THE EFFECTS OF SELECTED WEIGHT TRAINING PROGRAMS ON DYNAMIC STRENGTH, AND ITS RELATIONSHIP TO THE 40-YARD DASH

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I recommend acceptance of this seminar paper to the Graduate School in partial fulfillment of this candidate's requirements for the degree Master of Science. The candidate has completed his oral seminar.

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ABSTRACT

THE EFFECTS OF SELECTED WEIGHT
TRAINING PROGRAMS AND THEIR
RELATIONSHIP TO DYNAMIC STRENGTH
AND SPEED IN THE 40 YARD DASH

by

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Fifty-two junior and senior non-athletes of the South Milwaukee Senior High School, South Milwaukee, Wisconsin participated in the study of the effects of selected weight training programs and a relationship to their dynamic strength and speed in the forty yard dash. Group E1, E2, and E3 were designated as the experimental groups and C1 as the control group.

The four groups were pre-tested for strength and speed, followed by a training program for the experimental group. The training session lasted the entire school year, meeting twice per week. At the conclusion of the session the groups were again tested for strength and speed.

The difference between the pre-test means and the post-test means showed a marked increase in strength in the experimental groups, while the control group did not improve significantly.

The pre and post test means also indicated that the experimental groups had improved their speed in the 40 yard dash.

The t scores also indicated that the experimental groups increased significantly in strength, but not significantly in speed. Thirty-eight of the fifty-two subjects ran faster in the post-test. The control group did not make significant gains in strength or speed.

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CHAPTER I

INTRODUCTION

Man has had a continual and everlasting battle for survival during his existance on earth. He has had to develop his strength and speed to remain alive in a world of constant violence. Early in history man found that he needed strength and speed to survive, combat, and conquer in order to live in his environment.

Our society, today, does not retain many of the basic needs of speed and strength to survive and maintain life. With the inventions of our modern machinery, man has aquired a great amount of leisure time. In order for man to retain a wholesome degree of physical fitness man has had to rely on recreational activities and sports.

An athlete's ability to move quickly has become an effective means to evaluate his potential in athletics. Two of the main objectives in conditioning athletes are to (1) increase running speed and quickness, and (2) to increase the dynamic strength of the athlete. In athletic competition, if all other factors are equal, it would seem logical to assume that the athlete with the strongest leg power would win the race.

Albeck and Anderson (1) state that recent trends in athletics have brought to the surface the success of weight

training in athletics. The improvement of athletics and athletes through such a program cannot be accurately calculated over a short period of time as the program is geared to build strength and endurance. These are never accomplished in a short period of time.

During the past years there has been much controversy over which method of weight training best contributes to the speed and strength of an athlete. If one particular method of training could be found which would be most effective, training with programs which are less effective could be eliminated.

Statement of the Problem

The intent of this study was to compare three selected types of weight training programs and their relationship to strength increase and time decrease in the 40-yard dash.

Purpose of the Study

The purpose of this study was to determine if a weight training program will increase the dynamic strength as well as improve the athlete's time in the 40-yard dash.

Need for the Study

A recent study by O'Shea (26) of Oregon State University has indicated that there were significant increases in speed, strength, and muscle hypertrophy within each group but not between each group. O'Shea also indicated that there is a

need for a longer term study.

There is a need to determine which type of weight training program is necessary to use in achieving the greatest amount of strength and speed in the 40-yard dash. The results of this study would be beneficial to coaches and athletes engaged in competitive athletics.

Delimitations

The subjects involved in this study were selected at random, therefore, it follows that they represent the average non-skilled physical education performer. All of the subjects were checked to see if they were following any other type of rigorous training procedure that would introduce other variables. There were no boys participating in athletics or in any other rigorous activity.

The range of this study was limited to the number of students placed in the four groups by the author. Also, the facilities available had influence on the number limited to each group. The research period lasted thirty-two weeks. The length of the running was limited to the 40-yard dash.

There was no limit or restriction on the amount of weight a subject could lift as long as he stayed within his repetition range.

Limitations

The author had no control over the subjects after school hours, nor could human variables of diet, sleep, rest, etc. be standardized for all participants. Reaction time, somatotype, neuromuscular coordination, and athletic ability were other variables which could not be controlled.

Hypothesis

It was hypothesized that a weight training program will increase the dynamic strength as well as improve the athlete's time in the 40-yard dash.

Definition of Terms

Bench Press - subject will lay on bench on his back, feet on floor, the weight will be spotted to him at arms length over the chest, the weight will then be lowered to the chest and then returned to starting position.

Control Group - they are measured only at the start and the conclusion of the testing period, referred to as Group C1.

Curl - subjects will be standing, weight held at arms length, weight is then lifted to shoulder level and then returned to starting position.

Experimental Group - groups referred to as E1, E2, and E3.

1RM - one maximum lift

Neuromuscular Coordination - a matter of improvement in speed and accuracy with which the nervous system coordinates muscle activity. (9)

Reaction Time - this is the interval of time between the sound of the gun and the moment the subject left the starting blocks.

Repetition - the amount of times the exercise is repeated.

Set - any number of repetitions will equal one set.

Spotter - spot the weight to the lifter, he is also present for safety reasons.

One-Half Squat - a power rack was used in this exercise for safety reasons. The lifter was measured at shoulder height for starting, the lifter then squatted to a position in which his thighs were parallel to the floor, the distance was measured between the two points and this determined the position for the half squat.

Somatotype - this refers to the various body types which are a limitation to this study, Sheldon's mesomorph, endomorph, ectomorph. (12)

CHAPTER II

REVIEW OF LITERATURE

HISTORICAL BACKGROUND

There is no subject quite as fascinating to most young men as the subject of strength. The principle source of their conversation may be the deeds of their favorite athletic hero; such as Jim Taylor of the Green Bay Packers (who is retired) or maybe Wilt Chamberlin or Paul Anderson. Young athletes set goals for themselves and try to be like these great athletes. Weight lifting offers the young athlete the same qualities.

The Greek wrestler, Milo of Croton, who won fame in the ancient Olympic Games, is the first weight lifter of note in recorded history. The story has been told of how young Milo, to strengthen himself for all-out wrestling contests that frequently ended in death for the vanquished, practiced lifting a young bull and walking with it on his shoulders daily as it grew to its fullest size. (9)

This principle of progressive weight lifting from light to heavy is the same system we follow today with the use of barbells and dumbbells. Competing in an era when men were killed when they lost a match, Milo's strength and development were of great value to him in his long reign as a champion.

There is evidence that weight lifting in some form existed in Egypt, Ireland, China, and Greece prior to the Christian era. (8) In China, it is known that during the later years of the Chou dynasty (1122 - 249 B. C.) the special examination for military service included a demonstration of the candidate's ability to lift heavy weights. Other evidence shows that the early Greeks used dumbbells while practicing the broad jump. (8) These athletes would run down the runway and just as they would leave the ground cast off the heavy weight.

In, 1896, weight lifting was included in the events in the modern Olympics and by, 1912, it had become a well-organized sport, although primarily an event for large, heavy men. (3) Now weight lifting is classed according to body weight. This gives the lighter lifter a fair chance in lifting competition. This is the same principle used in boxing and wrestling.

About this same time the British Amateur Weight Lifting Association was organized. There were 42 different styles of lifting recognized. At this time Germany and France recognized only 7 lifts. Today, all international competition, such as the annual world championships and the Olympic Games are under the jurisdiction of the International Weight Lifting Federation which has its headquarters in Paris. (8) Seven standard lifts are recognized by this

organization, four one-hand lifts, and three two-hand lifts. Only the two-hand lifts are used in competition.

Today, Russia, the United States and Egypt dominate the weight lifting world, but this has not always been true. World champions have come from all over the world with Europe producing her share. Many of these European lifters were responsible for spreading the interest in weight lifting throughout the world. Some of these famous strong men were Josef Steinbach, Arthur Saxon, George Hackenschmidt, and Ronald Walker. (8)

The history of weight lifting in the United States is a record of gradual growth and development since 1850. Prior to 1850 there is very little mention of weight lifting in the United States. It has been established that the colonists had some knowledge of lifting dumbbells. Ben Franklin, in a letter to his son, strongly recommended lifting dumbbells to improve his health. (8)

Sandow's exibitions in America showed a trim, well proportioned man could be strong, and by lifting weights, he retained his Greek-godlike physique. One of the greatest native North American strongmen of all time, a contemporary of Sandow, Louis Cyr, had convinced many casual observers that his ponderous size was due to the fact that he lifted weights, rather than to a combination of body type and appetite. (8)

Cyr, a 69 inch Canadian who weighed approximately 300 pounds, performed great feats of strength, just prior to the turn of the century, to gain fame as the strongest man in the world.

During this period of weight lifting in America a new business was in the making. This was the era of the mail order instructor. Men like Sandow, Edmund Desbonnet, Alan Calvert, Mark Berry and Bob Hoffman (who later bought the Milo Barbell Co. from Alan Calvert) sold secrets of their strength to the public. (8)

Today, this is still a big business. Bob Hoffman, since the 1930's has probably been one of the most dominant figures in weight lifting. Hoffman has been the Olympic Weight Lifting Coach since 1932, and was the founder of the Hoffman Foundation in York, Pennsylvania. (5) Although Hoffman has had many imitators who have published books, magazines, courses, and sold apparatus, he has retained a lead in the field through his sponsorship of amateur weight lifting competition. Hoffman has made generous contributions in financial assistance to the A.A.U. and to the Olympic funds. He also personally sponsored trips to Europe during non-Olympic years that resulted in four world championship teams for the United States. (8)

Weight lifting became an official A.A.U. sport in

America during 1939. The A.A.U. is affiliated with the International Fuderation of Weight Lifting. The majority of countries throughout the world where weight lifting is an established sport, belong to this organization. (5)

The first official weight lifting A.A.U. championships were conducted in 1929 at the old German-American Athletic Club in New York. (5) Most of the lifters had a great deal of experience in the old country before making their home in New York. The greatest lift of the day was performed by Willie Rhorer who military pressed 187, snatched 203, and clean and jerked 286. Rhorer was a heavy weight. In comparing the heavy weight champion today, Bob Bednarski (military press 456½, snatch 340, and clean and jerk 486½) (31) you are able to see the improvement that weight lifting has gone through over the past fifty years in the United States.

There have been a great many American lifters who have contributed to the iron game. These men include such greats as John Davis, John Terpak, Steve Stanko (the first man in the world to total 1,000 pounds in the three lifts) Tommy Kono, Nobert Schemansky, and Paul Anderson.

Since World War II weight lifting has achieved widespread popularity and acceptance. It is still misunderstood by many, but much of the stigma once associated with it has been removed. In the United States it is becoming

an integral part of the physical education program, being introduced along with other sports in the curriculum, both 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 training as a therapeutic measure. (11) The literature pertaining to the sport is continually improving. Publishers of magazines devoted to weight training are making a conscious effort to provide accurate information on the subject. Also, research reports and articles of evaluation are appearing in the professional physical education literature.

For many years coaches did not let their athletes lift weights. In some cases, this is still true today. This prejudice is the result of a lack of knowledge concerning the nature of the activity and the basic physiological principles of conditioning. Today, our coaches and physical educators are realizing the importance of weight lifting and weight training. As an indication of the general trend in athletics toward the use of weight training we find the following names of famous athletes who are weight lifters; Bob Richards (5), Frank Stranahan (5), Randy Matson (31), Bob Feller (10), Mal Whitfield (5), Parry O'brien (5), Dick Cleveland (8) and many other athletes. All of these athletes are in different sports and this is evidence that weight training can be incorporated into any athletic activity.

Contrary to popular opinion, weight lifting and weight training require a great deal of skill. To prove this all you have to do is try to lift a heavy barbell. Skill is a fundamental requirement to success in weight lifting. It reduces the possibility of injury and it insures that the desired muscles are exercised properly. (8)

A carry-over sport is one which can be continued profitably throughout life and this is true for weight lifting and weight training. It can be continued competitively long after other sports are discontinued, and it can be continued in the form of weight training throughout the entire life span. (8)

PUBLISHED MATERIAL

Counsilman (22) stated in his research material that weight training does not cause muscle-boundness or cause the athlete to decrease in speed. Weight training seemed to improve power, speed, strength and flexibility. The effect upon agility and coordination needs more research. It also seems that no type of single exercise develops strength and endurance. The author felt that weight training had a definite place in the physical education program.

Steinhaus (29) stated that the strength of a muscle is in direct proportion to the area of its cross section. When a muscle becomes stronger through the result of exercise and hyperthrophies, the muscle cells do not increase in number,

but become larger. This largeness or thickness is dependent upon the work done per minute or per second. Muscles will grow larger as the result of exercise which is progressive. Progressive exercise will tax the muscle to its limit and with this hypertrophy comes greater strength.

Breckenridge and Vincent (2) indicated that no new muscle fibers are acquired after birth. Any increase in a muscle comes from an increase in length, breadth, and thickness of the present fibers.

Clark and Henry (21) measured arm strength, effective arm mass, and speed of a lateral adductive arm movement in sixty-two college men before and after a ten week program of weight training for one group and of no activity for a second group. They found that the weight training exercises (which did not directly involve the lateral arm test movement) apparently cause increased mean arm strength in the test position and increased mean speed of the test movement. Also, in those cases where no changes were involved in the relationship between arm strength/mass ratio and speed, there was no consistant correlation between individual differences in strength/mass ratio and maximal speed of arm movement, which was felt to support the theory of high neuromotor specificity.

Zorbas and Karpovich (37) used 600 men ranging in age from eighteen to thirty to determine the effect of weight lifting upon the speed of muscular contraction. The subjects were divided into two groups of 300 men each. One group consisted of men who had never participated in weight training, and the other group was composed of weight lifters who had been participating in a weight training program for a minimum of six months and were still engaged in this program. The subjects were tested for speed of a rotary movement of the arm. The results showed that the weight lifting group was significantly faster than the non-weight lifting group in performing a rotary motion of the arm.

Wilkin's (35) study revealed that one semester of weight training has no slowing effect on the speed of arm movement; however, it was also revealed that neither does it increase speed of movement more than a semester of swimming or golf. He also goes on to say that the chronic weight lifter is not muscle-bound in the sense that his speed of movement is impaired.

Chui (20) measured the speed of the standing press, curl, supine press, trunk extensions, squat, and sit-up to determine the effects of an isometric and isotonic training program upon the speed of these movements. He found that gains in strength exerted in performing a movement are

accompained by gains in the speed of execution of the same movement measured against resistance and against no resistance. He found no difference in speed gain from isotonic or isometric programs.

Capen (18) tested leg strength after three different programs of knee bends of varying repetitions. The first group did three sets of nine to ten repetitions, the second group did three sets of five to six repetitions, and the third group did three sets of two to three repetitions. The results showed that there was no significant difference between the three systems of training, with all three training procedures resulting in improvement of both static and dynamic strength.

Berger (15) used seventy-nine male subjects in a study to determine which proportions of maximum leg strength used in training were effective for increasing leg strength used in training were effective for increasing leg strength with one maximum effort performed each week. Three groups trained twice weekly at 66 per cent, 80 per cent, and 90 per cent, maximum effort respectively plus one session per week at maximum effort. The results showed that training with two-thirds maximum effort for one set, three times per week would not increase strength in a six week period. However, a significant increase in leg strength did occur after two weeks of training twice weekly with two-thirds or more

maximum effort and at least one maximum dynamic effort performed on the third weekly training session.

Alexander, et al., (13) did a study involving varsity ice hockey players, and found that the speed of shooting in the skating slap wrist shots improved significantly in association with a five week program of selected exercises designed to strengthen the particular muscle groups of the hand, arms, and the shoulder active in these two types of shots.

Whitley and Smith (36) studied various methods of strength development to determine which was the most influential in causing a speed increase in a horizontal flexion movement of the arm. The methods they used were isometric-isotonic, dynamic overload, and free swing. They found that regardless of the type of strengthing exercises used, increasing the strength of a muscle involved in a specific movement makes it possible for faster movement of the limbs.

McGraw and Burnham (17) indicate that no single method is adequate in achieving maximum development of both strength and endurance. They also state that isotonic and isometric methods appear to be best effective for persons who are strong initially.

McClements (25) study revealed that the four training programs investigated were equally effective in causing increase in the power of the leg and thigh muscles used in the verticle jump. He also states that strength is related to power, but gains in strength are not related to gains in power.

Berger and Henderson (14) conclude that dynamic leg strength and static leg strength are both related to leg power. They also state that neither leg strength nor static strength is more related to leg power than the other.

Bender and Kaplan (16) indicate that strength necessary to perform a dynamic movement can be measured by isometric techniques. They also indicate that failure in a given movement may be caused by a lack of strength only at a specific region in the range of the motion, and that some external assistance in passing through that region can produce success.

Thompson and Stull (34) found that speed in swimming was improved through direct practice, but found that weight training alone and a combination of both swimming and weight training to be detrimental to speed in swimming. It has been suggested that interference may occur when foreign activities to the skill are introduced.

It has previously been stated that leg power is one of the main essentials for running speed. Gray, et al., (24) studied the relationship between leg power as measured by the verticle jump and speed of leg movement as measured by the bicycle ergometer. He found that a +.470 correlation existed between leg speed and leg power, this being significant at the 0.1 per cent level of confidence.

This would seem to indicate that there is a relationship between leg strength and running speed, as has been pointed out by several studies. However, other studies have revealed that there is no relationship between the two.

Chui (19) tested twenty-two subjects on the sixty-yard dash before and after a three month weight training program. Seventeen of the subjects showed improvement, four showed no difference, and one ran slower by 0.1 seconds as a result of the weight training program. Of the seventeen who ran faster, the mean increase was 0.33 seconds, with the individual increases ranging from 0.1 to 0.6 seconds. These results seem to indicate the probability of increasing running speed through training with systematic weight training exercises.

Schultz (27) utilized three training methods (direct practice, repetitive sprinting, and weight training), to determine their effects on motor performance tests. He found

that direct practice of the zig-zag run was superior to both weight training and repetitive sprinting in improvement of performance in this event. Also, a combination of weight training and repetitive sprinting caused a slight improvement in speed in the sixty yard dash over the repetitive sprinting program alone. He concluded by saying "the superiority of weight training in the improvement of motor activities is not corroborated when it is compared with other intensive training programs.

Dintiman (23) used a flexibility training program, a weight training program, and a combination flexibility-weight training program to determine which would have the most significant effect on sprinting speed. He found that both the flexibility and the weight training programs, when used as a supplement to sprint training, did not improve running speed significantly more than the sprint training program alone.

Start, et al., (28) states that speed has considerable similarity to power and little to strength and that the latter two factors appeared reasonably separate entities.

PREVIOUS STUDIES

To the best of the investigators knowledge their has been no previous study concerning weight training programs and their relationship to the 40 yard dash at South Milwaukee

High School, South Milwaukee, Wisconsin.

UNPUBLISHED MATERIAL

Meisel (44) did a study to determine the effect of a weight training program on sprinting speed over a distance of ten yards. The weight training program consisting of arm curls, shoulder press, heel raises, squats, right and left flexion, and right and left gluteous pull significantly increased the strength of the legs as measured by a back and leg dynamometer. However, the program caused a loss of speed significant at the 2 per cent level of confidence in running the distance of ten yards.

Ness and Sharos (45) conducted a weight training program for four weeks to determine the effect of weight training on leg strength on the vertical jump. The weight training program consisted of deep knee bends and heel raises with heavy resistance of weights. Their results showed that the weight training group increased significantly over the control group in both vertical jumping ability and leg strength as measured by the back and leg dynamometer.

Brown and Riley (40) did a similar study using two groups of freshman basketball players at Springfield College. One group participated in a five week weight training program consisting only of heel raises, while the other attended

the regular physical education classes. The results of this study showed that a weight training program of five weeks using only the heel raising exercise significantly increase vertical jumping ability and leg strength.

Falin (42) used three different training methods to develop leg strength and vertical jumping ability. The first group participated in a weight training program and did jumping exercises with a weighted belt, the second group participated in a weight training program and did jumping exercises without a weight belt, and the third group was limited to a program of weight training alone. The results showed that both groups after using the jumping exercises had significantly increased in leg strength, with the group using the weighted belt being the most effective in the improvement of vertical jumping ability and leg strength.

Baldini's (38) study was to determine if weight training had any effects on students who scored lower than the thirtieth percentile on the "PFR" physical fitness test given each fall at the University of Tennessee, and were thus required to take a quarter of weight training. They were tested on the "PFR" (which included two-minute sit-ups, pull-ups, and a 250 yard shuttle run), chalk jump, and grip strength at the beginning and end of the quarter. After the quarter of weight training, there was no significant difference in

group strength, vertical jump, or sit-ups; while performance on the shuttle run and pull-ups increased significantly at the 1 per cent level of confidence.

Brown (41) tested fifty-eight subjects enrolled in a weight training class at The University of Tennessee for reaction time and speed of movement, and found that there was no significant difference in improvement of either as a result of the weight training program.

Barnes (39) used two groups of junior high school boys in a study to determine the effect of weight training on speed in the one hundred yard dash. One group attended the regular physical education classes, and the other participated in a weight training program consisting of half-squats, curls, and knee bends. He concluded by saying, "It appears that within the limitations of this study that a weight training program tends to increase speed in ninth grade jumior high school boys."

Reynolds (46) used a squat jump-knee bend program to determine its effects on speed in the one hundred yard dash in freshmen enrolled in a winter quarter weight training class at The University of Tennessee. The results showed that twelve of the subjects ran faster, three ran slower, and four showed no difference. He concluded by saying that heavy resistance exercises will probably increase speed in

the one hundred yard dash in freshmen boys.

Walters (48) tested thirty-five subjects on speed in the one hundred yard dash before and after a weight training program of squat jumps and knee bends. Ten of the subjects ran faster, sixteen ran slower, and nine showed no difference. The results of the study showed very little difference in speed in the one hundred yard dash after a period of weight training.

Sweeting (47) did a study to determine the effectiveness of running, weight training, and a combination of these on sprinting speed over a distance of thirty yards. He found that running improved speed significantly more than the weight training program, and also found running to be as effective as the combination program. The results showed that the program of weight training alone did not improve speed more than a program of no weight training at all.

Helixon (43) used first year high school track performers in a study to determine the effects of weight training on running and jumping ability. The experiment group participated in a program of half-squats, arm press behind head, and curls, while the control group was not involved in any formal exercise program. The results showed that there was no significant differences between the two groups in the vertical jump, one hundred yard dash, running broad jump, or mile run.

CHAPTER III

PROCEDURES

This chapter is concerned with the selection of subjects, the testing apparatus and procedures, and the administration of the weight training program.

SUBJECTS

The subjects used in this study were fifty-two male students enrolled in the junior and senior physical education classes at South Milwaukee High School. The subjects selected were non-athletes which eliminated the problem of conflicts with the coaching staff. Due to schedule conflicts, the subjects were limited to two workouts per week. None of the fifty-two participants was involved in any vigorous activity outside of class such as athletics.

The subjects were all put through a two week conditioning program before being randomly assigned to a specific group. This was done to (1) reduce the possibilities of injury, (2) teach the subjects the proper methods of lifting weights, and (3) aid the subjects in a starting point in the amount of poundage to be lifted.

The age of the subjects ranged from sixteen to nineteen with the mean age being sixteen point seven.

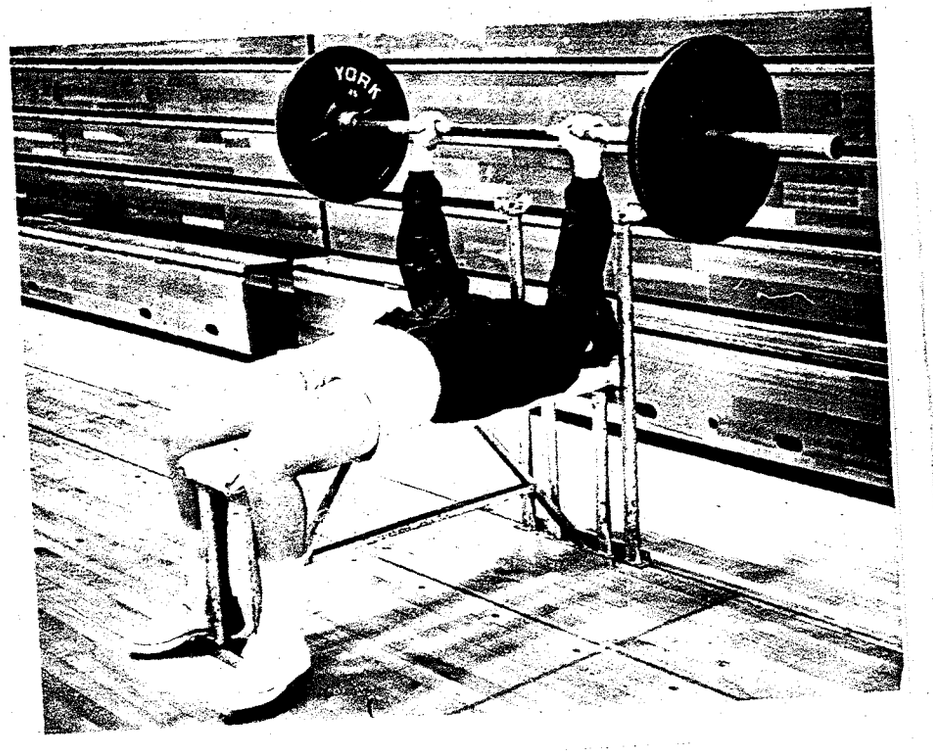
The subjects in the classes met for fifty-two minutes per day, two days per week through the entire school year and followed the attendance regulations set up by the investigator. The subjects were informed that they were participating in a study and were urged to put fourth maximum effort on the tests that would be used.

WEIGHT TRAINING PROGRAM

The exercises involved in this experiment are the bench press, (picture on page 26) standing arm curl with an E-Z curl bar, (picture on page 28) and the one-half squat. (picture on page 30) All of the groups did four sets of the three exercises, and were restricted to a specified number of repetitions.

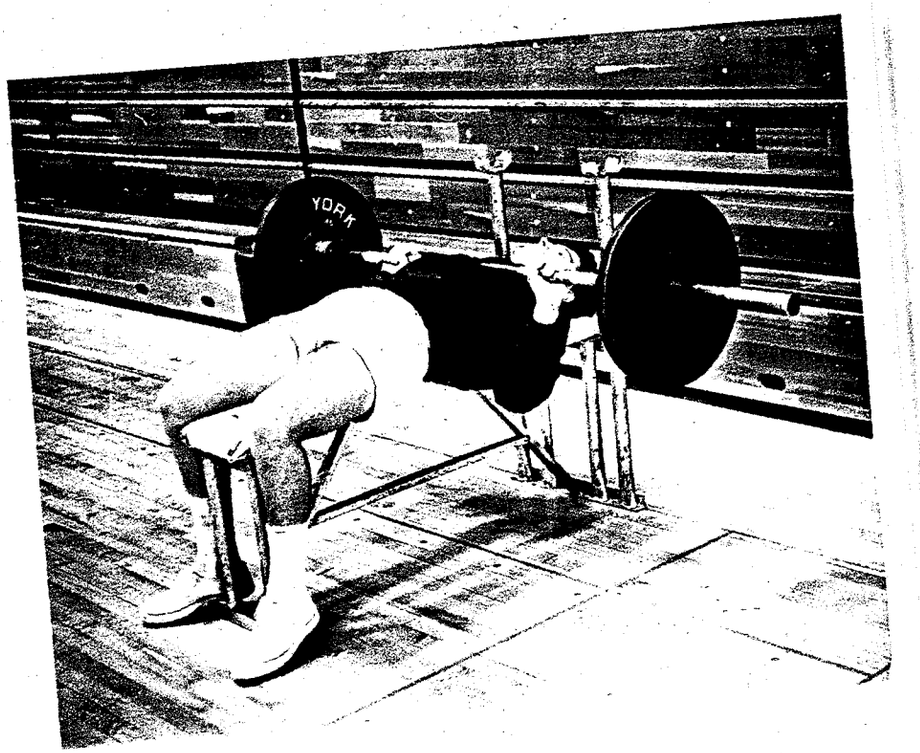
Group E1 used the most widely accepted method to increase strength; Group E2 used exercises for strength and endurance; and Group E3 used exercises for endurance. Group C1 was the control group and did not participate in the weight training program. This group was also used to determine if weight training had any effect on muscle hypertrophy, dynamic strength, and speed. (Raw scores in Appendix A)

On the first day of each week all groups (E1, E2, E3) increased at minimum standards $2\frac{1}{2}$ pounds in the bench press,



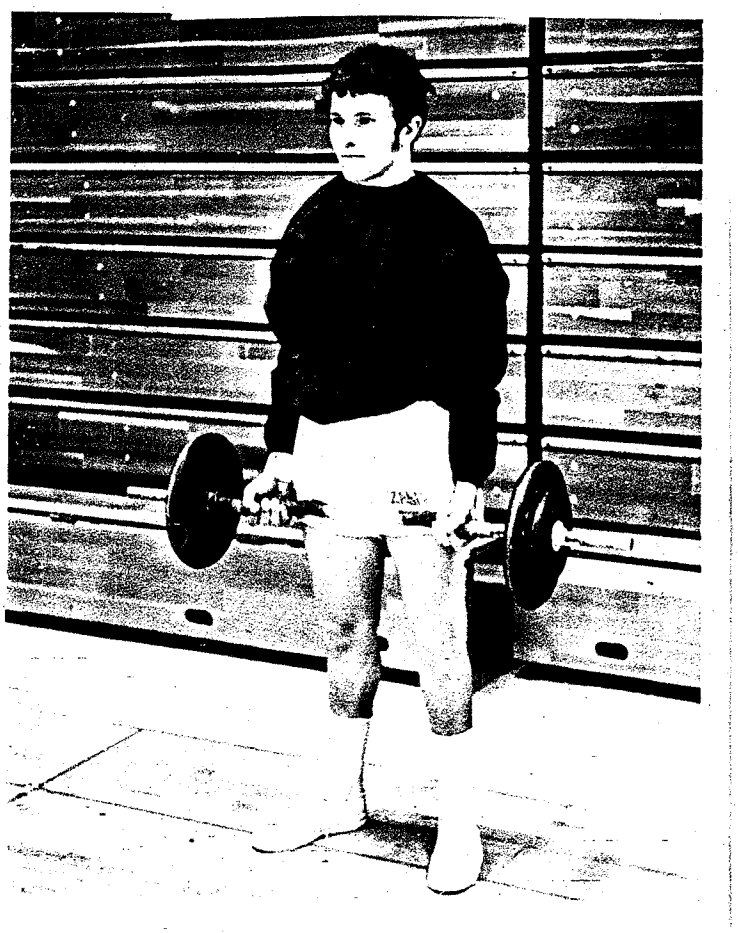
Bench Press

(Start and Lockout position)



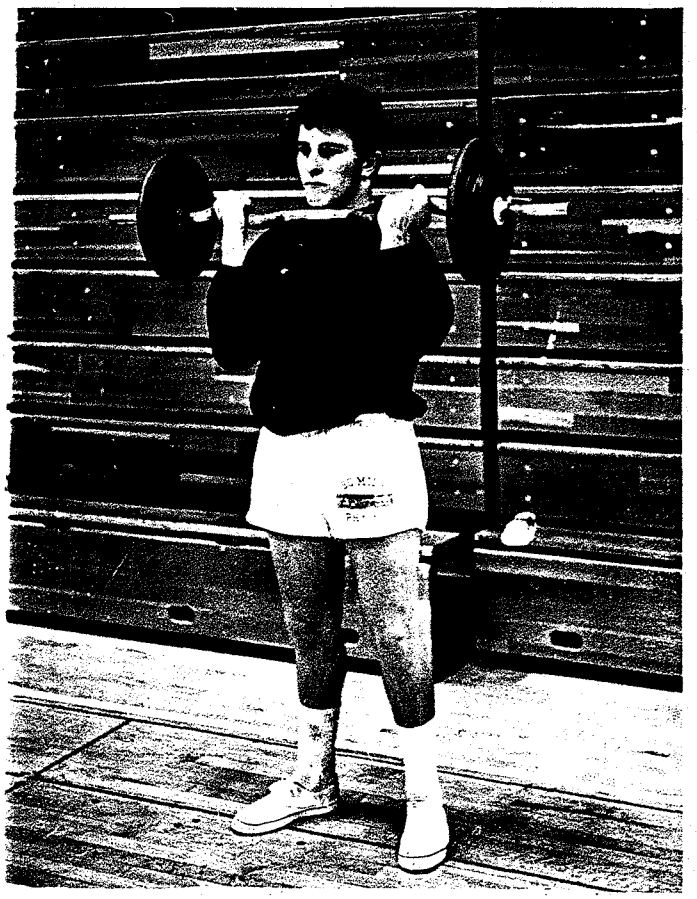
Bench Press

(Start of upward press)



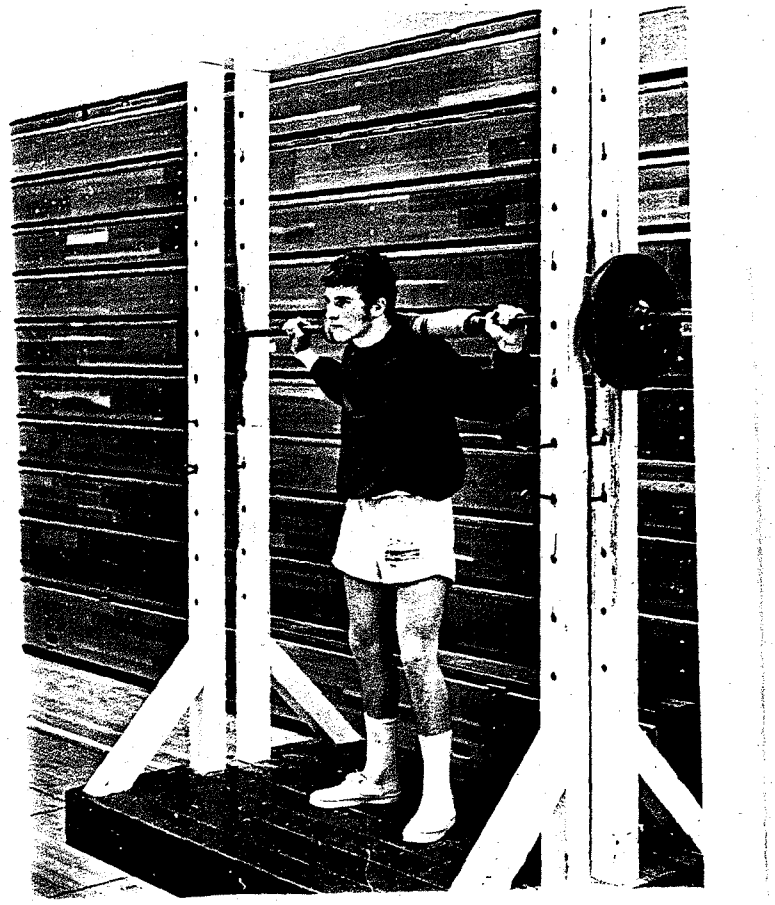
Standing Arm Curl

(Start and Finish position)



Standing Arm Curl

(Starting downward movement)



One-Half Squat

(Start and Finish)

One-Half Squat

(Starting upward movement)

$2\frac{1}{2}$ pounds in the arm curl, and 5 pounds in the one-half squat. Subjects who were unable to perform the required number of repetitions used the weight of the prior week. If they were able to handle more weight than indicated for the required amount of repetitions they were not restricted.

TEST APPARATUS

Weight Training Equipment

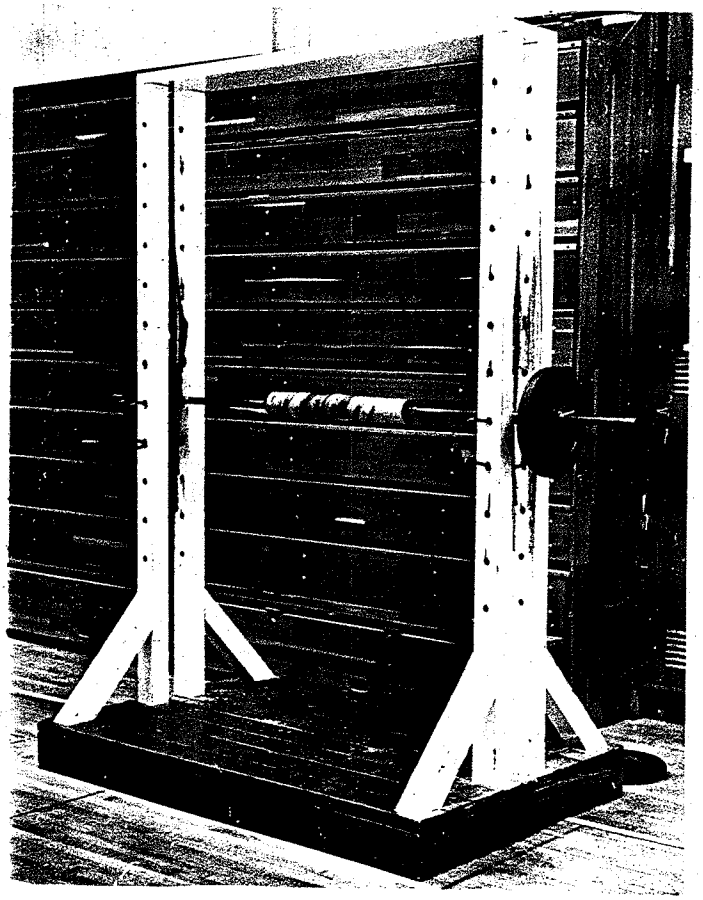
A power rack (picture on page 33) was used to test the subjects on one maximum repetition in the half squat. It was also used during their work out. The bench press was also tested on one maximum repetition. A barbell was used and a bench with racks. (picture on page 34) The curl was tested in the same manner and an E-Z curl bar was used. (picture on page 28)

Stop Watches

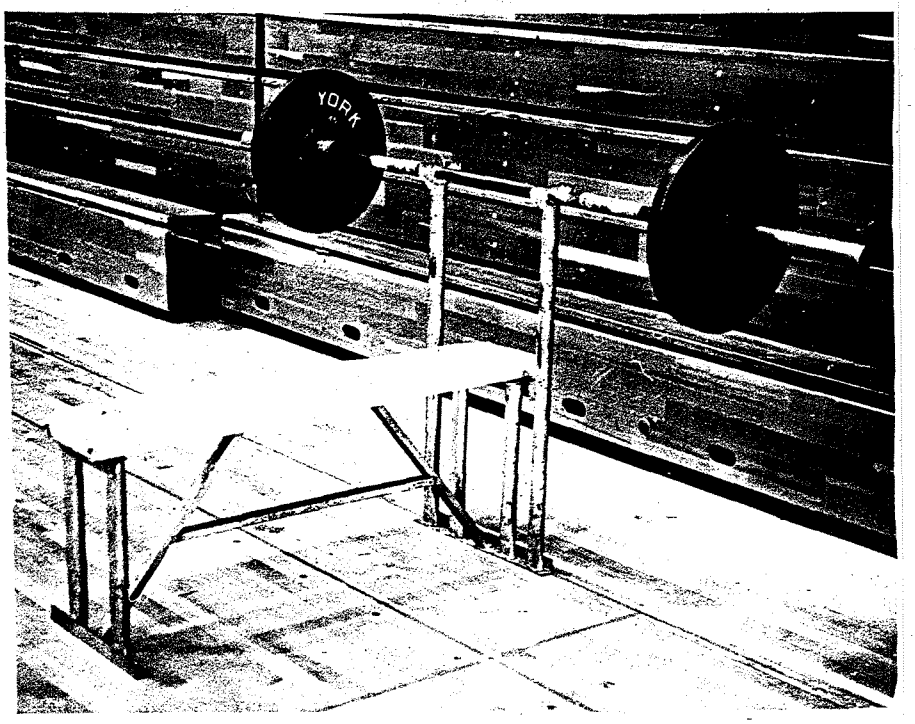
The stop watches used in this study were manufactured by Sportcraft, and were calibrated to the nearest one-tenth of a second.

Tape Measure

A steel tape measure was used to take all body measurements to the nearest one-quarter inch.



Power Rack



Bench and Barbell

TESTING PROCEDURES

Height and Weight

All subjects were measured for height and weight on the scales and stadiometer at the South Milwaukee High School training room at the beginning and end of the study. Height was recorded to the nearest one-half inch, and weight was recorded to the nearest pound.

Leg Strength

All subjects were tested for leg strength on the power rack. The subjects were given instructions to take a position under the bar on the rack with the bar behind the head. The pins were removed by the spotters and the subject squated to the half squat position and returned to the starting position. All subjects were instructed to keep their back straight, look up to the ceiling, inhale on the way down, and exhale on the way up. Subjects were given three chances at a maximum weight if they felt they could lift more.

Bench Press

All subjects were tested for strength in the bench press. The subjects were given instructions to lie on the bench on their back. They were to take their proper grip, give the spotter a verbal signal, bring the weight down to the chest at nipple level and press the weight to arms length in

required form. All subjects were required to press the weight evenly with both arms, buttocks were to remain on the bench as were the shoulders. Subjects were also given three attempts to lift what ever poundage they could handle.

Arm Strength

All subjects were tested for arm strength in the arm curl. Subjects were inctructed to use the E-Z curl bar. All of the subjects were in the standing position at the start and finish of the lift. The lift was started with the weight at arms length and then curled to the finish. Subjects were instructed to keep their feet flat on the floor and not to have any swaying or jerking motions in the lift. Subjects were given three chances to perform the lift.

Speed

All subjects were tested for speed on the South Milwaukee High School track. This assured that there would be no difference in the running surface for the initial and final tests.

The timer was placed at a mark forty yards from the starting position. The runners were instructed to start when they were ready and the timer would start the watch on his first initial move. All subjects were permitted to take a brief warm-up if desired. Subjects were permitted a maximum of three trials if they so desired. The best time was recorded.

CHAPTER IV

ANALYSIS OF DATA

The current investigation was designed to determine the effect of three selected weight training programs and their relationship to time in the forty yard dash. The data were recorded prior to and following an eight month training period.

This chapter consists of a report on the statistical data pertaining to the four groups of subjects and an analysis of the statistical treatment of this data.

Statistical Treatment

The data were statistically treated with an analysis of covariance to compensate for the difference in the mean scores of the treatment at the beginning and to adjust the post mean scores.

The analysis of covariance revealed that the statistical treatment was significant and further investigation was done to determine where the significance was located. The statistical data was then analyzed by the use of a t test. The t test was statistically analyzed within and between the four groups to determine where the test was significant.

Forty Yard Dash

TABLE I

40 Yard Dash

Initial and Final Scores

Group	Total	Mean	Total	Mean	F
E1	702	5.40	681	5.23	
E2	727	5.59	686	5.27	
E3	724	5.56	696	5.35	
C1	715	5.50	718	5.52	
					11.73*

(df=48)

*Statistically significant at the .01% level of confidence

The analysis of the forty yard dash revealed an F = 11.73 which was significant at the .01 per cent level of confidence. Since the obtained F is significant further treatment of this data is necessary to determine where the level of significance is located. Further analysis will be determined by the statistical treatment of the t test.

TABLE II

40 Yard Dash

t-Test Within Each Group

Group	Pre-test Mean	S.D.	Post-test Mean	S.D.	Diff.	t
E1	5.38	.23	5.23	.22	.15	.16
E2	5.59	.29	5.27	.27	.32	.28
E3	5.56	.32	5.35	.27	.21	.18
C1	5.50	.19	5.52	.18	-.02	-.03

(df=24)

A t test was used within each group to determine if there were significant differences. In order to be significant the obtained t must exceed a value of 2.06.

The t value for each of the groups did not reach the .05 per cent level of confidence. The statistical treatment used has indicated that there is no significant differences within each of the four groups tested in the 40 yard dash.

The experimental groups all had a faster time in the final analysis of the post test means. The control group ran slower in the post test than on the pre test.

TABLE III

40 Yard Dash

t-Test Between Groups

Group	Pre-Test Mean	S.D.	Post-Test Mean	S.D.	Diff.	t
E1 E2	5.48	.27	5.25	.24	.23	.70
E1 E3	5.47	.28	5.28	.25	.19	.63
E1 C1	5.44	.21	5.37	.25	.07	.28
E2 E3	5.58	.30	5.31	.26	.47	.67
E2 C1	5.54	.24	5.40	.25	.14	.32
E3 C1	5.53	.26	5.43	.24	.10	.25

(df=25)

The obtained t must exceed a value of 2.05 in order to be significant. The t test revealed that there was no significant differences between the four groups.

The analysis of the pre and post test means indicate that all of the groups ran faster in the post test.

TABLE IV

Bench Press

Initial and Final Scores

Group	Total	Mean	Total	Mean	F
1.	1815	139.6	2330	179.2	
2.	1460	112.3	2450	188.4	
3.	1605	123.4	2295	176.5	
4.	1820	140.0	1870	143.8	
					32.52*

(df=48)

*Statistically significant at the .01% level of confidence

The analysis of the bench press revealed an F = 32.52 which was significant at the .01 per cent level of confidence. Since the obtained F is significant further treatment of this data is necessary to determine where the level of significance is located. Further analysis was determined by the statistical treatment of the t test.

TABLE V

Bench Press

t-Test Within Each Group

Group	Pre-Test Mean	S.D.	Post-Test Mean	S.D.	Diff.	t
E1	139.6	18.53	179.2	24.48	39.6	-4.65*
E2	112.3	23.14	173.9	52.75	61.6	-3.85*
E3	123.4	14.63	176.53	24.69	53.1	-6.66*
C1	140.0	32.21	143.8	32.02	3.8	-0.29

(df=24)

*Significant at the .01% level of confidence

A t test was used within each group to determine if there were significant differences. In order to be significant the obtained t must exceed a value of 2.06.

The t value for each of the experimental groups exceeded 2.06 and the control group failed to exceed the necessary score. The statistical treatment revealed that there was a significant difference within the experimental groups at the .01 per cent level of confidence. All of the t values showed an inverse relationship. Group E3 had the highest t followed by Groups E1 and E2 respectively.

TABLE VI

Bench Press

t-Test Between Groups

Group	Pre-Test Mean	S.D.	Post-Test Mean	S.D.	Diff.	t
E1 E2	125.9	24.3	183.8	25.0	57.9	-10.9*
E1 E3	132.5	17.9	177.8	23.6	46.3	-13.5*
E1 C1	139.9	26.4	161.5	32.6	21.7	- 5.1*
E2 E3	117.8	19.4	182.5	25.4	64.7	-13.9*
E2 C1	126.1	31.2	166.1	36.0	40.0	- 5.0*
E3 C1	131.7	26.6	160.1	31.9	28.4	- 5.1*

(df=25)

*Statistically significant at the .01% level of confidence

The obtained t must exceed a value of 2.05 in order to be significant. The t test revealed that there was a significant difference between all of the groups at the .01 per cent level of confidence.

The statistical treatment revealed that all of the groups had an inverse relationship. The highest t value was found between groups E2 and E3.

TABLE VII

Half Squat

Initial and Final Scores

Group	Total	Mean	Total	Mean	F
1.	3530	271.5	5525	425.0	
2.	3080	236.9	62.60	481.5	
3.	3535	271.9	5685	437.3	
4.	3350	257.6	3570	274.6	
					37.90*

(df=48)

*Statistically significant at the one percent level

The analysis of the half squat revealed an F = 37.90 which was significant at the .01 per cent level of confidence. Since the obtained F is significant further treatment of this data is necessary to determine where the level of significance is located. Further analysis will be determined by the statistical treatment of the t test.

TABLE VIII

Half Squat

t-Test Within Each Group

Group	Pre-Test Mean	S.D.	Post-Test Mean	S.D.	Diff.	t
E1	271.5	45.9	425.0	71.7	153.5	-6.49*
E2	236.9	34.4	481.5	68.3	244.6	-11.52*
E3	271.9	49.9	437.3	68.4	165.4	-7.03*
C1	257.6	57.1	274.6	57.6	17.0	-0.75

(df=24)

*Statistically significant at the .01% level of confidence

A t test was used within each group to determine if there were significant differences. The obtained t must exceed a value of 2.06 in order to be significant.

The t value for the experimental groups was significant at the .01 per cent level of confidence and all of the scores had an inverse relationship. The control group did not reach the needed t value and was not significant at the .05 per cent level of confidence.

TABLE IX

Half Squat

t-Test Between Groups

Group	Pre-Test Mean	S.D.	Post-Test Mean	S.D.	Diff.	t
E1 E2	254.2	42.6	453.2	72.9	199.0	-12.7*
E1 E3	271.7	46.1	430.0	69.1	153.8	-13.8*
E1 C1	264.6	50.2	349.8	97.7	85.2	- 5.3*
E2 E3	254.4	44.7	458.2	71.3	203.8	-13.6*
E2 C1	247.3	46.4	378.0	119.9	130.7	- 5.2*
E3 C1	264.8	52.0	354.8	101.7	90.0	- 5.3*

(df=25)

*Statistically significant at the .01% level of confidence

The obtained t must exceed a value of 2.05 in order to be significant. The t test revealed that there was a significant difference between all of the groups at the .01 per cent level of confidence.

The statistical treatment revealed that all of the groups had an inverse relationship. The highest t value was found between groups E1 and E3.

TABLE X

Arm Curl

Initial and Final Scores

Group	Total	Mean	Total	Mean	F
1.	1085	83.4	1385	106.5	
2.	970	74.6	1485	114.2	
3.	1110	85.3	1440	110.7	
4.	1045	80.3	1140	87.6	
					25.31*

(df=48)

*Statistically significant at the one per cent level

The analysis of the arm curl revealed an F = 25.31 which was significant at the .01 per cent level of confidence. Since the obtained F is significant further treatment of this data is necessary to determine where the level of significance is located. Further analysis will be determined by the statistical treatment of the t test.

TABLE XI

Arm Curl

t-Test Within Each Group

Group	Pre-Test Mean	S.D.	Post-Test Mean	S.D.	Diff.	t
E1	73.2	10.9	104.8	11.6	31.6	-5.47*
E2	74.6	11.0	114.2	20.0	39.6	-6.22*
E3	85.3	12.8	110.7	13.0	25.4	-5.00*
C1	80.3	13.6	87.6	14.8	7.3	-1.31

(df=24)

*Statistically significant at the .01% level of confidence

A t-test was used within each group to determine if there were significant differences. The obtained t must exceed a value of 2.06 in order to be significant.

The t value for the experimental groups was significant at the .01 per cent level of confidence and all of the scores had an inverse relationship. The control group did not reach the needed t value and was not significant at the .05 per cent level of confidence.

TABLE XII

Arm Curl

t-Test Between Groups

Group	Pre-Test Mean	S.D.	Post-Test Mean	S.D.	Diff.	t
E1 E2	79.0	12.6	110.3	16.2	31.3	-11.8*
E1 E3	84.4	12.6	108.6	12.0	24.2	-16.6*
E1 C1	81.9	13.0	97.1	15.8	15.2	- 6.7*
E2 E3	80.0	12.7	112.5	16.3	32.5	-13.5*
E2 C1	77.5	12.2	100.9	21.5	23.4	- 6.1*
E3 C1	82.8	12.9	99.2	17.6	16.4	- 7.1*

(df=25)

*Statistically significant at the .01% level of confidence

The obtained t must exceed a value of 2.05 in order to be significant. The t test revealed that there was a significant difference between all of the groups at the .01 per cent level of confidence.

The statistical treatment revealed that all of the groups had an inverse relationship. The highest t value was found between groups E1 and E3.

TABLE XIII

Ranking of the Groups

Group	40 yard dash	bench press	squat	curl	Rank
E1	1	2	3	3	9*
E2	2	1	1	1	5*
E3	3	3	2	2	10*
C1	4	4	4	4	16*

*Points were awarded to 1st through 4th places. They were totaled and the group with the least amount was placed 1st etc.

The results of the averages of the post-test scores indicate that group E2 ranked as the strongest in the weight training exercises and was the second fastest in the forty yard dash. Group E1 was second, followed by Group E3 and the Control Group.

CHAPTER V

SUMMARY AND CONCLUSIONS

SUMMARY

This study was concerned with determining the effects of a weight training program designed to increase dynamic strength and decrease time in the forty-yard dash. Fifty-two subjects enrolled at South Milwaukee High School were used as subjects in this study. The subjects were given pre and post tests to determine their initial and final scores in strength and speed. They were tested on the bench press, one-half squat, curl and the forty-yard dash.

The fifty-two subjects were randomly selected into four groups. Group E1 did two-five repetitions, group E2 did eight-ten repetitions, group E3 did fourteen-fifteen repetitions, and group C1 was the control group and did not participate in the weight training program.

The experiment program ran for a period of eight months, with the first three groups meeting twice a week for fifty-two minutes a period.

The experimental groups increased in strength at the .01 per cent level of confidence. In the bench press Group E3 had the highest t value. In the half-squat Group E2 had the highest t value. In the arm curl Group E2 had the highest t value. The control group did not make any significant increases in strength or improvement in time in the forty-yard dash.

The first three groups experienced an improvement in time in the forty-yard dash as a result of the experimental program; however this was not a statistically significant decrease. Even though he results were not statistically significant a decrease of one-tenth of a second in time is observably and practically significant. The results showed that of the fifty-two participants 38 ran faster, 4 ran slower, and 10 did not improve in time.

The mean averages of the pre and post test in the forty yard dash revealed that Group E1 had the fastest pre-test mean and also retained the fastest time in the post-test mean average.

CONCLUSIONS

From the results of this study, the following conclusions were made:

1. A concentrated program of bench presses will increase strength in the chest significantly at the one per cent level of confidence.

2. A concentrated program of one-half squats will increase leg strength at the one per cent level of confidence.

3. A concentrated program of arm curls will increase arm strength at the one per cent level of confidence.

4. A weight training program designed to increase strength is beneficial in maintaining running speed in the forty-yard dash.

5. An increase in leg strength will not always result in an improvement in running speed in the forty-yard dash.

6. Speed is important in basic human motor performance and it would indicate that a weight training program would increase speed.

RECOMMENDATIONS

From the results of this study, the following recommendations were made:

1. A further long term study be made using athletes.

2. A study be made using a variety of different exercises such as the military press, snatch, or clean and jerk, and a combination of leg extensions and leg curls and the ergometer.

3. Use a shorter running distance.

4. Use a longer running distance.

5. Compare isotonic, isometric, and a regular weight training program over a period of eight months.

6. Use college students.

7. Use junior high students.

8. Study the effects of a long term weight training program on other aspects of movement.

9. Strength is important in basic human motor performance and it is felt that a weight training program should be part of a physical educators preparation.

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APPENDIX A

Appendix A contains the raw scores of both the pre-test and post-test of the 40 yard dash, Bench Press, One-half Squat and the Arm Curl for each of the four groups.

TEST SCORES for GROUP E1

40 Yard Dash		Bench Press		½ Squat		Arm Curl	
5.6	5.4	140	195	330	485	90	125
5.6	5.6	145	185	180	305	60	85
4.9	4.8	120	170	330	490	75	95
5.4	5.2	125	170	230	530	85	110
5.3	5.2	120	160	280	440	75	100
5.3	5.2	120	165	250	350	70	100
5.6	5.4	155	170	330	440	80	105
5.7	5.5	150	195	300	475	100	115
5.5	5.2	185	245	265	325	110	120
5.2	5.1	125	165	250	420	75	105
5.3	5.2	140	175	260	490	95	120
5.1	4.9	140	145	300	425	90	95
5.5	5.4	150	190	225	350	80	110

TEST SCORES for GROUP E2

40 Yard Dash		Bench Press		½ Squat		Arm Curl	
5.5	5.2	120	240	210	490	75	125
5.0	4.8	120	190	245	540	75	135
5.3	5.0	120	175	260	560	85	120
5.7	5.2	150	225	260	485	90	125
6.0	5.3	100	190	210	520	55	85
5.7	5.4	130	210	210	490	75	130
6.0	5.3	130	205	240	570	75	120
5.7	5.6	80	195	240	535	75	125
5.5	5.4	80	165	180	395	55	75
5.4	5.2	100	175	210	425	75	105
6.0	5.9	110	160	300	390	65	90
5.5	5.2	80	145	225	360	80	110
5.4	5.1	140	175	290	500	90	140

TEST SCORES for GROUP E3

40 Yard Dash		Bench Press		½Squat		Arm Curl	
5.5	5.3	120	160	325	460	100	125
6.0	5.3	125	160	325	538	100	120
5.2	5.1	105	140	175	425	60	85
6.2	6.0	120	195	250	458	100	120
5.1	5.1	90	135	225	405	75	95
5.1	4.9	140	180	323	458	100	120
5.5	5.4	125	205	225	275	80	105
5.6	5.3	130	180	325	538	80	120
5.7	5.2	140	170	325	538	90	120
5.7	5.6	115	165	280	340	80	100
5.8	5.6	120	185	265	355	70	95
5.6	5.4	135	205	240	395	90	115
5.4	5.4	140	215	250	400	85	120

TEST SCORES for GROUP C1

40 Yard Dash		Bench Press		½ Squat		Arm Curl	
5.3	5.3	180	180	285	290	90	90
5.5	5.4	120	130	220	230	80	85
5.3	5.4	125	125	230	240	85	85
5.3	5.3	170	170	330	350	95	100
5.8	5.8	70	80	170	190	60	75
5.3	5.3	160	170	330	345	95	100
5.4	5.5	150	145	330	340	90	105
5.7	5.6	170	160	330	345	90	85
5.5	5.7	180	190	250	300	85	105
5.7	5.7	150	150	235	235	70	70
5.4	5.4	135	145	205	235	75	85
5.8	5.8	90	95	195	200	50	55
5.5	5.6	120	130	240	270	80	100