and the Trunk Extension Backward were used as tests of back condition. The fourteen boys in the back group (four boys in the first semester and ten boys in the second semester) had a pre-test mean of 13.4 inches in the Trunk Flexion Forward and a post-test mean score of 9.6 inches. To show a gain in flexion forward, the score had to be reduced in inches. The correlation between the pre-tests and post-tests was .28. The difference between the pre-test and post-test was 3.8 inches. The development made here was indicated by a t ratio of 4.52 which was well above the .01 level of confidence. An analysis of the improvement in flexion indicated the benefit of specialized posture training through exercises.

In the Trunk Extension Backward, this same group of fourteen boys had an initial mean test score of 17.0 inches and a final mean test score of 19.7 inches for

an increase of 2.7 inches. To denote a gain in this test, the number of inches of trunk extension had to be increased. A correlation of .51 was made between the initial and final tests. A t ratio of 4.43 was found which was statistically significant above the .01 level of confidence. The figures in Table I summarize the preceding facts pertaining to posture training improvement.

TABLE I

AMOUNT AND SIGNIFICANCE OF CHANGE BETWEEN MEANS
IN POSTURE TRAINING SCORES

TEST	M ₁	M ₂	r	Diff.	Diff.	t Ratio	t RATIOS NECESSARY FOR SIGNIFICANCE		
							df	.05	.01
Posture Index Rating	1.7	.6	.01	1.1	.078	14.10	44	1.68	2.41
Standing Broad Jump ² (Used as test of foot condition)	77.3	82.5	.87	5.2	2.23	2.33	7	1.90	3.00
Trunk Flexion Forward ³ (Used as test of back condition)	13.4	9.6	.28	3.8	.84	4.52	26	1.71	2.48
Trunk Extension Backward ³ (Used as test of back condition)	17.0	19.7	.51	2.7	.61	4.43	26	1.71	2.48

¹Combined N from 1st semester (8) / 2nd semester (15) equals 23

²Combined N from 1st semester (4) / 2nd semester (5) " 9

³Combined N from 1st semester (4) / 2nd semester (10) " 14

II. THE AMOUNT AND SIGNIFICANCE OF CHANGE IN PHYSICAL FITNESS AS A RESULT OF SYSTEMATIC PHYSICAL TRAINING

Statement of problem (2) related to both posture and advanced body building groups. The first semester T_1 scores and second semester T_2 scores of both groups (posture and advanced body building) were each combined and compared separately with their own respective T_2 scores to examine the statistical significance of any change in physical fitness.

In the first of the physical fitness performance tests, the standing broad jump, the twenty-three boys of the posture group had an initial test mean of 78.0 inches and a final test mean of 83.4 inches. The correlation between the initial test and final test was .53. The difference between means was 5.4 inches. The t ratio for the difference between means was 3.07 which was significant beyond the .01 level of confidence.

In the same item, the fifty-two boys in the advanced body building section had an initial mean score of 82.6 inches and a post-test mean score of 88.2 inches for an increase of 5.6 inches. The correlation between the initial and final test was .82. The t ratio of 9.33

which was obtained, was statistically significant above the .01 level of confidence. The progress made here by both groups in the experiment was significantly above chance expectation and it indicates that posture training exercises, circuit training and resistive exercises definitely helped in the improvement of broad jumping.

In the softball throw, the posture group obtained an initial test mean of 166.8 feet and a final test mean score of 185.3 feet. The correlation secured from the initial test and final test was .85. A difference of 18.5 feet was gained between means. The t ratio of 5.87 was significant beyond the .01 level of confidence.

The advanced body building group had an initial mean test score of 173.9 feet and a final test mean score of 192.9 feet in the softball throw. A correlation of .74 was secured between T_1 and T_2 test scores. A gain of 19.0 feet was the difference between means. A t ratio of 5.55 was obtained which was significant above the .01 level of confidence.

The indication here is that exercises designed to build up and strengthen the arms and back in posture training, resistive exercise program and circuit training had a beneficial effect and were a contributing factor toward improving both groups in the performance of the softball throw.

The posture group made an initial test mean of 113.1 seconds (1:53.1) in the 600 yard run and a final test mean score of 103.3 seconds (1:43.3). The correlation here between initial and post-tests was .72. A gain of 9.8 seconds was made between means. The t ratio of 2.32 was significant at the .05 level of confidence.

In the 600 yard run, the advanced body building group had a T_1 mean score of 108.8 seconds (1:48.8) and a T_2 mean score of 101.2 seconds (1:41.2). The gain made here between means was 7.6 seconds. The correlation made between the T_1 and T_2 score was .87. The t ratio of 6.39 was statistically significant beyond the .01 level of confidence.

The indications here are that both posture and advanced body building groups benefitted from their respective training regimens as far as improvement in 600 yard run time is concerned.

In pull ups, the remedial group had a first mean test score of 6.2 pull ups and a final test mean score of 7.7 pull ups. The difference between the means was 1.5. The correlation between the first and final tests was .91. The t ratio obtained here was 4.05 which was significant beyond the .01 level of confidence.

The advanced body building group had an initial test mean score of 6.7 pull ups and a final test mean score of 9.3 pull ups. A correlation of .90 was obtained between the initial and final tests. The difference between the means was 2.6. The t ratio of 9.81 was significantly well beyond the .01 level of confidence.

The significant improvement in pull ups by both groups indicates that posture exercises, circuit training course, and resistive exercises engaged in by the two groups were effective means of developing strength, physical fitness and pull up performance. Table II summarizes the preceding data and is located on page 51.

In anthropometric measurements, the posture group had a T_1 mean score of 34.8 inches and a T_2 mean score of 35.4 inches in girth of the chest taken at normal inspiration. A gain of .6 of an inch was shown between the means. The correlation obtained between the initial and final test scores was .98. A t ratio of 4.62 was attained which was significant at the .01 level of confidence.

The advanced body building group in chest girth normal showed an initial test mean score of 33.7 inches and a final test mean score of 34.4 inches. The difference gained between means was .7 of an inch. A correlation of .95 was secured between T_1 and T_2 scores.

The \underline{t} ratio obtained here was 4.37 which was beyond the .01 level of confidence.

The significant gains made by both groups in chest girth normal indicates that both posture training and resistive exercises improved the body growth and development.

In arm girth tensed flexed, the posture group had an initial mean measurement of 11.7 inches and a post mean measurement of 12.4 inches for an increase of .7 of an inch. The correlation obtained between T_1 and T_2 scores was .94. The \underline{t} ratio of 2.50 was significant beyond the .01 level of confidence.

The advanced body building group showed a first mean measurement of 11.6 inches and a post mean measurement of 12.3 inches for a gain of .7 of an inch. The correlation between the initial test and final test was .84. The \underline{t} ratio here was 8.75 which was statistically significant well beyond the .01 level of confidence.

The progress made in girth of the arm flexed showed that posture exercises were not as beneficial in the development of the arms as were the resistive exercises of the advanced body building section, but that both groups made substantial gains well beyond chance expectancy.

In thigh girth, the posture group showed a first mean measurement of 20.6 inches and a final mean measurement of 21.0 inches. The correlation between the T_1 and T_2 score was .98. The gain shown between means was .4 of an inch. This gave a t ratio of 1.26 which was below the .05 level of confidence. Therefore, the gain made was not significant.

The advanced body building group had an initial mean thigh girth measurement of 20.5 inches and a post mean thigh girth measurement of 20.9 inches for a gain of .4 of an inch. The correlation obtained between the initial and final test was .97. The t ratio of .62 was again not significant.

The gains made by the thigh girth measurements by both groups were not significant indicating that neither the specific exercises in posture training nor the special resistive exercises were very effective ways of developing the thigh girth. It is quite possible that the thigh muscles were developed more nearly to their maximum in comparison to other less frequently used muscles which in the course of testing have shown a more dramatic increase of size, strength and performance.

The data indicated that the subjects of the posture group showed significant gains above the .01 level of confidence in three out of four physical fitness performance

tests, namely the standing broad jump, the softball throw and pull ups. In one test, the 600 yard run, the t ratio obtained was significant at the .05 level of confidence. The posture groups made significant gains above the .01 level of confidence in chest girth normal and also in the girth of the arm tensed flexed. The only anthropometric measurement in which the posture group did not make a significant gain was the thigh girth measurement.

In the same seven items, the advanced body building group made significant gains above the .01 level of confidence in six out of the seven items, namely the standing broad jump, the softball throw, 600 yard run, pull ups, chest normal and arm flexed. Only in thigh girth did the advanced body building group fail to make a significant gain. It is quite evident that in the improvement of both physical fitness performances and anthropometric measurements that the resistive exercises of the advanced body building group seems to be more effective and beneficial than the posture training exercises of the posture group. Only in the thigh girth measurement did either group fail to make a significant gain. This means that the exercises of both groups were not significantly effective in developing and strengthening the thigh girth muscles. These calculations can be found in Table II and Table III.

TABLE II

AMOUNT AND SIGNIFICANCE OF CHANGE IN PHYSICAL FITNESS PERFORMANCES
POSTURE GROUP AND ADVANCED BODY BUILDING GROUP

POSTURE GROUP ¹	M ₁	M ₂	r	Diff.	σ Diff.	t Ratio	t Necessary For Signif. (one-tailed test)		
							df	.05	.01
Standing Broad Jump	78.0	83.4	.53	5.4	1.76	3.07	44	1.68	2.41
Softball Throw	166.8	185.3	.85	18.5	3.15	5.87	44	1.68	2.41
600 Yard Run	113.1	103.3	.72	9.8	4.22	2.32	44	1.68	2.41
Pull ups	6.2	7.7	.91	1.5	.37	4.05	44	1.68	2.41
ADVANCED BODY BUILDING GROUP ²									
Standing Broad Jump	82.6	88.2	.82	5.6	.6	9.33	102	1.66	2.36
Softball Throw	173.9	192.9	.74	19.0	3.42	5.55	102	1.66	2.36
600 Yard Run	108.8	101.2	.87	7.6	1.19	6.39	102	1.66	2.36
Pull ups	6.7	9.3	.90	2.6	.265	9.81	102	1.66	2.36

¹Combined N from 1st semester (8) / 2nd semester (15) equals 23

²Combined N from 1st semester (15) / 2nd semester (37) " 52

TABLE III

AMOUNT AND SIGNIFICANCE OF CHANGE IN ANTHROPOMETRIC MEASUREMENTS
POSTURE GROUP AND ADVANCED BODY BUILDING GROUP

POSTURE GROUP ¹	M ₁	M ₂	r	Diff.	σ Diff.	t Ratio	t Necessary For Signif. (one-tailed test)		
							df	.05	.01
Chest Normal	34.8	35.4	.98	.6	.13	4.62	44	1.68	2.41
Arm Tensed-Flexed	11.7	12.4	.94	.7	.28	2.50	44	1.68	2.41
Thigh Girth	20.6	21.0	.98	.4	.316	1.26	44	1.68	2.41
ADVANCED BODY BUILDING GROUP ²									
Chest Normal	33.7	34.4	.95	.7	.16	4.37	102	1.66	2.36
Arm Flexed	11.6	12.3	.84	.7	.08	8.75	102	1.66	2.36
Thigh Girth	20.5	20.9	.97	.4	.65	.62	102	1.66	2.36

¹Combined N from 1st semester (8) / 2nd semester (15) equals 23

²Combined N from 1st semester (15) / 2nd semester (37) " 52

III. THE EFFECT OF THE ORDER OF TRAINING UPON POSTURE SCORES

For the purposes of this analysis, the changes in posture scores resulting from training in posture were analyzed separately for the eight students comprising the first semester group and the fifteen students who made up the second semester group. It was decided that the initial Posture Index scores of the eight and the fifteen students of first and second semester should be compared to determine whether the two groups could be reasonably considered as being from the same population as to their initial posture status. Calculation of the significance of difference between the initial means of these two groups resulted in a t ratio of .045 which indicated that the two posture groups could be indeed considered from the same population. No such t ratio comparisons were made, however, for the sub-divisions (back group and foot group) of the posture classes because of the sample size. These eight students comprising the first semester group began their semester with eight weeks of circuit training which was followed by eight weeks of posture training. The fifteen students in the second semester group began

with eight weeks of posture training and finished with eight weeks of circuit training.

In the Posture Index Rating the first semester group had a pre-test mean of 1.6 with a standard deviation of .1. The second semester group had a pre-test mean of 1.7 with a standard deviation of .2 and a post-test mean of 0.5 with a standard deviation of .2.

A t ratio test of the significance of difference between correlated means (one-tailed test) was computed for the first semester posture group on Posture Index. The t ratio was found to be 1.58. For 14 degrees of freedom ($N_1 + N_2 - 2$), the t ratio must be 1.76 to be significant at the .05 level of confidence. The same procedure was followed for posture scores of fifteen boys of the second semester posture group. In this case the t ratio was found to be 1.97. For 28 degrees of freedom this t ratio needed to be 1.70 in order to be significant at the .05 level of confidence. Thus, only in the case of the second semester group could the improvement posture scores as reflected in the Posture Index be considered as statistically significant and beyond the reasonable fluctuations of chance.

In Trunk Flexion Forward, the first semester posture had a pre-test mean score of 11.3 inches with a standard deviation score of 1.2 inches and a post-test

mean score of 10.2 inches with a standard deviation of 1.0 inches for an increase of 1.1 inches in difference in means with a .2 inches difference in standard deviation.

The second semester posture group had a pre-test mean score of 14.2 inches with an initial standard deviation score of 2.5 inches in Trunk Flexion Forward and a post-test mean score of 9.3 inches with a final standard deviation score of 3.0 inches for an increase of 4.9 inches in difference in means with a gain of .5 inches in standard deviation. The statistical data indicates that here again, the second semester remedial group showed larger gains in forward flexibility than did the first semester group.

The first semester remedial group showed an initial test mean score of 16.1 inches and an initial standard deviation of 2.5 inches in Trunk Extension Backward and had a final test mean score of 20.8 inches and a post standard deviation score of 1.0 inches for a gain of 3.5 inches in difference in means and a decrease of .8 inches in the standard deviation score. The indications here showed that the increase in back flexibility made by the second semester posture group was far greater than was the improvement made by the first semester posture boys.

In the standing broad jump used to indicate foot condition, the four boys in the first semester foot group had a pre-test mean of 71.0 inches with a standard deviation score of 11.3 inches, and a post-test mean score of 76.2 inches and a post-test standard deviation score of 10.2 inches. The difference between mean scores was 5.2 inches and the difference in the standard deviation scores was a decrease of 1.1 inches.

The five boys in the second semester foot group made an initial mean score of 82.4 inches with a first standard deviation score of 10.8 inches in the standing broad jump and compiled a final test mean score of 87.6 inches for an increase of 5.2 inches in the difference between mean scores and a decrease of .5 inches in the standard deviation score. These statistics indicate that the first semester foot group was equal to the second semester foot group in the improvement of the standing broad jump with an equal mean gain of 5.2 inches. However, the second semester group must be considered superior for the following reasons:

1. The broad jump score gains over the course of the semester were equal.
2. The second semester group had a higher initial mean score.
3. The changes over the course of the semester indicated that the second semester group was less variable.

An analysis of the two groups indicated that in each of the four posture items, the second semester posture group was superior in improvement to the first semester group.

A subjective comparison of these data indicated that posture development was influenced in a positive way by the order of training and that the retention of the increased scores in posture was also favorably influenced by the order of training. It may be recalled that the first semester posture group began its semester with circuit training and that the second semester group began its semester with posture training.

The figures listed in Table IV illustrate the above-mentioned facts about the effect of the order of training.

TABLE IV

POSTURE SCORES ILLUSTRATING THE EFFECT OF
THE ORDER OF TRAINING UPON POSTURE

1ST SEMESTER TEST	N	PRE-TEST		POST-TEST		DIFF. MEAN T ₁ T ₂	DIFF. S.D. T ₁ T ₂
		MEAN	S.D.	MEAN	S.D.		
POSTURE INDEX	8	1.6	.1	0.9	.1	.7	--
TRUNK FLEXION FORWARD	4	11.3	1.2	10.2	1.0	1.1	.2
TRUNK EXTENSION BACKWARD	4	16.1	2.5	16.9	2.5	.8	--
STANDING BROAD JUMP	4	71.0	11.3	76.2	10.2	5.2	-1.1 *
2ND SEMESTER TEST							
POSTURE INDEX	15	1.7	.2	.5	.2	1.2	--
TRUNK FLEXION FORWARD	10	14.2	2.5	9.3	3.0	4.9	.5
TRUNK EXTENSION BACKWARD	10	17.3	1.8	20.8	2.0	3.5	-.2
STANDING BROAD JUMP	5	82.4	10.8	87.6	10.3	5.2	-.5 *

* Indicates that the variability of test decreased whereas the mean score increased in size, during the course of the posture training.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

I. SUMMARY

Purposes

Following suggestions of the President's Council on Youth Fitness, South Central School District initiated a district-wide physical fitness emphasis as advocated by Youth Physical Fitness, in September 1961. This study was initiated by the writer because of a belief that pupils should be free of remediable defects before attempts at increasing physical fitness could be expected to be thoroughly meaningful. A background of training in remedial physical education prompted the writer to attempt this evaluation of the effectiveness of this program.

Briefly restated, the purposes of this study were to: (1) determine the amount and significance of change in posture; (2) determine the amount and significance of change in physical fitness, both as a result of the effects of specialized training; and (3) determine the effect of the order of training on the posture scores.

Seventy-five sophomore boys participated in the study, twenty-three as members of the remedial physical

education, fifty-two as members of advanced body building. The study was limited to participation in a single semester of physical education at sophomore level by allotment of ten to twelve minutes' time at the beginning of the class for remedial work.

Procedures

All tests were administered twice in each semester, one at the beginning and one at the end. Subjective judgments by the physician identified the boys to be assigned to the special posture group and further categorized them into foot or back cases by utilization of a simple four-point (0-1-2-3) scale. Previously mentioned objective tests of back and foot condition supplemented the observations of the examining physician.

Four of the seven tests of the A.A.H.P.E.R. Youth Fitness Test were administered to all the participants. The three tests deleted were left out because of the fact that they were felt not to be important in reflecting the state of training sought in this study.

Three girth (anthropometric) measurements were taken as follows: (1) arm tensed-flexed at bicep, (2) chest normal, and (3) thigh.

Boys in the posture group took part in exercises as prescribed by the examining physician whereas those

in advanced body building took part in resistive and body-building exercises during the ten to twelve minutes allotted to this phase of physical education in each class period. Each group participated in a service program, also.

Analyses of data were made by testing the significance of change in posture scores and of changes in physical fitness scores by means of the t test for significance of difference between means of correlated groups. It was necessary to determine the correlation between the groups because the initial test scores of both semesters were compared to the final test scores for both semesters.

The eight posture students of the first semester were compared to the fifteen students of the second semester in Posture Index and in Trunk Flexion Forward, Trunk Extension Backward and Standing Broad Jump in order to determine the effect of the order of training. Because it was the concern of this study to relate positive direction changes resulting from special training, all tests of statistical significance were considered as one-tailed.

II. CONCLUSIONS

Significance of Change in Posture Scores

Mean change in Posture Index Rating diminished greatly over the course of each semester, reflected in much reduced values ascribed to posture aberrations by the examining physician. Flexibility of the trunk shown by ability to reach closer to the floor in the forward flexion movement and as shown by ability to raise higher from the floor in the trunk extension movement also reflected great improvement of function. In the case of the three tests just reviewed, the significance of change greatly exceeded the .01 level of confidence. In the Standing Broad Jump, used here as a test of functional foot condition, the t ratio of 2.33 was found to be significant at the .05 level of confidence. It seems appropriate to conclude that, in general, specific effort in exercise was paralleled by specific results.

Significance of Change in Physical Fitness: Posture Groups

In the case of all four physical performance tests, changes were beneficial, that is, they reflected improvement in status. In the case of the 600 yard run time, the improvement was significant between the .05 and .01

levels of confidence. In each of the other tests, Standing Broad Jump, Softball Throw and Pull Ups, the improvements were beyond the .01 level of confidence.

Significance of Change in Physical Fitness: Advanced Body Building

The advanced body building group took the same four tests as were taken by the posture group. In each case the improvement in performance far exceeded chance expectations beyond the .01 level of confidence. Furthermore, the t ratios, with one exception, (Softball Throw) were considerably larger than those of the posture group. It seems safe to conclude that the training was also highly beneficial to the functional performances of both groups.

Significance of Change in Anthropometric Measurements:

Posture Group

As a result of training, the girth of the chest normal and of the arm tensed-flexed increased beyond chance expectation as shown by t ratios which exceeded the .01 level of confidence. While thigh girth did increase, it did not do so at a level beyond chance expectation.

Significance of Change in Anthropometric Measurements:

Advanced Body Building

As was true for the posture group, the improvement in girths of chest normal and arm tensed-flexed exceeded chance at the .01 level of confidence. Thigh girth increased so slightly that chance could easily account for the change. It might be hypothesized that thigh girth would be more difficult to increase because the legs participate in virtually all the body's locomotor movements.

Effect of Order of Training Upon Posture Scores

The eight posture students of first semester were compared with the fifteen of second semester. Calculation of the significance of difference between the initial means resulted in a t ratio of .045 indicating no difference between the two groups initially. A t ratio test of the significance of difference between correlated means (one-tailed test) was computed for each of the two posture groups on Posture Index scores. For the first semester group whose training began with eight weeks of circuit training and concluded with posture training, the t ratio was 1.58 for 14 degrees of freedom. Had this ratio reached 1.76, the Posture Index changes would have been significant. The corresponding t ratio for the

second semester group ($N = 15$) was 1.97; a t of 1.70 was required for significance at the .05 level of confidence. In terms of general posture scores the circuit training preceded by posture training seemed to be most productive of beneficial change in posture. This conclusion corroborates an identical one based on anatomical structure--function seems to be dependent upon structure.

Data for flexibility (Trunk Flexion Forward and Trunk Extension Backward) and for foot condition (Standing Broad Jump) were not analyzed statistically because of small sample size. However, in each of the three variables named the second semester group considerably exceeded the first semester group in the magnitude of difference between means. A cursory observation seemed to indicate that the magnitude of the differences in means favoring the second semester group would more than offset the slight magnitude of increase in variability of that group, thus favoring the procedure of posture training preceding the circuit training as used by the second semester group. The conclusion seems reasonably established that increases in physical performance attainment are of greater magnitude when preceded by correction of remediable defects.

III. RECOMMENDATIONS

Based upon results of statistical compilations and data presented, the investigator recommends the following:

1. Schools contemplating the establishment of a program of remedial physical education should arrange for the services of a medical doctor.
2. This study was based upon a half year effort in correction of physical defects through remedial physical education; the program was of approximately twelve minutes duration daily. The results shown by this study lead the investigator to recommend that remedial physical education be provided on a daily basis for the duration of the high school career of every student found to be in need of such remedial work.
3. Attempts to begin programs of remedial physical education in school should be based upon the best obtainable teaching conditions, standards of attainment, equipment, facilities, administration and teaching personnel. It is further recommended that such standards be set forth by the State Superintendent of

Public Instruction.

4. The findings of this study lead the investigator to recommend its continuance in the South Central School District. The findings merit a continuous up-grading of effort at every level toward a comprehensive program of remedial physical education.
5. This program had its beginning as a result of suggestions found in Youth Physical Fitness, published in 1961 by the President's Council on Physical Fitness. The provisions of the National Defense Education Act (NDEA) make Federal funds available for virtually every phase of curriculum except health and physical education. With the foregoing in mind, it is strongly recommended that every effort be expended toward support of any legislation seeking such Federal aid for any and all phases of health and physical education in the schools.

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APPENDIX A

SCHOOL:
 GRADE:
 DATE:

FOSTER JUNIOR-SENIOR HIGH SCHOOL
 SUBJECTIVE POSTURE TEST

NAME	POSTURE		SITTING		WALKING		FEET		COMMENTS AND RECOMMENDATIONS
	Side View	Back View	Align-ment	Sit Stand	Back View	Front View	Stand-ing	Walk-ing	
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									

- COMMON DEFECTS:**
- (1) Posture, Side View
- | | |
|--------|-----------------------|
| Symbol | Meaning |
| FH | Forward Head |
| RS | Round Shoulders |
| HB | Hollow Back |
| PA | Prominent Abdomen |
| OH | Overhang of Shoulders |
| WB | Weight Back |
| WF | Weight Forward |
- (2) Posture, Back View
- | | |
|------|--|
| Dev. | Deviation (curvature) |
| List | Sideward list or displacement of trunk |
| Rot | Rotation |
| Sh | Shoulder Low |
| H | Hip Prominent |
- (3) Feet (Foot Mechanics)
- | | |
|----|------------------------|
| Pr | Pronation |
| OT | Out-toe |
| PT | Pigeon Toe |
| LA | Longitudinal Arch |
| AA | Anterior Arch |
| HV | Hallux Valgus (bunion) |
- (4) Knees
- | | |
|------|-----------------------------|
| Back | Back Knee, hyper-extension |
| Flex | Flexed Knee |
| Bow | Bowed Legs |
| Kn | Knock-Knee |
| Inw | Inward Turning of Knee Caps |

DIRECTION OF DEFECT
 R. Right
 L. Left

DEGREE OF DEVIATION OR DEFECT
 0. Normal Alignment, No Defect
 1. Mild Deviation or Defect
 2. Moderate Deviation or Defect
 3. Marked Deviation or Defect (severe)

APPENDIX B

OBJECTIVE POSTURE TEST

NAME _____ (last) _____ (first) (a) BACK _____ (b) FOOT _____

GRADE _____

AGE _____

WEIGHT _____

HEIGHT _____

OBJECTIVE POSTURE TESTS:

PRE-TEST DATE _____

POST-TEST DATE _____

Trunk Flexion Forward

Trunk Extension Backward

Standing Broad Jump

APPENDIX C

FOSTER JUNIOR-SENIOR HIGH SCHOOL
 PHYSICAL PERFORMANCE AND ANTHROPOMETRIC
 MEASUREMENT TEST

NAME _____ DATE _____
 (last) (first)

GRADE _____

AGE _____

TOTAL IN MONTHS

TOTAL IN MONTHS

WEIGHT _____

_____ LBS.

_____ LBS.

HEIGHT _____

_____ INCHES

_____ INCHES

AAPYER YOUTH FITNESS
 TEST BATTERY (Selected
 items)

Pre-Test
 Date _____

Post-Test
 Date _____

Standing Broad Jump

Pull Ups

Softball Throw

600 Yard Run

ANTHROPOMETRIC MEASUREMENTS
 OF GIRTH

Arm Tensed-Flexed (Bicep)

Chest Normal

Thigh
