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An Experimental Study of the Effects of Weight Training on the Speed, Strength, and Endurance of Junior High School Boys

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AN EXPERIMENTAL STUDY OF THE EFFECTS OF WEIGHT TRAINING ON THE SPEED, STRENGTH, AND ENDURANCE OF JUNIOR HIGH SCHOOL BOYS

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CHAPTER I

THE PROBLEM AND DEFINITION OF TERMS USED

The physical education classes at Washington Junior High School in Yakima, Washington, like most junior high and high schools did not have a weight training program. This study was conducted to determine the effects of weight training on the speed, strength, and endurance of junior high school boys; as compared to the effects of traditional physical education class programs of calisthenics. All boys in the ninth grade physical education classes of Washington Junior High, Yakima, Washington, were pre-tested using three tests; the fifty yard dash for speed, the Rogers Strength Index and Physical Fitness Index Tests for strength, and the 600 yard run for endurance. The classes were again tested eight weeks after the pre-test, and the data were analyzed to show if there was a significant difference of increase or decrease in the speed, strength and endurance of the experimental and control groups.

I. THE PROBLEM

Statement of the problem. Up to the last decade or so the empirical principle that "use promotes growth" was accepted as a sufficient guide for the organization of

programs designed to help our weak and undermuscled student (10:236).

The problem is: are physical educators developing total physical fitness in their program of which speed, strength, and endurance is only a small part of the whole fitness picture? It was the purpose of this study to attempt to determine the effect, if any, that the introduction of weight training programs in the physical education classes would have on the speed, strength and endurance of the boys.

Importance of the study. Weight training has been too closely associated with weight lifting to allow much acceptance by the average layman. The cost of the program both in equipment and facilities is another detriment which arises when weight training is discussed. Then there are always the erroneous ideas toward weight training and its affects on physiological aspects of speed, strength, endurance, flexibility, etc. of muscle development. It is the ambition of the author to determine if these beliefs are correct or incorrect according to the results obtained through a well organized weight training program.

II. LIMITATIONS OF THE STUDY

The following are recognized as limitations of

the study:

1. The tests were administered twice and no practice tests were given.

2. Only ninth grade boys were utilized in the program.

III. DEFINITION OF TERMS

Endurance. The ability to sustain prolonged activity.

Dynamometer. An apparatus for testing muscular strength of selected body parts.

Wet Spirometer. An apparatus used to measure lung capacity.

Strength Index. The strength index is the gross score obtained from the six strength tests and lung capacity included in the Rogers PFI. The strength index is not a measure of physical fitness, but is a measure of general athletic ability.

Physical Fitness Index. A score derived from comparing an achieved strength index with a norm based upon the individual sex, weight and age. It is a measure of general physical fitness, indicating the immediate ability of the individual for physical activity. A PFI of 100 is considered average.

Manuometer. An apparatus used to measure grip strength.

Weight training. A routine of calisthenics performed with barbells and dumbells using seven to ten repetitions per set with three sets. The calisthenics are designed to develop all areas of the body.

Repetition. One complete contraction and extension of an exercise.

Set. A set is made up of a specified number of repetitions.

Curl. A biceps exercise. Stand with the feet braced apart, barbell across the thighs. Take the under grip (palms up), with the knuckles toward the body. Draw a deep breath. Keep the elbows close to the sides, curl the bar up until it touches the chest. Exhale as it rises; inhale as you slowly lower the bar to the position across the thighs.

Reverse curl. This is done with a much lighter weight than in the regular curl with the knuckles toward the floor. Grip the bar at shoulder width, back of the hands up, and slowly curl it to the chest and lower it to the thighs.

Military press. In the military press the bar is raised to the chest, standing with the feet comfortably apart, one foot a few inches in advance to aid balance. Take a deep breath and press the bar above the head until the arms are straight. It is then lowered while inhaling. Keep the bar at chest height and do the remainder of the repetitions.

Lateral rise. A dumbell exercise for the deltoid muscles of the shoulders. Stand with the feet a short distance apart. Hold the weights at the side. Keep the elbows straight, raise the weights to the side until the hands are about a foot above shoulder height. Lower slowly.

Shoulder shrug. Stand holding the bar across the front of the thighs, the arms straight, knuckles toward the front. Stand tall. Hunch the shoulder forward while exhaling, then lift toward the ears while inhaling and continue breathing in as the shoulders travel back and down. Hold an instant, then hunch the shoulders forward again.

Rowing. A biceps, shoulder and back exercise. Stand with the feet apart, barbell at thigh height, hands a little wider than the shoulders. Keep the knees straight and lean over from the waist. Keep the head up and back

flat. Pull up slowly until the bar touches the chest. Elbows should point out to the sides. Breathe in as the weight comes up, exhale as you lower it. Let it hang just clearing the floor.

Squat. A thigh (and some lower back) exercise. Start with the feet eight to fourteen inches apart, flat on the floor. Take a deep breath, hold it. Lower down to where thighs are parallel to the floor. Spreading the knees slightly. Return to a standing position, exhaling as you rise.

Bench press. Lay supine on a bench. The feet should be a comfortable distance apart to aid balance. The arms extended, the bar is then lifted from the floor by other members of the weight training group and placed in lifters hands. The lifters grip is shoulder width, palms up. The bar is then lowered to the chest while inhaling, hold breath and push the bar back to the starting position and exhale. The lifter continues until he completes the set of repetitions. The bar is then lifted to the floor by members of the weight group and the next member takes a position on the bench.

Sit ups. The head, shoulders and back are curled up. Lie on back with the feet hooked under something solid, knees bent. Clasp the hands behind the head, then curl the

head up, next the shoulders, followed by the trunk trying to bend over and touch the elbows to the knees. Add weights in the hands to gain strength.

Weight lifting. Lifting one repetition with maximal effort. This is strictly a strength and bulk building exercise and is not designed to develop all areas of the body.

IV. OVERVIEW OF REMAINDER OF THESIS

Chapter II contains the procedure used in forming the experimental and control groups, also the procedures used in the testing of the two groups. Chapter III contains a review of the related literature. Chapter IV contains experimental results including statistical methods used. Chapter V contains the summary and conclusions found by the evaluation of the thesis. The appendix contains the results in table form of the analysis of significance of the pre-test and post-test involving the test criteria used in the evaluation of the problem.

CHAPTER II

METHODS AND PROCEDURE OF TESTING

The experimental group was made up of twenty-five, ninth grade boys ranging in age from fourteen years, five months, to sixteen years, nine months. The members of the group were chosen voluntarily from fifty ninth grade boys in a sixth period physical education class. The sixth period class was chosen because if the boys did not finish their workouts they could continue after school. The group was a cross section of junior high boys having a range of pre-test SI of 618.6-2288.15 and PFI of 35.41-134.58. The experimental group was divided into five homogenous groups. Their ability was established by taking seventy percent of the maximum amount of weight they could lift correctly once. Each group was given one long bar, two dumbells, 110 pounds of weight, and a bench for use in the bench press. The exercises used were the curl, bent over rowing, lateral rise, one-half squat, sit-ups, and the reverse curl. Each exercise was executed at least seven times and not more than ten times. These seven repetitions made up one set.

The experimental group did a complete set of each exercise the first two weeks. The next three weeks it

increased to two sets of seven for each exercise and the last three weeks they again increased to three sets of seven repetitions for each exercise. An increase of weight was made when a boy could easily do ten repetitions of the exercise. The rest between sets was determined by the amount of time it took for each of the five boys to complete their set of exercises. The class was started each day with a warm-up drill consisting of calisthenics and then left to proceed on their own. Each exercise was demonstrated and correct breathing explained by the author. The author kept close observation of the class and corrected incorrect form and lifting procedures when they occured. The class was always in a "u" shaped formation for easier observation by the author and for safety precautions. The experimental group met three times a week for forty-five minutes except for the last three weeks when it met for as much as an hour because of the three sets of seven repetitions.

The fifty yard dash was given to measure speed. The Rogers Physical Fitness Index and Strength Index were given to measure strength. The 600 yard run was given to measure endurance.

The fifty yard dash and 600 yard run were chosen becauwe both tests are on the national physical fitness test adopted by the Yakima School District. The scores of

all ninth grade boys were easily accessible for comparison with the experimental group and no time was lost in physical education classes due to testing.

The Rogers PFI Strength Test was given due to the high reliability and objectivity as stated in the following (8:172):

Accuracy of the PFI Tests

> The reliability and objectivity of the Physical Fitness Test, when administered by competent testers, were established in 1925 by Rogers and have since been verified by other investigators working independently. The results of Rogers' original investigation resulted in the following self-correlations:
>
> | | |
> |---|---|
> | Lung capacity | .97 |
> | Right grip | .92 |
> | Left grip | .90 |
> | Back strength | .88 |
> | Leg strength | .86 |
> | Pull-ups | .91 |
> | Push-ups | .90 |
> | Strength index | .94 |

The test was also given because of access to the testing equipment through the physical education department of Central Washington State College.

Since the training program for the control group was the program set up in the physical education classes and since transfer of students from one class period to another was not feasible, the control group was not equated before the training began. The physical education program during weight training consisted of basketball and wrestling units.

The boys were tested for speed using the fifty yard dash. The boys were paired off according to age, height, and weight. Two boys ran at one time to give added incentive to compete for good time. One instructor would start the boys and the author used two stop watches to time the boys. Non-suiters in class recorded the boys names and times at the finish of the sprint.

The Rogers PFI Test was given for the strength test. Since two sets of testing equipment were available, it was easier to set up different stations for testing. The author chose the most mature and reliable boys from each class period to test the first time through and then these boys were used to help administer the test to the other boys. The test consists of the Wet Spirometer, used for measuring lung capacity, a Monuometer or hand dynamometer for measuring left and right grip strength, a back dynamometer to measure back strength, the leg dynamometer with a belt to measure leg strength, and pull-ups (palms away) and push-ups (dips) used to measure arm strength. Non-suiters were used to record at the PFI Test station when available. Suggestions for the administration of the Rogers PFI Test can be found in (8:156-172).

The six hundred yard run was used to measure endurance. An instructor or competent class member started

the 600 yard run. The researcher was the timer and again non-suiters were used to record the names and times at the finish. The boys were instructed to run as hard as possible but if they felt tired or weak to stop running and walk. The boys were run in groups of ten to fifteen and again this created the desired amount of competition for better test results. The three tests previously described were given before the weight training program started and at the end of the eight week training session. The results of these tests are discussed in Chapter IV of this thesis.

CHAPTER III

REVIEW OF LITERATURE

I. HISTORY

Although weight training is becoming increasingly more popular in our modern physical education and athletic program, there have been many obstacles to overcome in the history of weight training. The earliest weight lifter of note, was the great Greek wrestler, Milo of Croton, who won fame in ancient Olympic Games (35:3). In germany and other middle European countries weight lifting, as we know it today, got its start in carnivals and vaudeville. The weights lifted in the early days were solid, clumsy, and very heavy. A man had to be extremely strong to get into weight lifting because of the non-adjustable weight (35:5). Joseph Steinbauch and Karl Swoboda were a couple of early German weight lifters who were known for their brute strength. They ranged from two-hundred and fifty to three-hundred pounds and had large waist lines to match their massive arms and legs (35:6). Arthur Saxon, 1905, was another great German professional strongman, although not a huge man at two-hundred and ten pounds, he had the distinction of having lifted more weight overhead under control than anyone except

Paul Anderson, the famous Twentieth Century American weight lifter (35:6).

It was not until the development of adjustable weights that a below par physical specimen could strengthen himself through weight lifting. An early Twentieth Century French lifter, Charles Rigoulot, Olympic Games champion in 1924, made a one hand snatch of 192 pounds (23:10). Many European professionals toured the United States, helping to foster interest in weight lifting. Harry Poschall was an early American weight lifter and later writer in the field of weight lifting (23:10). Eugene Sandow might have done more in making Americans muscle conscious than anyone else. Sandow, although not extremely strong, showed a trim, well-proportioned man could be strong and retain a Greek god-like physique (23:11). In the United States the first instructor to bring sound weight training methods to a mass audience was Alan Calvert, who established the Milo Barbell Company in 1903. Calvert sold a course of weight training that could still be followed today with good results. Calvert was a truly inspirational writer in his book, Super Strength, now a collectors item, and in a small magazine he published called, Strength. Later the Milo Barbell Company and Strength Magazine was headed by Mark Berry, who was also the official coach of the 1936 Olympic team (38:12).

The original Milo Company was bought by Bob Hoffman in 1934. Two years earlier Hoffman had founded the York Barbell Company. Although Hoffman has had many imitators who have published magazines, books, courses, and sold apparatus, he retained a lead in the field through his sponsorship of amateur weight lifting competition. York Barbell Club won the United States team championships every year from 1932 to 1954, with the exception of 1952 (23:14). The Russians made their debute in world championships in 1946 and then did not appear again until 1949 (38:18). The "Mr." contests first started in 1939 as a side line of the weight lifting championships. This contest had a great influence on weight lifting to develop the body beautiful (23:21). Weight lifting for the body beautiful had a bad affect on weight training. It was the public advocacy of weight training by such renowned athletes as Bob Richards, Parry O'Brien, Fortune Gordien, Dick Cleveland, Jack Kelley Jr., Henry Wittenberg, and Frank Stranahan, that did much to offset the bad publicity received by the "showoffs" (23:23).

The following quote taken from the January 27, 1962 issue of the Journal of American Medical Association Magazine expresses the ideas of most physical educators and coaches toward weight training (15:309):

When practiced sensibly under good supervision, weight training provides a wholesome activity for youth. There is no justification for weight lifting devoted to the development of muscles for the sake of muscles alone. Weight training, as it is coming to be known, is distinguished from weight lifting in that it is developmental or rehabilitative in nature rather than competitive in terms of the poundage that can be lifted in various standardized lifts. Weight training is successfully used in physical education to strengthen underdeveloped persons, in physical therapy to aid recovery following injuries and operations, and for the conditioning of athletes. As with any vigorous physical activity, a medical examination is a prerequisite to weight training. When a youth who wishes to participate in weight training is found to be in good basic health, he should be encouraged to embark on a rational program under the supervision of a professionally prepared physical educator. Periodic medical re-evaluation at appropriate intervals is also recommended.

Another advocate of weight training states:

Dr. Charles H. McCloy, professor of physical education at the State University of Iowa, believes it is the use of weight training at home that is its most valuable and training in schools and colleges because of its lifetime carry-over value (38:24).

II. PHYSIOLOGICAL REVIEW OF MUSCULAR PROPERTIES AND PRINCIPLES OF MUSCULAR CONTRACTION

The physiological aspects of the bodies muscles must be understood to better help the student of weight training understand the relationship between weight lifting and the development of the muscles of the body.

Definition. A muscle may be described as a bundle of red and white contractile fibers held together by a sheath of connective tissue. It is attached to bone by

means of tendons or aponeuroses which stem from the connective tissue sheath.

The Properties of Muscular Tissue.

1. Extensibility. Property of muscular tissue to be stretched until it is approximately half again its normal resting length.

2. Elasticity. Property of muscular tissue to return again to its normal resting length after the stretching force is removed.

3. Contractility. Property of muscular tissue to shorten approximately one half its resting length.

The Physiologic Principles of Muscular Contraction.

1. All or none principle of muscular contraction. Whenever a muscle fiber contracts, it contracts maximally.

2. Staircase or treppe phenomenon. When a muscle contracts repeatedly, the first few contractions are each progressively greater than the preceding until the maximal response is reached (47:22).

3. Over-load principle. Strength can be augmented significantly only by contracting against a degree of resistance that calls forth near maximal effort (18:6).

Physiological Definition of Muscle Properties.

1. Stretch. Muscles contract more forcefully if

they are first put on a stretch (47:337) (18:10).

2. Reciprocal inhibition of antagonistic muscles. Decrease in tone of antagonistic muscles to allow movement (34:37).

3. Muscle tone. Muscles of the body are normally firm to the touch. This is due to the continuous slight contraction of a small fraction of muscle fibers (34:30).

4. Viscosity. The rearrangement of muscles is opposed by resistance when a muscle changes its size and shape (34:21).

5. Isometric contraction. A type of response in which the muscle is unable to shorten (34:21).

6. Isotonic contraction. The muscle will be able to shorten and move the weight (34:22).

III. SPEED

In a study by Mosely and Donaldson (29:315), a larger increase in speed and co-ordination was evident in the weight training group than in a control group which participated in volleyball for the same period of time. Zorbas and Karpovich found that weight lifters were faster in the rotary motions of the arm than the non-lifters (49:148). Hunsicker and Greey concluded from their research that strengthening of muscles about a joint does not necessarily slow down the speed of joint

movement (25:119). Two studies, one dealing with size and weight of the arm (38:331), and the other dealing with muscular force of the limbs, gave no substantial evidence that size, weight or force generated by the limb would give an increase in speed. In conclusion, it is definitely a false belief that weight training slows down movements when a well rounded weight training program is followed.

IV. STRENGTH

A muscle will perform the task it is assigned, if the task is within reason (23:19). But what about the boys in physical education and athletic programs that are too weak to perform even elementary movements? Must they always meet defeat because they are too weak to complete a pull-up, reach the pit in the running broad jump, rebound in basketball, escape from being pinned in wrestling class? The answer to these questions is obviously no, because through progressive resistance exercises these boys can gain in strength and size. A development in increase in size of skeletal muscles was evidenced by an increase in their cross sectional areas by Bernard V. Buck (5:78). In training for strength, muscles increase in size because strength depends on the cross section of muscle fiber. Although the size of muscle increases with weight training the number of

fibers stays the same (25:119) (23:37). This development is also referred to as the "Law of overcompensation". In weight training the muscle fiber and connective tissue are broken down and natural elements replace lost or damaged tissues with larger or greater amounts (41:21).

As physical educators and coaches it is not enough to develop those boys who possess all the capabilities for success in our programs but we must work to achieve some degree of success for all boys. Building strength through weight training programs is one very important tool, which in itself is not the end, but only a means to the end for a strong physical education and athletic program.

V. ENDURANCE

There are two distinct types of endurance:

1. Cardiovascular. The development of heart, lungs, and circulatory system to sustain long periods of work.

2. Muscular endurance. Development of muscles to sustain contraction over a long period of time or to maintain a state of contraction against heavy resistance.

It has been said cardiovascular endurance is developed best through high repetition with low resistance type of weight training. This is a belief held by men in the physical education and athletic fields. In readings made

by the author there is evidence of increased cardiovascular endurance but further study is still needed (46:614) (12:99). In a study by Capen comparing weight training with a program designed to emphasize cardiovascular endurance the weight training program seemed to be as effective in development of cardiovascular endurance as the other program (7:92). Contrary to cardiovascular endurance there was a very strong development of muscular endurance developed in weight training programs. Tuttle and associates state that individuals with the greater maximum strength have a greater absolute strength endurance index but that the development of strength endurance is not proportional to the development of maximum strength (45:106). McCloy has stated that when the strength of a muscle is increased, fewer motor units will be required to lift a given load. The fewer the motor units used, the longer they may be alternated and still perform the work. An increase of strength of a muscle therefore, would seem to be accompanied by an increase in muscular endurance (33:84). Schneider and Karpovich state that in active muscles more capillaries are open and their average diameter is greater than in resting muscles (41:198). There is an increase in the number of capillaries and the content of muscle hemoglobin, phosphocreatine, and glycogen develop in the

muscle during weight training or heavy work (34:14). The net effect of all of these changes is a gain in endurance which is sometimes striking. Wilkin concludes that in his study there was an increase in muscular endurance by the weight training group (48:369).

More research is needed in the relationship between cardiovascular endurance and weight training, but there is definitely an increase in muscular endurance by weight training programs.

VI. FLEXIBILITY

The age old belief that weight lifting causes muscle boundness is a falacy brought out by Wilkin (48:369). Morehouse and Miller (34:10) state that the loads to be overcome when performing progressive resistance exercises may stretch the muscles concerned beyond their normal resting length. This is advantageous. It has long been known that skeletal muscles develop greater force after being previously stretched. In Kusinitz and Keeney's study they concluded that weight training does not decrease speed or flexibility and no harmful affects were experienced by forty-six junior high school boys in the study (27:300). In an article written by James E. Councilman, he summarized that weight training seems to improve power, speed, strength and

flexibility (16:20). Through weight training more efficient timing and adjustment is affected so that when one muscle contracts its antagonist offers a minimum of resistance (20:379). There is definite evidence to say that through a well planned weight training program there is an increase in flexibility.

VII. WEIGHT TRAINING TRENDS

The remainder of the research will be concerned with how to determine the type of weight program to be used and how much weight to use per repetition. Berger states the findings of his study suggest that groups that are homogenous in strength can be formed initially in weight training classes on the basis of the military press (2:514). In another study by Berger, he stated that weight training for nine weeks with heavy loads, fewer repetitions per set, and more sets does not increase strength more effectively than light load, more repetitions per set, but fewer sets (4:397). Still another study by Berger indicates the best weight training procedure for increasing strength is to use six repetitions per set and three sets (3:177). In Masleys study there was an increase in strength developed in six weeks (29:315). Chui made studies of the effect of weight training on jumping ability, power development

related to eight pound and twelve pound shot puts and power related to sprinting (9:190-193). An interesting fact discovered by the author was that brought out by Campbell. Campbells study shows evidence that weight training programs should be carried on into the competitive season (6:347). Rasch and Burke state that muscular strength is perhaps the most important of all factors in athletic performances (39:436).

In conclusion, the evidence read and summarized by the author points to a very critical need for weight training in physical education and athletics. In the following chapter the authors results and analysis of data will only augment this need.

CHAPTER IV

ANALYSIS OF DATA

The subjects of the weight training program and control group were compared by gains or loss in mean scores. These calculations can be found in the appendix under Table I.

The raw score obtained from the Rogers Physical Fitness Index first had to be calculated to find the Strength Index. The Strength Index, or SI is the total score determined by adding together the scores made on each test item: lung capacity, right grip, left grip, back strength, leg strength, and arm strength. Arm strength is scored according to the following formula: (pull-ups+ push-ups) x $(\frac{W}{10}+H-60)$, in which W represents the weight in pounds, and H the height in inches. Fractions are corrected to the nearest whole numbers (10:168). Lung capacity scores are multiplied by sixty-one to change cubic inches to pounds. All test items are added to give an achieved SI. The normal SI is found by norms which are based on sex, weight, and age. The norms used by the author are found in the text, Measurement in Physical Education (30:73). From the achieved SI and normal SI the Physical Fitness Index is scored by the

following formula: $PFI=\frac{\text{Achieved SI}}{\text{Normal SI}} \times 100$.

Raw scores for the pre and post tests of the Rogers Physical Fitness Test of the experimental group can be found in the Appendix A, under Table IV. Raw scores for the pre and post tests of the Rogers Physical Fitness Test of the control group can be found in the Appendix A, under Table III. The results of the scores obtained in the fifty yard dash, six hundred yard run and Strength Index can be found in the Appendix A, under Table V. The mean scores of all the tests were then calculated to show if there were sufficient differences in the two groups, no matter how often other simularly selected samples are compared, the same level of confidence will persist. Also it is important to know if the differences are not significant how near they approach a significance. The statistical means of achieving these comparisons is to formulate t relationship between the control and the experimental tests and also the t improvement within each group.

Arm strength. The control group had a pre-test mean score of 214.62. The experimental group had a pre-test mean score of 294.40, which gives a mean difference of 79.86. This results in a t of 1.51, which is not significant showing that there is no appreciable difference between the control and experimental group on arm strength

at the beginning of the experimentation.

The arm strength mean score on the post-test for the experimental group was 528.33. The control group had a mean score of 290.74, which gave a mean difference of 237.59. This is a t of 3.55, which is beyond the .01 level of confidence. This is decisive evidence that weight training develops arm strength far more than does the traditional program of physical education calisthenics.

The next comparison will show the improvement the control group made in the eight-week program and the improvement made by the experimental group over the same period.

The pre-test mean score of the control group on arm strength was 214.62. The mean score on the post-test arm strength was 290.74, which is an increase of 76.12. This gives a t of 1.33, which is not significant. The pre-test mean score on arm strength for the experimental group was 294.40. The mean score on the post-test was 528.33, which shows a mean increase of 233.93. This gives a t of 3.77, which is beyond the .01 level of confidence and points out that the weight group improved significantly in arm strength.

The following figures illustrate the preceding facts about the arm strength tests:

	Pre-Mean	Post-Mean	Diff. of Mean	t	Level of Confidence
Exp. Group	294.40	528.33	233.93	3.77	.01
Control Group	214.62	290.74	76.12	1.33	___

Leg lift. The control group had a mean score of 633.75, on their pre-test leg lift. The experimental group had a leg lift mean score of 631.00. This shows a difference of mean scores of 2.75, and results in a t of .04, which is not significant.

The post-test mean score obtained by the control group was 726.25. The experimental group post-test mean score on the leg lift was 783.50, which shows a difference of 57.35. The t obtained is .46, which is not significant.

Although no degree of confidence is evident by the t obtained in the experimental group, it did improve more than the control group. The author reasons that the leg strength of junior high school boys is a lot stronger in comparison with other parts of the body as was the case in this experiment. The little improvement made would have to be an outcome of not enough over load on the legs during the eight week training sessions (18:6).

Another comparison made by the author was that of the amount of growth made in each of the groups. In this comparison the mean scores of the pre-test control is compared with the mean scores of the post-control groups to determine, if any, the amount of gain.

The leg lift pre-test mean score for the control groups test was 633.75. The post-test mean score was 726.25, for an increase of 92.50. This gives a t of 1.05, which is not significant.

The experimental group mean score for the leg lift pre-test was 631.00. The mean score on the post-test was 783.50, which is an increase of 152.52. The t obtained is 1.30, which is not significant, but the improvement made in the experimental group is better than one-half again that made by the control group. This in itself shows the weight training is more effective in development of leg strength than a program of routine physical education class calisthenics. The following figures illustrate the above facts about the leg lift tests:

	Pre-Mean	Post-Mean	Diff. of Mean	t	Level of Confidence
Exp. Group	631.00	783.50	152.50	1.30	___
Control Group	633.75	726.25	92.50	1.05	___

Back lift. The mean score of the pre-test control group on the back lift was 253.50. The mean score of the pre-test experimental group was 247.50, a mean difference of 6.00. This results in a t of .30, which is not significant showing there was no appreciative difference between the two groups at the beginning of the experimentation.

The mean score on the post-test of the control group was 243.25. The mean score on the post-test of the experimental group was 282.00, which shows a difference of 38.75. The t obtained was 1.79, which is a significant gain above the .10 level of confidence and indicates that weight training has more of an effect on building strength of the back than does the traditional physical education program of calisthenics.

The next comparison will show the growth within the control and experimental groups.

The control group had a pre-test mean score of 253.50, and a post-test mean score of 243.25. This gives a decrease of 10.25 in the control group and results in a t of .52, which is not significant.

The experimental group had a pre-test mean score in the back lift of 247.50, and a post-test mean score of 282.00, for an increase of 34.50. This results in a t of 2.21, which is significant beyond the .05 level of

confidence. The results of these comparisons again show the weight training group had a more appreciative gain than did the control group. The following figures illustrate the preceding facts about the back lift tests:

	Pre-Mean	Post-Mean	Diff. of Mean	t	Level of Confidence
Exp. Group	247.50	282.00	34.50	2.21	.05
Control Group	253.50	243.25	-10.25	.52	___

Left grip. The control group mean scores on the pre-test were 89.70. The pre-test of the experimental group on the left grip had a mean of 102.00, which gives a difference of 12.30. The t result is 2.41, which is significant at the .02 level of confidence. This shows that at the beginning of the experiment the control and experimental group differed significantly.

The post-test mean score on left grip for the control groups is 103.80. The post-test mean score for the control group is 91.45, which gives a difference of 12.35. This gives a t of 2.33, which shows that both groups improved about the same amount.

The comparisons of improvement made by the control and experimental group programs parallel the above results.

The control group mean score for the left grip was 89.70. The control post-test mean score for the left grip was 91.45, an increase of 1.75. The obtained t is .05, which is not significant.

The experimental group mean score for the left grip pre-test is 102.00. The post-test scores for the experimental group on the left grip was 103.80, a gain of 1.80. This results in a t of .10, which is not significant. The following figures illustrate the above facts about the left grip tests:

	Pre-Mean	Post-Mean	Diff. of Mean	t	Level of Confidence
Exp. Group	102.00	103.80	1.80	.10	___
Control Group	89.70	91.45	1.75	.05	___

Right grip. The mean score for the control groups right grip pre-test is 100.20. The mean score for the experimental groups right grip pre-test is 110.00, which gives a difference of 9.80. This is a t of 1.43, which is not significant.

The right grip post-test mean score for the control group is 100.55. The experimental group post-test mean score for the right-grip is 110.80, which gives a difference of 10.25. This results in a t of 1.66, which approaches the .10 level of confidence. This t shows that

there was an increase in strength of the experimental group over the control group which tends to support that weight training does improve grip strength more than the non-weight training control groups routine calisthenics.

The development of grip strength within each group shows more evidence of improvement by the use of weight training.

The pre-test control groups right grip was 100.20 and the post-test was 100.55, which gives a difference in mean scores of .35. This results in a t of .05, which is not significant.

The mean score of the experimental group on the right grip pre-test was 110.00. The post-test mean score was 110.80, which is a difference in the means of .80, which gives a t of .10, which is not significant. The following figures illustrate the above facts about the right grip tests:

	Pre-Mean	Post-Mean	Diff. of Mean	t	Level of Confidence
Exp. Group	110.00	110.80	.80	.10	___
Control Group	100.20	100.55	.35	.05	___

Lung capacity. The control group had a mean score on their pre-test of 237.29. The experimental group had a mean pre-test of 219.91, which results in a difference

in the means of 17.38. This is a t of 1.06, which is not significant.

The control group post-test mean score was 241.26 and the experimental group post-test mean score was 248.27. This gives a t of .43, which is not significant.

Looking at each group separately gives a little better picture of growth of lung capacity. The control group pre-test was 237.29 and their post-test was 241.26. The result is a difference of 3.96, which is not significant because of the t obtained is .25. The experimental group however started with a pre-test mean score of 219.91 and had a post-test of 248.27. This is an increase in mean scores of 28.36, which is significant above the .10 level of confidence as shown by a t of 1.75.

In conclusion the author would like to emphasize the significant improvement the experimental group made from pre-test to post-test and the increase in lung capacity should definitely have a beneficial effect on the individuals respiratory system. The following figures illustrate the above facts about the lung capacity tests:

	Pre-Mean	Post-Mean	Diff. of Mean	t	Level of Confidence
Exp. Group	219.91	248.27	28.36	1.75	.10
Control Group	237.29	241.26	3.96	.25	___

Strength index. The control group mean score on pre-tests was 1530.01. The experimental group mean score pre-test was 1604.01. This gives a difference in mean scores of 74.09. The result is .47, which is not significant. The t again shows that the control and experimental groups did not differ statistically at the beginning of the experiment.

The control group had a post-test mean score on the strength index of 1693.70 and the experimental group had a post-test mean improvement of 2053.83. The difference of the mean scores is 360.13, which gives a t of 2.62. This t is significant above the .02 level of confidence.

Although the two groups did not show significant differences to start with, at the end of the experimental period the weight group showed a tremendous improvement and difference over the control group.

The improvement in the mean score of the control group on the pre and post test was 163.69. This gives a t of 1.20 which is not significant.

The improvement of the experimental group pre and post test was 449.82, which is almost three times as much as made by the control group. This gives a t of 2.83, which is above the .01 level of confidence. The author would like to explain that although the SI is not a

measure of physical fitness, it is a measure of general athletic ability and has a significant relationship with the learning of motor skills (10:259). The following figures illustrate the preceding facts about the strength index tests:

	Pre-Mean	Post-Mean	Diff. of Mean	t	Level of Confidence
Exp. Group	1604.01	2053.83	449.82	2.83	.01
Control Group	1530.01	1693.70	163.69	1.20	---

Physical Fitness Index. The control group had a mean score of 83.48 on the pre-test. The experimental group had a mean score pre-test of 88.05 for a mean difference of 4.57. This results in a t of .57. The t is not significant and indicates there was no statistical difference at the start of the experimental program between the control and experimental groups.

The post-test mean score of the control group on physical fitness index was 90.86. The experimental group mean score on post-test was 105.70, which is a mean difference over control group of 14.84. This gives a t of 2.14, which is above the .05 level of confidence.

Again the weight training group had a significant gain over the control group. An average score on the PFI is 100. Deviations from this figure should be classified

as physically superior or inferior, as the case may be (10:178). The weight training group improved from 11.95 points below average to 5.70 above average. This is an indication of development of superior physical fitness.

The growth within the two groups is about the same as the improvement made between the groups. The control group pre-test PFI mean score was 83.48. The post-test PFI mean score for the control group was 90.86. This shows an increase of 7.38 and a t of 1.20, which is not significant.

The experimental group had a mean pre-test score of 88.05 and a post-test mean score of 105.70. This gives an increase of 17.65, better than twice the increase made by the control group. The t obtained is 2.43, which is above the .02 level of confidence. The following figures illustrate the above facts about the PFI tests:

	Pre-Mean	Post-Mean	Diff. of Mean	t	Level of Confidence
Exp. Group	88.05	105.70	17.65	2.43	.02
Control Group	83.48	90.86	7.38	1.20	___

Fifty yard dash. The control group had a mean score on the fifty yard dash of 7.35 seconds. The experimental group had a mean score of 7.09 seconds. This results in a difference of .16 seconds. The t obtained is .43, which

is not significant. This again indicates the control and experimental group did not differ statistically at the beginning of the experiment.

The post-test control group had a mean score of 6.99 in the fifty yard dash. The experimental group had a mean score of 6.64 in the post-test of the fifty yard dash. The difference of the mean score of the control and experimental group on the fifty yard dash is .35 of a second. This gives a t of 6.36, which is well above the .01 level of confidence. The indication here is that weight training increases speed and weight trainers are not slowed down, as is believed by some individuals.

The control group had a pre-test score of 7.35 and a post-test score of 6.99 in the fifty yard dash. The improvement made is .26 of a second, which gives a t of .69. This indicates there was not a significant improvement made by the control group.

The experimental group had a pre-test mean score of 7.09 and a post-test mean score of 6.64 in the fifty yard dash. The gain obtained in the eight week training period was .35 of a second. This gives a t of 6.43, well above the .01 level of confidence.

The growth of the weight training group shows that weight training does not slow down an individuals speed as measured by the fifty yard dash. The following figures illustrate the preceding facts about the fifty yard dash tests:

	Pre-Mean	Post-Mean	Diff. of Mean	t	Level of Confidence
Exp. Group	7.09	6.64	.35	6.43	.01
Control Group	7.35	6.99	.26	.69	___

600 yard run. The control group had a pre-test mean score of 2:01 minutes in the 600 yard run. The experimental group had a mean pre-test score of 1:53 minutes. The difference between the mean scores is eight seconds. This gives a t of 4.60, which is significant above the .01 level of confidence and shows there was a great difference between the two groups at the beginning of the experiment.

The control group had a post-test mean score of 1:53 and the experimental group had a post-test score of 1:48. This gives a difference in mean scores of five seconds and the t obtained is 3.70, which is significant above the .01 level. The developments made here cannot be easily compared because of the great difference between the two groups to start with.

An analysis of the group growth itself gives no indication of an endurance increase in the experimental group or control group. The control group had scores of 2:01 on pre-test and 1:53 on post-test for an increase of eight seconds. The experimental group had a pre-test score of 1:53 and a post-test mean score of 1:48 for an increase of five seconds. The t obtained by the control group was 1.20, which is not significant and the t obtained by the control group was 1.00, which is also not significant. Indication from this experiment shows that although weight training does not improve endurance it also indicates it does not hamper it either. There is definitely some growth of endurance. The following figures illustrate the above facts about the 600 yard run tests:

	Pre-Mean	Post-Mean	Diff. of Mean	t	Level of Confidence
Exp. Group	1:53	1:48	:05	1.00	___
Control Group	2:01	1:53	:08	1.30	___

All equations used in calculation of data are illustrated in Figure 1, Appendix B.

The PFI, fifty yard dash and 600 yard run score card used to record the test scores is found in Figure 2, Appendix B.

A summary and conclusion of the thesis will be found in Chapter V.

CHAPTER V

SUMMARY AND CONCLUSION

Forty, ninth grade boys enrolled in physical education classes at Washington Junior High School, Yakima, Washington, were used in this study. The boys were divided into two groups; a control group and an experimental group. The two groups were tested with the fifty yard dash for speed, the Rogers PFI for strength, and the 600 yard run for endurance, prior to the start of the eight week experimental period. The experimental group participated in a weight training program three days a week and two days a week they had first aid in the classroom. The control group participated in the regular physical education classes. The units covered during the eight week period were basketball and wrestling. The control group had physical education three times a week and first aid in the classroom two days a week. At the end of the eight week experimental period the two groups were again tested with the fifty yard dash for speed, the Rogers PFI for strength, and the 600 yard run for endurance. The results were that the experimental group showed a greater gain in nine of the ten areas tested.

The weight training group had a significant improvement at the .01 level of confidence on arm strength, fifty

yard dash and strength index. They had significant gains at the .05 level of confidence on the back lift and PFI. The lung capacity and leg lift were at the .01 level of confidence. There were gains made in the right grip and left grip but there is not sufficient evidence to show a significance.

It may be concluded that a program of weight training when properly administered and supervised will increase speed, as measured by the fifty yard dash, strength as measured by the Rogers Strength Index, and physical fitness as measured by the Rogers Physical Fitness Index. Evidence established in Chapter III and Chapter IV showed there was not sufficient evidence of an increase in cardiovascular endurance as measured by the 600 yard run, but did support that there was an increase in muscular endurance.

The author reasons that the test results of the right and left grip would have been better if a practice test would have been given first. The leg lift, and back lift results would have shown a better increase also, if a practice test were given. Correction made on the back lift post-test caused the control group to have a mean decrease of 10.25 and the mean gain by the experimental group was held down to 34.50. The author concludes that had more resistance been put on the legs, the leg lift would have

improvement comparable to that of arm strength. The limit of weight available at the time (110 pounds) for each group is not a sufficient over load. Weight training with loads between 180 pounds and 250 pounds would not be too much at the junior high level. If the psychological level of lifting ability can be raised to meet the muscular strength ability of the subjects a great improvement could be made. Simple competition tests from time to time during weight training sessions help keep the interest high. Once an individual can clearly see the fruits of his efforts, your weight program will be a success. The author is hopeful that this study has been helpful in encouraging an interest in weight training both in the field of physical education and athletics.

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A P P E N D I X A

TABLE I

EXPERIMENTAL AND CONTROL GROUP MEAN SCORES
FOR PRE AND POST TEST

Test	Pre-Control	Pre-Experimental	Post Control	Increase Control	Post Experimental	Increase Experimental
Arm Strength	214.62	294.40	290.74	76.12	528.33	233.93
Leg Lift	633.75	631.00	726.25	92.50	783.50	152.50
Back Lift	253.50	247.50	243.25	-10.25	282.00	34.50
Left Grip	89.70	102.00	91.45	1.75	103.80	1.80
Right Grip	100.20	110.00	100.55	.35	110.80	.80
Lung Capacity	237.29	219.91	241.26	3.96	248.27	28.36
Strength Index	1530.01	1604.01	1693.70	163.69	2053.83	449.82
P. F. I.	83.48	88.05	90.86	7.38	105.70	17.65
Fifty Yard Dash	7.35	7.09	6.99	.26	6.64	.35
600 Yard Run	2:01	1:53	1:53	:08	1:48	:05

TABLE II

FISHER t FOR EXPERIMENTAL GROUP AND CONTROL GROUP

Test	Pretest Control vs Post test Control	Pretest Experimental vs Post test Experimental	Pretest Control vs Pretest Experimental	Post test Control vs Post test Experimental
Arm Strength	t=1.33	t=3.77	t=1.51	t=3.55
Leg Lift	t=1.05	t=1.30	t= .04	t= .46
Back Lift	t= .52	t=2.21	t= .30	t=1.79
Left Grip	t= .05	t= .10	t=2.41	t=2.33
Right Grip	t= .05	t= .10	t=1.43	t=1.66
Lung Capacity	t= .25	t=1.75	t=1.06	t= .43
Fifty Yard Dash	t= .69	t=6.43	t= .43	t=6.36
600 Yard Dash	t=1.30	t=1.00	t=4.60	t=3.70
P. F. I.	t=1.20	t=2.43	t= .57	t=2.14
S. I.	t=1.20	t=2.83	t= .47	t=2.62

TABLE III

RAW SCORES FOR CONTROL GROUP PRE AND POST
PFI TEST

Case	Arm Strength		Leg Lift		Back Lift		Left Grip		Right Grip		Lung Capacity		P.F.I.	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
A	169.6	308.85	810	800	240	270	110	100	110	100	262.3	244.0	85.09	88.10
B	46.8	96.3	300	325	105	130	40	42	52	50	195.2	213.5	45.06	50.73
C	256.7	281.2	870	1120	300	270	110	96	110	115	195.2	207.4	118.22	139.02
D	593.4	750.4	1065	1320	300	420	118	130	125	128	335.5	335.5	107.77	131.01
E	427.5	387.6	600	700	360	300	90	102	100	100	244.0	244.0	97.43	116.17
F	118.0	172.9	760	520	300	240	104	100	104	120	237.9	256.2	86.89	73.70
G	248.95	251.55	500	630	225	240	100	100	103	100	207.4	219.6	79.79	86.53
H	51.9	45.5	430	660	180	210	54	79	95	96	183.0	170.8	48.59	58.26
I	48.9	103.8	430	520	200	160	89	78	100	80	158.6	189.1	78.96	79.53
J	186.0	264.0	290	420	150	160	90	90	70	71	231.8	231.8	69.57	84.54
K	30.5	0	600	630	270	220	90	90	110	120	244.0	250.1	40.82	38.93
L	219.6	372.4	540	585	240	245	84	88	83	90	219.6	244.0	96.26	105.48
M	291.25	357.0	430	370	280	250	90	105	100	102	189.1	219.6	59.78	64.10
N	546.0	779.8	860	1410	350	350	115	114	130	125	353.8	366.0	107.56	143.76
O	107.1	121.1	340	470	210	170	80	80	90	100	207.4	213.5	76.69	85.59
P	313.5	377.4	960	1110	260	280	96	90	114	98	244.0	256.2	114.1	124.32
Q	145.5	307.5	500	630	290	270	78	70	90	95	244.0	237.9	82.92	96.66
R	37.5	140.0	540	725	250	170	69	68	92	80	256.2	244.0	75.57	82.34
S	233.75	342.4	860	1080	280	260	121	117	120	121	219.6	207.4	96.09	108.78
T	220.0	355.2	990	500	280	250	85	90	106	120	317.2	274.5	102.47	79.84

TABLE IV

RAW SCORES FOR EXPERIMENTAL GROUP PRE AND POST
PFI TEST

Case	Arm Strength		Leg Lift		Back Lift		Left Grip		Right Grip		Lung Capacity		P.F.I.	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
A	362.2	699.	750	1020	320	290	112	90	120	111	298.9	325.3	98.2	122.44
B	393.6	533.	660	720	300	250	101	101	90	101	280.6	298.9	101.96	102.7
C	70.8	409.2	290	600	100	190	72	88	88	84	250.1	256.2	54.84	99.41
D	377.4	807.3	700	870	280	300	110	107	132	110	280.6	335.5	93.02	110.39
E	204.5	394.2	380	770	280	330	106	110	108	122	128.1	189.1	76.13	110.39
F	404.7	626.4	870	1020	360	340	78	117	132	122	134.2	201.3	97.43	116.17
G	392.58	625.6	710	590	260	290	140	130	138	160	170.8	225.7	104.52	110.51
H	457.73	558.	390	480	260	260	105	90	100	92	201.3	213.5	75.7	81.07
I	298.	600.25	540	700	240	220	98	102	100	104	176.9	225.7	94.1	121.84
J	109.35	254.7	630	710	180	210	71	83	83	80	189.1	219.6	88.78	95.83
K	0	188.4	600	720	250	310	119	117	121	121	231.8	305.0	42.54	55.96
L	391.2	605.5	890	840	210	280	100	113	115	129	231.8	201.3	134.58	136.40
M	602.6	791.7	1180	1290	350	400	120	147	164	145	225.7	219.6	122.05	129.67
N	429.25	900.45	1000	1020	320	370	121	117	119	138	298.9	311.1	115.01	140.16
O	78.5	265.6	160	360	110	190	79	79	89	77	176.9	164.7	47.17	72.93
P	379.05	712.30	590	620	190	240	82	105	111	108	244.0	237.9	89.26	106.29
Q	0	17.7	220	770	100	160	62	61	78	74	158.6	225.7	35.41	68.43
R	251.1	460.13	540	680	220	200	102	101	111	107	195.2	262.3	91.1	107.06
S	437.00	657.2	720	1100	300	300	103	108	103	114	256.2	274.5	102.69	120.91
T	247.5	460.	800	750	320	390	123	110	118	117	268.4	274.5	96.25	101.42

TABLE V

RAW SCORES FOR EXPERIMENTAL AND CONTROL GROUP FOR FIFTY YARD DASH, 600 YARD RUN AND SI

Experimental Group	50 Yard Dash		600 Yard Run		Strength Index		Control Group	50 Yard Dash		600 Yard Run		Strength Index	
	Pre	Post	Pre	Post	Pre	Post		Pre	Post	Pre	Post	Pre	Post
A	7.0	6.5	1:42	1:38	1944.1	2533.3	A	6.8	6.7	1:35	1:40	1790.9	1822.85
B	7.0	7.1	1:56	1:54	1825.2	2043.9	B	8.1	8.2	2:20	2:15	739.0	856.8
C	6.8	6.4	1:41	1:38	870.9	1627.4	C	6.9	6.6	1:50	1:50	1841.9	2089.6
D	6.8	6.7	1:57	1:43	1880.0	2592.8	D	6.5	6.3	1:58	1:56	2536.9	3083.9
E	7.0	6.8	1:58	1:56	1206.6	1915.3	E	7.7	7.1	2:07	1:51	1821.5	1833.6
F	6.8	6.3	1:47	1:45	1978.9	2426.7	F	7.4	6.9	2:05	1:51	1623.9	1409.1
G	7.0	6.0	1:45	1:39	1811.38	2021.3	G	7.2	6.8	1:52	1:43	1388.35	1541.15
H	7.1	6.9	1:51	1:48	1514.03	1693.5	H	8.2	8.0	2:19	2:13	993.9	1261.3
I	8.5	7.4	2:05	2:00	1262.45	1557.3	I	7.8	7.1	2:06	1:57	1026.5	1130.9
J	6.9	6.5	1:50	1:46	1452.9	1951.95	J	6.9	6.8	1:54	1:54	1017.8	1236.8
K	7.5	7.0	2:10	2:03	1321.8	1761.4	K	9.9	8.9	2:55	2:17	1344.5	1310.1
L	6.7	6.2	1:43	1:36	1938.0	2168.8	L	7.0	6.6	1:52	1:41	1386.2	1624.4
M	6.4	6.0	1:41	1:35	2642.3	2993.3	M	7.5	7.4	1:58	1:55	1380.35	1403.6
N	6.5	6.0	1:42	1:38	2288.15	2856.55	N	6.4	6.1	1:52	1:44	2354.8	3144.0
O	7.1	6.5	2:03	2:01	693.4	1136.3	O	7.7	7.1	2:10	2:08	1034.5	1154.6
P	6.8	6.4	1:45	1:37	1596.05	2123.2	P	6.3	6.0	1:35	1:28	1987.5	2211.6
Q	9.0	8.5	2:50	2:33	618.6	1308.4	Q	7.9	7.0	2:03	1:52	1347.5	1610.4
R	7.1	6.8	1:51	1:44	1419.3	1810.43	R	7.0	6.8	1:50	1:47	1244.7	1427.0
S	6.8	6.4	1:46	1:44	1919.2	2553.7	S	6.7	6.5	1:44	1:39	1834.35	2127.8
T	7.0	6.3	1:37	1:34	1876.9	2101.5	T	7.1	6.9	2:07	2:06	1998.2	1589.7

A P P E N D I X B

MEAN	=	$\frac{\Sigma X}{N}$
σ	=	$\sqrt{\frac{EX^2}{N} - M^2}$ / N
σ_M	=	$\frac{\Sigma X^2}{\sqrt{N-1}}$
σ_D	=	$\sqrt{\sigma_{M_1}^2 + \sigma_{M_2}^2}$
D_m	=	$m_1 - m_2$
t	=	$\frac{D_m}{\sigma_D}$

FIGURE 1

EQUATIONS USED IN ANALYSIS OF DATA

Name (Print) Last First

Grade

Date	First Test	Second Test	Third Test	Fourth Test
Age	Yrs. Mos.	Yrs. Mos.	Yrs. Mos.	Yrs. Mos.
Weight	Lbs.	Lbs.	Lbs.	Lbs.
Height	Ins.	Ins.	Ins.	Ins.
Multiplier				
Pull-ups				
Arm Strength				
Leg Lift				
Back Lift				
Left Grip				
Right Grip				
Lung Capacity				
Strength Index				
Normal SI				
PFI				
Fifty Yard Dash				
600 Yard Run				

FIGURE 2

AN ILLUSTRATION OF A SAMPLE PFI SCORE CARD