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A Discriminative Study of the Weight Training and Physical Fitness Program in Physical Education

George W. Carberry, Jr.
Central Washington University

A DISCRIMINATIVE STUDY OF THE WEIGHT TRAINING AND PHYSICAL FITNESS PROGRAM IN PHYSICAL EDUCATION

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by

George W. Carberry, Jr.

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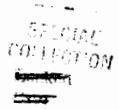

THIS PAPER IS APPROVED AS MEETING THE PLAN 1 REQUIRMEMENT FOR THE COMPLETION OF A THESIS.

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Everett A. Irish, COMMITTEE CHAIRMAN

_____

Dohn A. Miller

_____

L. E. Reynolds
FOR THE GRADUATE FACULTY

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CHAPTER I

INTRODUCTION

The low physical fitness level of American youth is becoming more and more apparent. Until recently, little has been done to build areas of the student's body which need development. However, at present doctors, educators, and people in general are becoming increasingly aware that our fitness level must be raised so that we may survive as a leading nation. This renewed interest has brought with it problems to be solved.

First, who is responsible for increasing the fitness level of our youth? Second, is there a lack of facilities and materials to develop such a program? Third, is there a lack of teachers trained in physical education and with a sincere interest in helping children become healthier citizens? Fourth, what type of program can best develop physical fitness?

It was the purpose of this paper to explore one phase (weight training) of a physical education program to determine if it can improve physical fitness.

I. AIM OF STUDY

Statement of the problem. This study was undertaken to (1) determine the present physical fitness level

of boys enrolled in physical education classes at Wilbur High School, Wilbur, Washington; (2) test this program and ascertain the level of development; (3) determine the value of weight training in physical education; (4) determine if this program is suitable to a small high school; and (5) aid teachers in developing and instructing students in a weight-training program in the ninth, tenth, eleventh, and twelfth grades.

This information is not designed for the physical education teacher alone, but for presentation to administrations or communities wanting to know more about the program.

Fifty-five male students enrolled in the physical education program at Wilbur High School were the subjects for this investigation. The students were divided into an experimental group and a control group. Both groups were tested at the outset of the program. The experimental group was subjected to a weight-lifting program while the control group participated in the regular physical education program. At the end of the ninety-day experimental period, both groups were retested.

Limitations of the study. This study was limited to the ninth, tenth, eleventh, and twelfth grades at Wilbur High School, a school of 135 students in a rural farming area. The proposed program, however, could be used by high

school and junior high school teachers anywhere who are interested in improving the physical education program in their school. While conducting this study, many 1960 editions of books, periodicals, speeches, and weight-training materials were investigated in order to use the latest information possible concerning physical fitness.

II. DEFINITIONS OF TERMS USED

Clean. The definition of the term "clean" was made by Parke Cummings:

> The first movement of the clean and jerk. It is the raising of the bar to shoulder height before it is subsequently jerked over head (5:74).

Clean and jerk. Parke Cummings gives the following definition for "clean and jerk":

> Weight-lifting--A prescribed lift. The two hands clean and jerk is one of the three tests that must be passed to qualify for a weight-lifting certificate, the weight lifted equaling that of the candidate. In this the bar is laid horizontally in front of the feet, gripped with both hands and brought with a single distinct motion from the ground to the shoulders while either lunging or springing on bent legs. It must not touch the chest before reaching its final position at the shoulders, and must then rest on the chest or closely flexed arms. The feet are then brought back to their original position, on the same line. The legs are then bent, and both legs and arms are then suddenly stiffened with a jerk so as to lift the bar to the end of the vertically raised arms. The weight must there be held motionless for two seconds, with the feet on the same line and not more than 16" apart, the knees and arms stiffened. There is also a one hand clean and jerk, with records listed for each of the arms. The same two

distinct movements must be used--the clean, and the jerk. In the pull-in to the shoulder the trunk may be bent sidewise, and the elbow may rest on the thigh prior to standing erect, but the bar must at all times be kept clear of the body in that phase. The elbow may be rested on the body prior to jerking, and the bar may be in contact with the shoulder at the start of the jerk. The bar must be held in the final position until the referee passes the lift. It may not be touched with the non-lifting hand, and no part of the body save the feet may touch the ground (5:15).

Barbell. Barbell or bar-bell is defined as follows:

A heavy gymnastic weight consisting of a bar 2-3' long with disk-shaped weights attached to each end. Longer ones with heavier weights are used in weight-lifting, and must have a maximum length of 7', a maximum thickness of 1", the diameter of the largest disk must not exceed 18". Weights of varying heaviness may be attached to each end of the barbell which is thus, in effect, a large adjustable dumbell (5:23).

Weight lifting and weight training. The following definitions are given by Massey, Freeman, Manson, and Wessel:

Modern-day weight lifting consists of lifting weights in the form of bar bells or dumbbells either for purposes of exercise or as a competitive sport. When the lifting is done competitively, it is termed "weight lifting" or "competitive lifting" and when it is done systematically for purposes of exercise it is called "weight training." People generally "weight train" for one of, or a mixture of the following reasons: overall physical conditioning, development of the physique--"body building," conditioning for some specific sport such as football or basketball, rehabilitation of certain muscle groups weakened through disease or injury, and preoperative conditioning of muscle groups such as the extensors of the knee before undergoing knee surgery. In physical therapy and medical circles weight training is often referred to as "progressive resistance exercise" (15:1).

Military press.

The bar bell is placed on the floor, horizontally in front of the lifter. It must be brought, using the two hands in one single distinct movement, up to the chest rest position. In executing this initial movement, the lifter may address the mat using the crouch position, and in the shouldering of the bar the movement may be abetted by quickly dropping the body under the bar using either a spring and drop with bent legs (partial squat) or a lunging movement (moving the legs and feet into a split position). To conclude the first phase of this lift, the feet must be brought back so as to be on a line and at a distance apart no greater than 16 inches. The feet must be in this position before the second phase of the lift can be started.

After the bar has been held for two seconds in the chest position, or near the chest on closely flexed arms, with the body motionless, the referee claps his hands and the bar is then pressed vertically until the arms are fully extended overhead. The movement must be continuous and not jerky or halting. Upon completion of the movement, this position, with the arms and legs fully extended, must be held for at least two seconds. Throughout this second phase of the exercise, the lifter's body and head must remain approximately in the vertical position and the heels cannot be raised from the floor (15:122).

Physical fitness.

Fitness is a word that has significance as a general concept as well as a specific one. Fitness means optimum health. Fitness or optimum health is the foundation upon which a person develops his abilities and capacities to earn his daily bread, to live happily, and to contribute to his family, his community and his nation.

Fitness is a condition or state of being. It is the condition of the mind, the body, the spirit, and the emotions. A person has optimum health or fitness when he has--

1. A sound well-functioning body
2. A body free from disease and remedial handicaps

3. A body that adjusts efficiently to the physical demands of life
4. A high degree of emotional stability
5. A will to live, to persevere, to endure until the job is done satisfactorily (21:86).

Bar.

A round length of solid steel used as a handle with which to practice weight lifting and progressive resistance exercise. Progression is made possible by adding weights to each end of the bar, or handle. Bars vary in length from four to seven feet (21:86).

Collar.

A circular iron or steel ring secured to a bar by a screw which is used to keep adjustable weights from sliding from the ends of exercise bars and to keep the weights from coming in contact with exercisers' hands. Four collars are a part of each barbell (21:86).

Progressive resistance exercise.

The process of lifting barbells and dumbbells in a variety of ways to develop muscular size and strength, and to place the body in physically fit condition. Progressive resistance exercise is also known as body building and weight training (21:87).

Pronated grip.

The hands are in a position similar to that found when the arms are extended horizontally, in front of the body, with the palms downward. In this position the thumbs are towards each other. In gripping the bar the thumb usually is wrapped around the bar and meets with the index finger. In certain lifts some lifters prefer to place the thumb alongside the index finger rather than around the bar. They feel that it provides added support (15:65).

Supinated grip.

This is the reverse of the pronated grip in that the thumbs are away from each other as is found when the arms are extended in front of the body with the palms of the hand turned upward. This grip is the same as normally used in chinning the bar with the palms of the hands turned toward the body. Again the thumb may be wrapped about the bar or placed alongside the index finger (15:65).

CHAPTER II

REVIEW OF THE LITERATURE

The rise in popularity of "weight training"--not only in competition but also as a means of body building and an aid in conditioning for various other sports as well--is relatively recent. Weight lifting goes back to the days of the early Greek Olympic games, and weight training, in a sense, has developed along with it. Milo of Croton, the great Greek wrestler, believed to be the first weight lifter of note in recorded history, furnishes one of the first examples of preparing for another competitive sport by "weight lifting." The "weight training" prepared him for his wrestling contests. He said to have lifted a young bull and walked with it on his shoulders daily as it grew to its full size. "Milo's principle of gradual progression from a relatively light weight to a heavy poundage is the same one followed today to develop strength and improve physical condition by exercising with adjustable barbells and dumbell" (20:3).

There is little mentioned of the sport of weight lifting in the United States prior to 1850 although it is known that the Colonists used dumbbells for exercising. Benjamin Franklin once wrote in a letter to his son that

"Exercising with dumbbells was once a method of obtaining better health" (2:83).

Most of the interest in weight lifting in the United States came through immigrants from Central Europe and Germany during the nineteenth century. From 1850 to 1900 interest was added through the growing number of professional strongmen from other countries as well as through physical culturists interested in the activity for its fitness value. In the nineteenth century large numbers of strongmen toured the United States giving lifting exhibitions. Many of those men performed their stunts on vaudeville stages or with carnivals. Most of the men got their starts in amateur clubs, often in the back rooms of taverns where vigorous young men met to wrestle, box, and lift weights. These weights were solid, clumsy iron globes with iron or steel connecting bars or single weights with handles projecting from their sides. A man had to be strong even to make a start as a weight lifter when the barbells were not adjustable. It was not until the development of the adjustable barbell that weights came into use as a strengthener of the person below par physically.

Because of the location of the old athletic clubs, many of these huge men added to their size by developing "beer bellies" as well as big muscles.

Although weight lifting as a sport is ancient, "weight training" as a means of conditioning, of building the body for all sorts of competitive sports, is fairly recent. Coaches and competing athletes know that a skilled man with strength always has an advantage over a man who depends upon skill alone. In addition it is easier for a strong man to develop endurance and learn to move his body effectively because his muscles have the ability to carry him through the necessary movements.

During the nineteenth century, "weight lifting" became popular in Germany and other European countries. Famous strong men made their appearance. Professional weight lifters, as mentioned earlier, traveled about from country to country giving performances. Exhibitions of this sort were soon given in North America.

Notables in this group were Josef Steinbach, Karl Swoboda, and Herman Goerner--one of the strongest men of all time. "Possibly the greatest professional strongmen of all time was Arthur Saxon who did his best lifting in the early nineteen hundreds. Saxon was not a huge man but in 1905 had a lift of 448 pounds to his credit. This is the greatest overhead lift recorded until 1948 when Paul Anderson's lift of 459 surpassed his mark. This was an overhead lift called the "two hands anyhow" (11:59). At this time George

Hackenschmidt, a great weight lifter, was gaining fame as a wrestler. Hackenschmidt held the world record for the one-hand snatch. This was 197½ pounds.

Some twenty years after the Saxon, Swoboda, and Hackenschmidt era, Charles Regoulot, a French lifter, did much to put speed into weight lifting. "In 1930 Regoulot improved the one-hand snatch record to 256½ pounds. He was also the first man to clean and jerk over 400 pounds" (20:10).

The European professionals who toured the United States helped to foster interest in weight lifting and feats of strength. Sandow, a European with a beautiful body, showed that a thin, well-proportioned man could be strong. Another great lifter at this time was the Canadian Cyr, 69 inches tall and weighing 300 pounds. His size was due largely to a heavy appetite. He was primarily interested in lifting heavy platforms with a number of people standing on them.

With the inspiration of the leading professionals, including many worthy performers, weight training also received a great boost from the thinkers and organizers, the men who sold weights and instructions by mail order. One of the first instructors was Theodore Siebert, who developed in Germany a training routine not basically different from the exercise used today. France also had its "train-you-by-mail" instructor in Edmund Desbonnet. Sandow took a brief

fling at selling heavy barbell and dumbbell routines which he actually practiced. 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. His first barbells had hollow globes on the ends and could be made progressively heavier by pouring shot into the ends. Later he began using plates of different weights, similar to those used to grade the resistance of barbells today.

> Calvert was a truly inspirational writer in his book Super Strength, now a collector's item, and in a small magazine he published called Strength. His courses were divided into three stages: a basic routine of a dozen exercises; a more advanced routine, including heavier leg work and teaching lifts in vogue, such as the one-arm press; and a third course, which taught the strong-man stunts used by stage performers. Calvert improved on the ideas of continental instructors Siebert and Desbonnet by recognizing the need for a rebuilding period between exercising sessions. He taught that the body's strength and muscle size could develop more quickly if the days of exercise were separated by days in which no exercise was practiced (15:22).

Another "mail order" instructor of note was Bob Hoffman.

> Hoffman's start as a weight training mail-order instructor and manufacturer resulted from personal interest in athletics. Weighing 180 pounds at more than 74 inches in height, Hoffman was a salesman for oil burners produced in York, Pennsylvania. He was also active in local YMCA sports and gained fame for his ability in canoe racing (21:37).

Interested in physical activity of all kinds, Hoffman became an enthusiastic weight lifter when he learned of this type of exercise. He found that he gained in size and strength from weight training as he never had from his other athletic participation. He became a full-fledged heavyweight of 230 pounds, competing in weight-lifting contests. Hoffman also continued his interest in YMCA competition in track and field events as well as canoeing and rowing. Finding that his performances improved as he gained size and strength, he became the first man to widely publicize his belief. Weight training could help athletes in other sports of their choice.

Unfortunately, because of over-enthusiasm for their product many of these commercial interests made outrageous claims concerning the sport. These unfounded claims by the strongmen gave weight lifting a reputation only now beginning to be erased. By 1903, weight lifting was fully accepted as an amateur sport.

> In 1948, Paul Anderson, a 58 inch 300 pound man with great strength, entered the American weight lifting scene; at first he seemed a throwback to the slow moving lifters of the early 1900's but Anderson could move when he had to and had good coordination. At 22 he became the first man to score a 1,100 pound total on 3 lifts (20:17).

In 1946, the Russians entered their first team in the world championship. They were beaten by the United States

11 to 9. They returned home and did not appear again until 1949 when they were again beaten by the United States and Egypt, but this time they scored more points: the United States 18, Egypt 15, and the Russians 14. Again they dropped out of competition until 1952 when they were beaten by the United States. This is the first year that no Egyptian lifters were able to place as high as third. We now had a two team battle for weight lifting supremacy. In 1953 the Soviet achieved its goal by winning the team title. In 1954 the results were much the same as the year before.

In 1939, as a side attraction to the weight lifting championships, the "Mr. America Contest" was held to determine the best developed man competing in the lifting meet. In 1940 and 1941, the winner was John Grimic. These contests were later enlarged to include "New World" and "Mr. Universe." This affair appealed to young people who wanted to look like "Mr. America." This helped stimulate young people to practice specialized lifts. In many cases the winners of the "Mr." contests were not athletic in movement and were lacking in strength. They did not practice athletic movements, fearing they would shrink their muscles.

This extreme devotion to body building impaired our weight-lifting program in America. The actual number of

body builders was comparatively small compared to physical conditioners. The "Mr." contests did help to get people thinking of weights, and many transfered lifting to worthwhile purposes.

The public following of weight training by such renowned athletes as Bob Richards, Parry O'Brien, Fortune Gordien, Dick Cleveland, Jack Kelly, Jr., Henry Wittenberg, and Frank Stranahan did much to offset bad publicity received by the "show-offs" and the "Mr." contests.

As many athletes began using resistance exercise to develop strength to help them excel at their favorite sports, competitive weight lifting gained in popularity. The most widespread use of barbells and dumbbells was as a "keep fit" activity practiced at home.

Since World War II weight lifting has achieved widespread popularity and acceptance. Although it is still misunderstood, many of the falacies once associated with it have been removed. In the United States it is rapidly becoming an integral part of the physical education program, introduced along with other sports into the curriculum on the secondary and college level. Athletes and coaches are more and more employing weight exercises as a means of conditioning, and physicians are using weight lifting as a therapeutic measure. The literature of the sport is continually improving. Publishers of magazines devoted to

weight lifting are making a conscious effort to provide accurate information on this subject. Also, research reports and articles of evaluation are appearing in the professional physical education literature. Weight lifting, both competitive and weight training, is enjoying a status it never has known.

Dr. Charles H. McCloy, late professor of physical education at the State University of Iowa, believes the use of weight training at home is its most valuable application. McCloy favors the teaching of weight training in schools and colleges because of its lifetime carry-over value.

> This form of exercise takes little time to effectively work the entire body vigorously, and requires little space. Barbell and dumbell exercise can be practiced a few minutes daily in the privacy of a person's bedroom, and all the equipment needed can conveniently be stored by simply rolling it under the bed (16:8).

McCloy contrasts this with other means of exercise, such as gymnastics, needing space and large apparatus; swimming, needing an expanse of water; and such sports as tennis, wrestling, and basketball, all of which require other participants as well as special facilities.

Many articles have been written concerning weight training and a specific athletic event, e.g. weight training and swimming; weight training and basketball, etc.

CHAPTER III

PROCEDURE

I. PREPARATION

In preparing for a weight-training program several items must be taken into account. First is the approval of the school administration. Early in the spring of 1959, it was decided to add weight training to the 1960-61 physical education program at Wilbur High School, Wilbur, Washington. A brief of plans prepared and presented to the Superintendent and Principal was received with enthusiasm. This prior preparation and advanced planning of the program was instrumental in its acceptance. Included in the report were the lifts used and how the determination of weights to be used would be handled as well as the equipment necessary to provide an adequate program. The cost of facilities and equipment was listed and justified. The pre-testing and post-testing plans were described. Any physical education teacher planning such a program should consider this method of presenting it. It not only clarifies the program for the administration but also solidifies the program for the teacher and often will bring about new ideas and innovations.

Second in importance in planning is acquiring materials and facilities necessary to carry on the program with adequate safety and the achievement of desired results.

In planning any program, it is necessary to obtain a space large enough to allow for 6 six by ten mats, 6 benches, and a knee-bend stand. This would require a room about twenty-feet square. The ceiling must be at least eight and one-half feet high to allow for the overhead lifts. It should be equipped with chalk boards used to record daily progress. The toe boards for the calf raises were 6 four-foot 2x6 blocks acquired from the industrial arts department. The knee-bend rack was built by a shop class from scrap pipe at no cost. The greatest cost lies in the barbells. The cost will vary according to the quantity of weight desired. To be adequately equipped, each group of six boys should have 150 pounds of weight, a six-foot bar, and 2 twelve-inch bars. A pair of health shoes and a head harness for weights (which develops the neck) may be added but are not absolutely necessary. The division of weights should be 2 twenty-five-pound weights, 6 ten-pound weights, 6 five-pound weights and 4 two-and-one-half-pound weights. The total of 150 pounds is made up with the six-foot bar weighing from 20 to 30 pounds. Both inside and outside collars must be used as a safety feature. The school purchased two 110-pound

sets of weights and added 150 pounds in 25-pound bars at a cost of twenty-five cents per pound.

The benches used for lifts and resting were 8 feet long, 10 inches wide, and 30 inches high. By using a narrow bench, it was possible to use it for an abdominal board. The chinning bar was made of one-and-one-half-inch pipe suspended from a balcony in a gym. In the gym, a horizontal ladder was used in conjunction with the sessions of dipping and chinning exercises. Dip bars, constructed by a high school shop class, were attached to the wall of the gym. The room to carry on the program was suitably equipped for $97.00.

The third problem is educating the parents and students as to what the program is designed to accomplish and how much weight the boys will be required to lift. This is very important in that failure to do so before the program is initiated may result in boys who are reluctant to work.

The fourth and final problem lies in administrating the program and a method of grading. Each boy was graded daily as well as at the end of each six-week period. Grading was based 70 per cent on improvement. Written tests were given covering the execution of exercises and actions of the major muscle groups affected. This helped the boys under what each lift was designed to accomplish. Attitude and class behavior affected the grades also.

II. THE PROGRAM

The enrollment in the Wilbur High School physical education classes was 20 sophomores, 14 freshmen, and 5 seniors. Since only one 72-minute period was alloted each day to physical education, all weight training had to be accomplished during this period. Work with the weights was done on Mondays, Wednesdays, and Fridays.

Each period opened with ten to twelve minutes of calisthenics, followed by twenty-five minutes of weight exercises, concluded with running or work on the horizontal ladder or chinning bar. The calisthenics vary somewhat but generally include the side straddle hop as a warm up and flexibility for the shoulders and the butterfly to loosen up the trunk and hips. For the abdomen, the four-count leg-lift was used. Next was a stretching exercise to increase flexibility. After stretching warm-up, the student was required to hold his finger tips on the floor for a count of ten, then the knuckles on the floor for a count of ten, and finally, hands flat on the floor for a count of ten. Thirty-five push-ups, the first 15 on the fingers and the next 20 using the whole hand, were done next. Following this, the concluding calisthentic was the sit-up. This was done in the bent-knee position, hands behind the head and

alternate left elbow to the right knee, right elbow to the left knee and both elbows between the knees. On Monday of each week the students started with 30 sit-ups and increased this 5 per day until the following Friday when 50 sit-ups were done.

This program of calisthenics was carried on five days a week. On the weight days, the weight-training room was used and the class separated into six prearranged groups according to the amount of weight they could handle. Each squad was led by a squad leader who checked to see that progress reports were filled in daily and kept constant check on safety items. Squad leaders in five of the six groups were seniors; an advanced sophomore led the sixth group. Each squad was equipped with a plastic mat 4 feet wide and 5 feet long, knee-bend stand, bench, plank for heel raises, barbells, and a varying amount of weight. Six 110-pound sets of weights plus 100 pounds of bulk weight in 25-pound bells were used. Every boy was to wear the regular physical education uniform except that T-shirts were not required. Shoes, of course, had to be worn at all times.

During the sixty minutes the boys were in physical education and, more specifically, the weight room, they were not allowed to go out of the room to drink water or to waste time in general.

After the calisthenics, a warm-up lift was used by each squad. Each student should maintain the same order of exercise during the hour so as to insure that they get from three to five minutes of rest between exercises. The warm-up lift used consists of four dead lifts, followed by four cleans to the chest, followed by four cleans with four presses added. This was a very good warm up, as it starts slow and does not involve too many muscles at first, but by the time the four presses had been completed, the whole body was activated. This warm-up lift should be done with light weight as it is not designed to cause a great amount of fatigue. For a 160-pound boy, about 57 to 60 pounds should be sufficient. Fifteen repetitions was the maximum on the warm-up lift. The student should be trained and constantly checked to see if he is inhaling while lifting and exhaling while lowering the weight.

The second exercise is the stationary squat, done with the aid of spotters and a bench approximately knee high. The spotters must be present and alert at all times. The boys should go far enough down to touch his buttocks or the bench each time.

The boy is to inhale through his nose and mouth while raising on the squat and exhale on the way down in the squat. This is a very good exercise for the quadriceps. It is very important that the squad leader as well as the instructor

check for rhythmical breathing, vitally important in all weight lifting but especially so in the squat. In the beginning the squat was performed from 12 to 16 times using approximately three-fourths the body weight. Many of the boys were able to go far above this weight in a short time. One boy in the program who weighed 156 pounds was squatting with 285 pounds for 15 repetitions. Many other boys who could squat with one and one-half times their body weight and several with twice their weight were in the class. This was after only three months of the program.

The third exercise used was the bench press or supine press. About one-half the body weight was used and from 8 to 16 repetitions were performed. After the student has reached 16 repetitions, ten pounds were added and the boy worked back to 16 repetitions by doing one or two more repetitions each work out. He should be given as many repetitions as he can handle up to 16. This exercise is very good for the triceps, the deltoids, and the pectorals. It is important to have two spotters when using this exercise. The spotters place the weight on the performer's chest and position themselves on each side of the student in case he needs help in removing the weight at the end of the exercise. Each boy must be reminded to inhale while pressing the weight upward, then hold the breath until the

bar is down to the chest position. This increases the pressure on the pectorals, as the chest box is expanded while the arms are being lowered. A coaching point is a wide hand grip which will tend to build more pectoral bulk than the narrower grip. This press, as well as the military press, helps to build the triceps and deltoids. After three months in this program, one group was pressing 135 pounds, the amount of repetitions varying with the individual. The slowest group was pressing only 50 pounds.

At this point as some breathlessness is evident, the fourth exercise was the pullover. This is a good lift for this time, as it is accomplished while lying on the back, using from 25 pounds with the slowest group to 47 pounds with the most advanced group. At the beginning of the program one squad could not raise the bar without weights; therefore, much progress was evident here.

In this event they also build up to 16 repetitions and never exceed 50 pounds as the student should be able to relax. The primary reason for including this exercise is that a deep breathing exercise is desired which will completely ventilate the lungs and increase the size of the chest box. The emphasis was not on the amount of weight used but on the deep breathing of the student. In this exercise the instructor and squad leader must check to see

that the reverse breathing is used. This means that the boy exhales as he raises the weight to a position directly over his chest then inhales as he lowers the weight over the head to a position approximately five inches from the mat, where he again stimulates the lift. The boys were instructed to cross their lower legs and pull them up toward their buttocks. In this position the back will remain on the mat and prevent any injury or strain to the lower back or lumbar region.

The next exercise was the full arm-curl. It is advisable to have the student stand against a wall so that the bicep muscles and not the back does the work. The Rogers Physical fitness index showed many of the boys tested were weak in the upper body; a great amount of time, therefore, was devoted to this exercise. Many boys were unable to do one chin or dip in the pre-testing. In the post-test only one student in the program could not perform a chin.

In planning next year's program the neck bridge will be added as not enough time was devoted to developing the neck. The exercise used to develop the neck was accomplished by using the "buddy" system where one student works against resistance applied by another student. This was a fair exercise but can be improved if weight is used where improvement can be measured. Actual improvement is one of the greatest motivators of this program.

The sixth exercise was rowing. The bent position was used for this exercise. The main purpose of rowing is to build the trapezius, deltoids, and in general most of the upper back and arm muscles. Here again, the student was not to go over 16 repetitions, but a weight was used which the student could raise from five to sixteen times. This was the same number of repetitions used in the curls and presses. When the student reached 16 repetitions, ten pounds were added, which lowered the performance approximately 60 per cent. From here he had to increase to sixteen again. The student was required to bend from the waist with his head against a padded vertical wall to prevent his straightening up, which would incorporate the muscles of the lower back in the performance of the lift.

The next exercise was the heel raise or calf raise, performed on a 2 x 6 plank fastened to the floor. In this exercise the heaviest amount of weight in the entire program was used. The heavy weight is necessary to work the large gastronemic muscles in the lower leg. One set was performed with the student toed in, one set straight ahead, and one set with toes pointed outward. Balance was found difficult in the first and third positions. The pigeon-toed position was done first, before the students were bothered by fatigue, an important factor in balance. The repetitions on this lift were increased from 16 to 25 to

fully activate the entire muscle. As on all leg exercises, the spotter is a must. Normal inhaling while lifting and normal exhaling at the relaxed position was utilized.

The ninth exercise is the shoulder shrug. In this, heavy weight is used. The boy stands against a wall and with his arms straight down, inhales to raise the weight with his shoulders and exhales to lower it. Careful attention should be devoted by the squad leader so that the boy does not raise the weight with his arms. This exercise builds the upper body and helps to increase the size of the chest cavity.

The last exercise is the military press or overhead press. This is a good exercise to conclude the period as the students liked it and the deltoids and triceps were well rested. Bent rowing was the last exercise used extensively.

The press is performed from eight to sixteen repetitions, adding weight until the students reached seventeen repetitions. One set of presses behind the neck and two sets in front of the face were performed.

Each student had a daily record of progress kept up to date in the weight room. Each squad had a chart with each event listed in order of performance. The squad leader was responsible for recording the weights and repetitions used each day. Each boy had on file a personal record card giving his weight, height, and progress. These

cards, checked each six weeks, were kept in the instructor's office for reference use by the instructor and students. Special note was made on each card of any weakness discovered in the pre-testing program.

These notes were very helpful and minimized the chance of overlooking a remedial case. Special resistive exercises were added for boys who needed work on a certain set of muscles rather than the large major muscle groups covered in the general program. The boys who needed extra work were very cooperative about spending extra time on their deficiencies. Each boy filled in his card and handed it in to the squad leader. The boy then took a warm shower and was through for twenty-four hours.

To motivate the program, the use of the newspaper, letters to the parents, and measurements of the boys were utilized to show the increases in weights and sizes due to weight training.

This program could be started in any school, large or small, with a small cash outlay providing the instructor and student put forth a maximum effort. A weight room could be equipped to meet the needs of a class of twenty to twenty-five students for approximately $150.00 and some resourceful thinking.

III. PUBLIC RELATIONS

After completing the first test and tabulating the results for each individual as well as the group, the next problem was to make the information available to the parents. This part of any program is vital and may well lead to its success or failure. Each parent should know the purpose of the program, have explained its need and where their child stands in relation to the national and local norms.

The first step was to contact the president and program chairman of the local P.T.A. Unit. The program was explained to them and time was extended at the first meeting (traditionally the most well-attended meeting of the year) for explanation and demonstration of the weight training aspect of the program.

The P.T.A. program began with an explanation of the need of the physical fitness program and cited statistics pointing out the lack of fitness in our American youth. It is very vital in a meeting of this type that the speaker realizes he is speaking to a lay group and must gear his explanation to these people and not talk over their heads but uses words, graphs, etc., the average person will understand.

The opening statements lasted about twenty minutes, covering the doctor's examination that must be turned in before any student was permitted to lift weights. The county health doctor gave these checkups at no cost to physical education students at the school. Also covered was what the parents might expect in the way of individual gain on the part of his or her son.

After these opening statements, a demonstration of the program was offered by six members of the physical education class. In this demonstration the lifts were described as were the areas they were designed to improve. The safety factor was stressed in that no boy was required to lift a weight so heavy he was in danger of incurring physical injury. It was also pointed out during the demonstration that no lift was attempted without the aid of two spotters whose sole purpose was to insure the safety of the boy. This portion of the program accomplished a great deal, shown by the many questions asked after the session. Many parents stated that they would like to be informed of their boy's fitness level when the figures had been compiled. This brought about the second means of reaching the parent. A dittoed letter was sent to each parent with an explanation of their son's rank in relation to the national and local norm. At this time the scores ranged from 48 to 124 and the local average was 84.7, based on a national average of 100.

This note served to stimulate more interest in the program as many parents (27 of 39) found their child below the national average.

Following the first letter, the parents only received information through periodical articles in the local paper, until after the ninetieth day of school. At that time the parents received another letter of much the same type as the first but containing more information about each individual boy with a resume of the over-all results of the program. As the average gain was 23.7, the parents expressed great satisfaction with the program.

After the P.T.A. program, parents expressed a desire to see the testing equipment that had been borrowed from Central Washington College of Education in Ellensburg. Many people contacted the P.T.A. President about the possibility of the P.T.A. sponsoring such a program. The program chairman then arranged to have the equipment shown and described to the interested parents at a future meeting. The week prior to this meeting, letters were sent to the parents to inform them of test results and the planned program to demonstrate the equipment to be followed by a question and answer period. After the program the parents were invited to personally try the equipment. This invitation was well accepted. Each person in the group tried the maneometer

and a large percentage tried the wet spirometer. Much was accomplished in the way of dispelling the old adages which accompany the use of weights.

The parents, through this close contact, felt they played a part in the program and this resulted in their desire to help in any way possible.

IV. ADMINISTRATION OF THE ROGERS PHYSICAL FITNESS INDEX

In the selection of the test to be given, one was needed that would test the fitness of the body as a whole. Not only was a test needed for evaluating the physical fitness benefits of the program but such a test was also needed to select those boys who were deficient in fitness so that their particular needs could be studied and improved. To accomplish these items the Rogers Physical Fitness Index was utilized.

In selecting the individual elements composing the Physical Fitness Index Battery, Rogers included tests that would measure most of the large muscle groups of the body. As a result the complete test involved the following muscle groups: forearms, upper arms, shoulder girdles, back, and legs. Most of the large muscles not tested were antagonistic of those tested.

With the construction of norm tables for many combinations of sex, age, and weight, two major scores are possible. These are the Strength Index and the Physical Fitness Index. Each has a different purpose. Rogers, by the construction of these norm tables, created the Physical Fitness Index, a score and concept unknown to other testers.

The Strength Index is the gross score obtained from six strength tests plus lung capacity. It is proposed as a measure of general athletic ability and is neither a measure of skill in any particular sport nor a measure of physical fitness.

The Physical Fitness Index is a score derived from comparing an achieved strength index with a norm based on the individual's age, sex, and weight. It is a measure of basic physical fitness elements.

In all tests the individual should be encouraged to do his best but should not be driven. The following method of testing was worked out with the assistance of Dr. Everett Irish, Physical Education Department, Central Washington College of Education.

The testing stations were set up as follows:

Station 1: Age, height, weight, record cards, scales and Stadiometer

Station 2: Lung capacity: Wet spirometer

Station 3: Grip strength: manuometer

Station 4: Back and leg strength: back and leg dynamometers

Station 5: Pull-ups: horizontal bar

Station 6: Push-ups

Station 7: Score card receiving desk

The Test:

Age, height and weight. The age and weight should be recorded according to the following instructions.

1. The age should be taken in years and months, such as 15 years, 7 months.
2. Height and weight will be taken in gymnastic uniforms and recorded at the nearest half-inch and pound, respectively.

Lung capacity. Lung capacity is measured in cubic inches with a wet spirometer.

1. The spirometer should be equipped with an extra length of rubber hose, 36 to 48 inches, filled with water to within one inch of the top and placed at such a height that all subjects can stand erect when beginning the test. A good guide would be from four to four and one-half feet from the floor.

2. An individual wooden mouthpiece is used for each subject. The mouthpiece should not be handled by the tester but inserted by the subject being tested.
3. The subject should take one or two deep breaths before the test. Then, after the fullest possible inhalation, he should exhale slowly and steadily while bending forward over the hose until all the air within his control is expelled. Do not let air escape through the nose or from around the mouthpiece and see that a second breath is not taken by the subject during the test. If the test was not performed correctly it should be repeated.
4. The tester should watch the indicator closely to see when it reaches its highest point.

Grip strength. A manuometer of hand dynamometer of the rectanglar type is used to measure grip strength. Both left and right hands will be tested.

1. The tester should take the right hand corner of the manuometer between the thumb and forefinger of his right hand and place it in the palm of the subject's hand while holding the hand to be tested with his left hand in such a manner that

the convex edge of the manuometer is between the first and second joints of the fingers and the rounded edge is against the base of the hand. The thumb should touch or overlap the first finger. The dial of the manuometer should be placed face down in the hand.

2. In taking the test the subject's elbow should be slightly bent and his hand should describe a sweeping arc downward as he squeezes the manuometer. The hand should not be allowed to touch the body or any object while the test is being administered.
3. The right hand should be tested first then the left. The weight should be scored to the nearest pound.
4. Gymnastic chalk should be available for the hands.
5. The indicator should be returned to zero after each test.

Back and leg dynamometer. The back and leg dynamometer is the instrument used in measuring the strength of both back and leg muscles.

1. Several back and leg dynamometers are on the market, the better ones being rather expensive. The instrument selected should be easy to read,

should be calibrated in pounds, and should be capable of measuring a lift of at least 2,500 pounds. The chain purchased with the dynamometer should be at least twenty-four inches in length, and the handle should be from twenty to twenty-two inches long.

2. Certain dynamometers are equipped to measure compression, or crushing strength. In testing for back and leg strength, the handles supplied for this purpose should be removed. The outer edge of the dynamometer carries the scale for measuring lifting strength, while the inner scale is for crushing power. Care, therefore, should be taken to read back and leg lifts from the outer scale only.

3. Small pointers of white adhesive with the weight indicated on the broad ends may be placed at each hundred-pound interval on the dial to facilitate reading the lifts.

4. The dynamometer base should be placed on a small elevated platform, a stall bar bench will serve nicely, so that the tester may sit in a chair before the instrument in the administration of the tests. The wooden base, however, should not

be fastened to this platform. It is very important that this base be solid and steady so that the subject will have a feeling of security throughout the test.

5. The handle or cross-bar may be taped to facilitate firm handling by the subject, and a block of magnesium carbonate or chalk should be supplied with which to dust the hands if they are moist and slippery.

6. In all lifting tests, the feet should be placed parallel, about six inches apart, with the center of the foot opposite the chain. To save the tester's time and energy, foot outlines should be painted on the base to indicate the position of the feet.

7. In the back and leg lifts, the tester should guard against any snap resulting from a kink in the chain, which might jar the indicator beyond the true lift made by the subject.

Back lift.

1. With the feet in the proper position on the base of the dynamometer, the subject should stand erect with the hands on the front of the thighs, fingers extended downward. The tester should

then hoop the chain so that the bar level is just below the finger tips. The subject should grasp the handle firmly at the ends of the bar, with thumb clenching fingers and with one palm forward and one palm backward. When the subject is in position to lift, the back should be slightly bent at the hips, so that he will not completely straighten when lifting, but the legs should be straight with no bend at the knees. The head should be up and eyes directed straight ahead. It is highly important not to bend the back too much, as the resultant poor leverage is conducive to a poor lift as well as to the possibility of strain. With the back properly bent, however, there is very little likelihood of injury from lifting.

2. The subject should lift steadily. Care should be taken to keep the knees straight. The tester should grasp the subject's hands firmly during the lift.

3. The subject's feet should be flat on the platform. It is necessary to retest after shortening the chain, if he attempts to lift by standing on his toes. Any initial lateral sway should be immediately checked.

4. At the end of lifting effort, the back should be almost straight. If not, repeat the test.

Two methods have been proposed for administering the leg lift on the back and leg dynamometer. These methods may be characterized as "without the belt" and "with the belt." Everts and Hathaway perfected the belt technique in order to aid both the subject and the tester in obtaining more objective results and to improve the validity of the PFI battery itself. The belt technique is advocated and has been generally adopted by physical educators as the standard technique in the administration of the test. Consequently, the leg lift with the belt only is described below.

1. The subject should hold the bar with both hands together in the center, both palms down, so that it rests at the junction of thighs and trunk. Care should be taken to maintain this position after the belt has been put in place and during the lift.
2. The loop end of the belt is slipped over one end of the handle or cross-bar; the free end of the belt should be looped around the other end of the bar, tucking it in under so that it rests next to the body. In this position, the pressure of the belt against the body and the

resultant friction of the free end against the standing part holds the bar securely. The belt should be placed as low as possible over the hips and gluteal muscles.

3. The subject should stand with his feet in the same position as for the back lift. The knees should be slightly bent. Maximum lifts occur when the subject's legs are nearly straight at the end of the lifting effort. Experienced testers become adept at estimating the potential lift by noting the degree of muscularity of the subject's legs; as a consequence, they will start the stronger subjects at a lower chain link, so as to allow for the extra distention in the dynamometer. If too high a link is used, the subject's knees may snap into hypertension during the lift, although an alert tester can always anticipate such an occurrence and interrupt the performance.

4. Before the subject is instructed to lift, the tester should be sure that the arms and back are straight, the head erect, and the chest up. These details are of great importance to accurate testing. Beginners will err in results

by from 100 to 300 or more pounds if the single detail of leg-angle is wrong. Therefore, even experienced testers repeat leg-lift tests for most subjects immediately, changing slightly the length of chain, even by twisting if a link seems too great.

5. Record the best of two or three tests.

Pull-up test for boys. The boys' pull-up test is administered from a chinning bar to which, preferable, rings have been attached. This arrangement permits the wrists to twist naturally as the subject performs the test. The rings should be high enough from the floor so that the feet of the tallest boy do not touch the floor when performing the test. If this is impossible, it will be necessary for tall individuals to bend their knees in order not to touch the feet on the floor in lowering the body to a straight-arm hand.

1. In taking the pull-up test, the subject hangs from the rings by his hands, and chins himself as many times as he can. In executing the movement, he should pull himself up until his chin is even with his hands, then lower himself until his arms are straight. He should not be permitted to kick, jerk or use a kip motion. (Without rings, use forward hand grip).

2. Half-counts are recorded if the subject does not pull all the way up, if he does not straighten his arms completely when lowering the body, or if he kicks, jerks or kips in performing the movement. On four half-counts are permitted.

Push-up test for boys. The push-up test for boys may be administered either on the regular gymnasium parallel bars or on wall parallels (or "dipping bars"). The regulation parallel bars are much to be preferred, since their width and height may be adjusted to the height of the subject.

1. The bars should be adjusted at approximately shoulder height.
2. The subject should stand at the end of the parallel bars, grasping one bar in each hand. He jumps to the front support with arms straight (this counts one). He lowers his body until the angle of the upper arm and forearm is less than a right angle, then pushes up to the straight-arm position (this counts two). This movement is repeated as many times as possible. The subject should not be permitted to jerk or kick when executing push-ups.

3. At the first dip for each subject, the tester should gauge the proper distance the body should be lowered by observing the elbow angle. He should then hold his fist so that the subject's shoulder just touches it on repeated tests.
4. If the subject does not go down to the proper bent-arm angle or all the way up to a straight-arm position, half-credit only is given, up to four half-credits.

General instructions for pull-up and push-up tests.

1. After four half-credits have been recorded in the push-up and pull-up tests, no more should be allowed for partial performance.
2. At the fifth incomplete exercise, it is advisable to stop the test and repeat after a rest period.
3. Counting should be audible to the subject, the count being made sharply at the end of each evolution and the reason for each half-count briefly given at the time it occurs.
4. The subject should rest five minutes between pull-up and push-up tests unless fewer than three counts have been made. No rest periods are necessary between the other parts of the test.

Scoring. Scoring of the Physical Fitness Index tests is accomplished in the following manner:

Arm strength. Arm strength is scored according to the following formula: (pull-ups + push-ups) $(\frac{W}{10} + H - 60)$, in which W represents the weight in pounds and H the height in inches, Fractions are corrected to whole numbers.

For example, a boy pulls-up 7 times and pushes-up 8 times. His weight is 155 pounds and his height 68 inches.

$(7 + 8)$ $(\frac{155}{10} + 68 - 60)$, or $(15) \times (16 + 8)$,

which gives an arm strength of 360 pounds. If the subject is below 60 inches in height, height should be disregarded, the formula thus becoming: (push-ups + pull-ups) x $(\frac{W}{10})$ (The above three formulae are taken from Rogers' Strength Index Norms reproduced by Fred Medart Products, Inc.).

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.

The norm. The norm charts are based upon sex, weight, and age, the normal score being changed for each two-pound increase in weight and for each half-year increase in age. Instead of interpolating to determine the norm for those

individuals between points on the norm charts, the weight above and the age below should be taken. For example, if an individual weighs 151 pounds, the norm at 152 should be taken; if he is 16 years and 5 months of age, the norm at 16 years should be taken.

As norm charts have been prepared for PFI tests both when the belt is used in the leg lift and when it is not used, care should be taken to use the proper chart in scoring the tests.

Physical Fitness Index. The Physical Fitness Index is computed from the following formula:

$$PFI = \frac{\text{Achieved SI}}{\text{Normal SI}} \times 100.$$ (Formula from Rogers Strength Index Norms).

A standard card should be used for recording the scores made on the PFI test. Spaces for several tests should be provided on this card to allow for retests, together with annual tests over a period of years.

CHAPTER IV

RESULTS

The results of the study show that on ten of the twelve tests the experimental group had greater gains than those of the control group. These results are shown in Table I.

TABLE I

EXPERIMENTAL AND CONTROL GAINS

Test	Control		Experimental		Increase	
	Pre-Test	Post-Test	Pre-Test	Post-Test	Control	Experi.
Push-ups	5.5	5.5	4.17	7.16	0	2.99
Pull-ups	6.1	7	5.82	11.8	.9	6
Left Grip	106	115	91.84	101.48	9	9.64
Right Grip	112.43	126.14	98.25	107.18	13.61	8.93
Back Lift	669.37	879.64	522.94	818.91	210.27	285.97
Leg Lift	825.31	615.43	999.64	891.21	174.33	275.87
Arm Strength	257.06	296.17	202.51	420.81	38.65	200.3
Lung Capacity	278.25	290	253	255.24	11.75	2.24
P.F.I.	89.5	102.42	87.64	116.59	12.9	28.95
Sargent Jump			16.26	20.53		4.27

Push-ups. Control--The mean push-up score for the control group was 5.5 in the pre-test. The post-test score was also 5.5, showing no gain in the tricept, bicep, and deltoid muscle groups.

Experimental--The mean pre-test score for the experimental group was 4.17 on the push-up test; this score was raised to a mean score of 7.16 on the post test. This is a mean gain of 2.99 points or a t of 16.2, significant beyond the .01 level. Thus we can say that weight lifting will strengthen the large deltoid, bicep, and tricep muscle groups.

Pull-ups. Control--The mean pull-up score for the control group on the pre-test was 6.1; the score on the post-test was 7, showing a mean gain of .9 points on the Rogers scale. This resulted in a t of .5, which is not significant.

Experimental--The mean pre-test score for pull-ups by the experimental group was 5.82. The post-test score for this group was 11.82, showing a mean gain of 6 points, a t of 12.04--significant beyond the .01 level. Again this shows that the large muscle groups of the deltoids and triceps are greatly developed through weight training.

Arm strength. Control--The mean arm-strength score for the control group on the pre-test was 257.06. The post-test score was 296.71, an increase of 38.65 points. This is a t of 2.23 and is significant at the .05 level of probability.

Experimental--The experimental group had a mean pre-test arm-strength score of 220.51. The mean post-test score for the experimental group was raised to 420.81, for a 200.3 gain. The t for this test was 23.4, significant beyond the .01 level. Therefore, we can say that weight training aided the development of the deltoids, biceps, trapezers, and pectoral muscles.

Leg lift. Control--the mean pre-test score for the control group on the leg lift was 825.31 points. On the post-tests the mean leg lift score of 999.64 was a mean gain of 174.33 points. The t for this test was 9.52, making it significant beyond the .01 level.

Experimental--The mean pre-test score for the experimental group was 615.43. The mean post-test score for the same group was 891.21. This is a mean gain of 275.87 points. The t on this test was 19.92, significant beyond the .01 level. The difference in increase, 174.33 for the control group and 275.87 for the experimental group, shows that the quadriceps and illiac muscle groups are more rapidly developed

through weight training even though both showed gains significant beyond the .01 level of confidence.

Back lift. Control--The mean pre-test score for the control group in the back lift was 669.37. The mean post-test score on the back lift test was 879.64, a gain of 210.27 points on the Rogers scale and a t of 7.53, significant beyond the .11 level.

Experimental--The mean pre-test score for the experimental group on the back lift test was 522.94. The post-test score was 818.91, an increase of 285.97 points. This results in a t of 10.84, significant beyond the .01 level. Thus, we can say that the added resistance achieved through weight lifting is conducive to developing the gluteus maximus, latissimus dorsi, and muscles of the lower back.

Left grip. Control--The mean pre-test score for the control group on the test for left grip strength was 106. The mean post-test score for the control group on the left grip was 115. This is a gain of 9 points. This is a t of 2.55, significant beyond the .05 level.

Experimental--The mean pre-test score for the experimental group on the left grip was 91.84. The post-test score was 101.48. This gain of 9.64 gives a t of 3.79, significant at the .01 level. The difference between the control and experimental group is significant.

Right grip. Control--The mean pre-test score on the right grip test for the control group was 112.43. The post-test mean score was 126.14. This is a mean gain of 13.61 points. This is a t of 2.75, significant at the .05 level of confidence.

Experimental--The experimental group had a mean pre-test score on the right grip test of 98.25. The mean post-test score for the experimental group was 107.18, a mean gain of 8.93. This is a t of 2.18, significant at the .05 level. This variable shows that the control group increase was greater than that of the experimental group. The author believes the reason for the gain of the two groups was due to the fact that no exercise was added to the weight training program to develop the muscles of the wrists and fingers. The author cannot explain the greater gain of the control group; however, the gain was not significantly higher.

Lung capacity. Control--The mean pre-test score for the control group on the test for lung capacity was 278.25. The mean score for the same group on the post-test was 290, a gain of 11.75 points on the Rogers scale. This t of 2.02 is not significant.

Experimental--The mean pre-test score for the experimental group on the lung capacity test was 253. The mean

post-test score for this same group was 255.24, a mean gain of 2.24 points. This t of 1.24 is not significant. On this test the control group increased more than the experimental group both on the total score and mean gain. The author cannot explain the reason for this difference but one can assume that the exercise included in the program for the purpose of increasing lung capacity was not effective.

Strength index. Control--The mean pre-test score for the control group on the strength index was 2156. The mean post-test score for the same group was 2707.14. This is a mean gain of 551.14 points on the Rogers scale.

Experimental--The mean pre-test score for the experimental group strength index was 1826. The mean post-test score for this same group had raised to 2583.26, a mean gain of 757 points on the strength index. This fact that the experimental group had a gain of 195.9 points more than the control group is indicative that the strength index (a total of all scores based upon national norms) is a true indicator of the increase in strength.

Physical fitness index gain. Control--The mean pre-test score for the control group on the P.F.I. was 89.5 on Rogers scale. The mean post-test score for this same group was 102.42 points. This is a mean increase of 12.9 points on the Rogers scale. This t of 1.5 is not significant.

Experimental--The mean P.F.I. pre-test score for the experimental group was 87.64. The post-test score for the experimental group was 116.59, a gain of 28.95 points. This is a t of 3.52, significant beyond the .01 level. Therefore, we can say that weight training is conducive to building physical fitness. The control group had a physical fitness gain of 12.9 points. At the same time the experimental group had a gain of 28.95 points, more than double that of the control group.

Sargent jump. This test was not administered to the control group as it was not in the Rogers battery of tests. The test was given to the experimental group the same day they took the Rogers battery of tests. On the pre-test the experimental group had a mean sargent jump of 16.26 inches. On the post-test the mean score was 20.53 inches, a mean gain of 4.27 inches. This increase, significant at the .01 level of confidence, is indicative that weight training will increase jumping ability.

There was no significant difference between the groups before the program was initiated, as shown by the computation of t's in Table II.

Table III shows a significant difference between the pre-test and post-test scores at the .05 level in the left grip, right grip, and arm strength. A significant difference at the .01 level was shown in the leg lift.

TABLE II

PRE-TEST
CONTROL AND EXPERIMENTAL

Test	m diff	t	Significance
Push-ups	1.33	1.28	-
Pull-ups	.28	1.33	-
Left Grip	14.16	.70	-
Right Grip	14.18	.90	-
Back Lift	146.43	1.87	-
Leg Lift	209.88	.97	-
Arm Strength	54.55	1.93	-
Lung Capacity	25.25	.85	-
P.F.I.	1.86	.95	-

TABLE III

CONTROL
PRE-TEST AND POST-TEST

Test	m diff	t	Significance
Push-ups	0	.43	-
Pull-ups	.9	.50	-
Left Grip	9	2.55	.05
Right Grip	13.61	2.73	.05
Back Lift	210.27	2.16	-
Leg Lift	174.33	9.52	.01
Arm Strength	38.65	2.32	.05
Lung Capacity	11.75	2.02	-
P.F.I.	12.9	1.55	-

A significant difference between the pre-test and post-test scores at the .05 level in the right grip is shown in Table IV. A significant difference at the .01 level was evidenced in the push-ups, pull-ups, left grip, back lift, leg lift, arm strength, physical fitness index, and sargent jump.

Table V shows there is no significant difference between the two groups in the back lift. There is a significant difference between the two groups at the .01 level of confidence in the pull-ups, arm strength, physical fitness index, and increase in physical fitness.

TABLE IV

EXPERIMENTAL
PRE-TEST AND POST-TEST

Test	m diff	t	Significance
Push-ups	2.99	12.04	.01
Pull-ups	6	16.20	.01
Left Grip	9.64	3.79	.01
Right Grip	8.93	2.18	.05
Back Lift	285.97	10.84	.01
Leg Lift	275.87	19.92	.01
Arm Strength	200.3	23.40	.01
Lung Capacity	2.24	1.24	-
P.F.I.	28.95	3.52	.01
Sargent Jump	-	5.04	.01

TABLE V

POST-TEST
CONTROL AND EXPERIMENTAL

Test	m diff	t	Significance
Push-ups	1.16	1.12	-
Pull-ups	5.95	4.56	.01
Left Grip	13.52	.85	-
Right Grip	18.86	1.70	-
Back Lift	60.73	2.28	.05
Leg Lift	108.43	1.95	-
Arm Strength	224.10	7.95	.01
Lung Capacity	34.76	5.51	.01
P.F.I.	14.17	14.42	.01
S.I.	123.88	1.66	-
Gain	14.17	17.44	.01

CHAPTER V

SUMMARY

Fifty-five male students enrolled in the physical education program at Wilbur High School were the subjects for this investigation. The students were divided into an experimental group and a control group. Both groups were tested at the outset of the program. The experimental group was subjected to a weight-lifting program while the control group participated in the regular physical education program. At the end of the ninety-day experimental period, both groups were retested. The results show the experimental group, in nine of eleven cases to be better than the control group.

The experimental group made improvement significant at the .05 level in the right grip test. Significance at the .01 level were achieved in the push-ups, pull-ups, left grip, back lift, leg lift, arm strength, P.F.I., and sargent jump.

The experimental group increased significantly more than the control group in push-ups, pull-ups, left grip, back lift, leg lift, arm strength, and P.F.I.

We may conclude that a program of weight training is conducive to increasing the size of the muscle, the

physical fitness index as measured by the Rogers Physical Fitness Index, and the jumping height as measured by the sargent jump.

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APPENDIXES

APPENDIX A

LETTER TO PARENTS

Dear Parent,

This year at Wilbur High School we entered into a program to improve the physical fitness level of your boy through the use of restrictive exercises and the use of weights. Early in September I tested your boy with the testing equipment designed for the Rogers Physical Fitness Test. This equipment was borrowed from Central Washington College in Ellensburg. After this pre-test the boys were subjected to the physical education program for four months. At the end of this time they were retested.

Our first test showed the average fitness level of the boys in Wilbur High School was 87.7. The national level is 100. Our post-test shows that the average gain was 25.5 points, to a fitness level of 113.3--13.3 points above the national level.

In our first test_____had a fitness level of_____ which was_____points above, below the national level.

In our second or post-test his level had raised to_____ points, or_____above, below the national average.

If you have any questions about these figures or the program in general, please contact me.

Sincerely,

George Carberry

P.S. The program will be explained and testing equipment will be shown at the P.T.A. meeting on January 17, 1961.

APPENDIX B

CHART USED FOR THE PRE-TEST AND THE POST-TEST

DEPARTMENT OF PHYSICAL EDUCATION

Dates M_____
D_____
Y_____

SCHOOL_____

NAME

Grade						
Age						
Weight						
Height						
Multiplier ($\frac{Wt.}{10}$ + Ht.- 60)						
Pull-ups						
Push-ups						
Arm Strength						
Leg Lift						
Back Lift						
Left Grip						
Right Grip						
Lung Capacity						
Strength Index						
Normal S.I.						
Physical Fitness Index						
I.Q.						
Sargent Jump						

APPENDIX C

BODY BUILDING EXERCISE CHART

Attendance Record

MONTH	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
January																
February																
March																
April																
May																
June																
July																
August																
September																
October																
November																
December																

MONTH	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
January																
February																
March																
April																
May																
June																
July																
August																
September																
October																
November																
December																

APPENDIX D

FORMULAS USED FOR COMPUTING DATA

Mean $$M = \frac{EFX}{N}$$

Standard Deviation $$\sigma = \sqrt{\frac{NEX^2 - (EX)^2}{N}}$$

Standard Error of Mean $$m = \frac{\sigma}{\sqrt{N}}$$

Standard Error of Mean Difference $$\sigma_D = \sqrt{m_1^2 + m_2^2}$$

Student t $$t = \frac{M_1 - M_2}{\sigma_D}$$

APPENDIX E

GAIN FOR STUDENTS

(According to Classes)

Freshmen	Sophomores	Seniors
-7	7	24
4	8	27
14	13	28
19	20	28
19	20	51
22	21	27.6 m gain
34	24	
41	24	
43	24	
48	25	
48	26	
53	28	
55	32	
29.6 m gain	33	
	35	
	35	
	36	
	38	
	46	
	28.5 m gain	

APPENDIX F

INDIVIDUAL GAINS

Student	Pre-Test	Post-Test	Gain
1	106	161	55
2	78	131	53
3	70.8	121	50.2
4	112	160	48
5	93	141	48
6	63.4	109	45.6
7	64	108	44
8	110	153	43
9	81.8	122	40.2
10	87	125	38
11	108	144	36
12	75.7	110	34.3
13	81.4	116	34.6
14	70.1	104	33.9
15	103	136	33
16	90.1	122	31.9
17	120	148	28
18	82.3	110	27.7
19	76	103	27
20	91	117	26
21	112	137	25
22	101	125	24
23	108	132	24
24	68	92	24
25	90	112	22
26	47	68	21
27	107	127	20
28	48	68	20
29	73	92	19
30	101	120	19
31	81.3	95	13.7
32	88	101	13
33	60.9	69	8.1
34	98	106	8
35	91	98	7
36	124	128	4
37	111	103	-7
38	92.3	Dropped	
39	61	Dropped	