A STUDY OF THE EFFECTS OF WEIGHT TRAINING ON LOWER LIMB STRENGTH AND SPEED

A Thesis

Presented to

the Division of Health, Physical Education and Recreation

Kansas State Teachers College of Emporia

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

---

by

Robert M. Gay

May 1972

ABSTRACT

Robert M. Gay
May 1972

A STUDY OF THE EFFECTS OF WEIGHT TRAINING ON LOWER LIMB STRENGTH AND SPEED

Dr. William Harper, Chairman
Dr. Ronald Slaymaker
Dr. Wiley Alberg

Statement of the Problem

The problems of this investigation were to determine, (1) if there is an effect on leg strength and speed by using the specialized weight training program of the exercises: leg curls, leg extensions, abduction and adduction, and (2) to try to determine if there is a correlation between the change in strength, if any, and change in speed, if any.

Summary of Procedure

The test and retest method and a comparison of pre and post-test were used in this study. Exercises used were right and left leg curl and right and left leg extension for measures of strength. The forty yard dash was the test of speed. Subjects did the exercises three times a week for a six week period. The program was a percentage type where each subject started the exercises at fifty percent of their maximum strength and increased ten percent each week until they reached their maximum.

Review of Conclusions

1. The specialized weight training program will improve the strength performance of the individuals lower limbs.
2. The specialized weight training program will not make a significant improvement in the speed of the individual.
3. There is a significant relationship between the change in strength and the change in speed with this program.

William A. Harper

Approved for the Major Department

Approved for the Graduate Council

TABLE OF CONTENTS

Chapter Page

LIST OF TABLES

Chapter 1

INTRODUCTION TO THE PROBLEM

The inherent values of weight training have been recognized only recently by trainers, physical educators, coaches, and physicians. If properly carried out, weight training will contribute to the general physical well-being of the athlete as well as improve his speed, explosive power, and endurance.[1]

There has been increasing controversy as well as interest in the area of human strength and the effects of various exercise programs upon strength development. Many studies which have dealt with strength and its relationship to speed of body movement have been conducted, but very few seem to deal specifically with the development of ankle and leg strength. A need therefore arises to establish a specialized weight program for the lower body development, and to determine, if possible, if there is any correlation between the program and (1) leg strength and (2) speed.

Purpose

The purposes of this study were threefold: (1) to investigate the effect of a specialized weight training

---

[1]Carl E. Klafs and Daniel D. Arnheim, Modern Principles of Athletic Training (Saint Louis: C. V. Mosby Co., 1969), p. 76.

program for the development of the lower limbs on leg strength, (2) to study the effect of the same weight training program on speed, and (3) to try to determine a correlation between the change in strength, if any, and the change in speed, if any.

Problem

The problems of this investigation were to determine, (1) if there is an effect on leg strength and speed by using the specialized weight training program of the exercises: leg curls, leg extensions, abduction and adduction, and (2) to try to determine if there is a correlation between the change in strength, if any and the change in speed, if any.

Hypotheses

1) There is no relationship between a specialized weight training program for the development of the lower limbs and (1) leg strength and (2) speed. 2) There is no correlation between the change in strength and the change in speed of this particular weight training program.

Assumptions

1. Each subject had the same advantage in making progress.

2. The subject did not undertake additional practice.

Definition of Terms

Abduction. Abduction is a movement of a body part away from the median plane.

Adduction. Adduction is a movement of a body part toward the median plane.

Cable tensiometer. A cable tensiometer is an instrument designed to measure the tension of aircraft control cable, for testing the strength of individual muscle groups.

Chronometer. A chronometer is a clock which is especially constructed for measuring time with a high degree of accuracy.

Dash. A dash is a short race at one's greatest speed.

Leg curl. A leg curl is from a prostrate position, raise the leg to a ninety degree angle.

Leg extension. Leg extension is straightening the knee to a position parallel to the floor while sitting on a bench.

Strength. Strength is the capacity to exert force; the ability to do work against resistance.

Specialization. Specialization exercises are geared to the demands made upon the body in specific activities.

Speed of movement. Speed of movement is a change in distance per unit of time in any direction.

Weight training. Weight training is a system in which a series of progressive resistance exercises are used in body (muscle) development.

Universal gym. The universal gym is a versatile conditioning system with fifteen stations; used for multiple resistive exercises for individual and group training.

Limitations

1. The total number of junior and senior boys was limited.

2. It was not possible to control the previous experience of the subjects in regard to weight training and their use of the universal gym.

Delimitations

1. This study was conducted at Topeka High School, Topeka, Kansas.

2. Only junior and senior boys enrolled in physical education were eligible for use in this study.

3. Due to the time of the year that this study was conducted, the temperature, wind and weather may have had specific bearings on the forty yard-dash times.

4. This study concerned itself with three parameters:

   a. effects of this specialized program on leg strength.

b. effects of this specialized program on speed.

c. correlation between the change in leg strength, if any and the change in speed, if any.

Method

The method used in this study was of the test and retest type. Twenty-five subjects performing the specified exercises and tests were used in the study. The only previous experience found among the group, in regard to the weight training program, was the training they received as sophomores and juniors in their physical education classes in the previous year. In regard to their previous training with the forty yard-dash, most subjects received some experience in elementary school.

The instruction given were the explanation of the exercises involved, the proper use of the universal gym, the testing equipment and the definition of the forty yard-dash. For this test, the Dekan timer was used since many studies have shown that a chronometer of this type is most accurate in measuring movement time. Also a cable tensiometer was used for testing the strength of legs as it has been shown to permit less stretch or displacement than a dynamometer.[2] The cable tensiometer was attached to the immobile universal gym during the leg strength test.

---

[2]Frank T. Kennedy, "Substitution of the Tensiometer for the Dynamometer in Back and Leg Lift Testing," Research Quarterly 30:187, May, 1959.

The forty yard-dash was selected for the following reasons: (1) it is one of the tested dashes in the Physical Fitness Manual, and (2) it was chosen to approximate desirable football speed.[3]

In weight training, arms generally receive relatively more attention than any other part of the body.[4] Therefore, this study seems to be unique in that the four exercises employed were selected for their use in the development of the lower body.

This study took place for a duration of six weeks, starting the third week of the 1971-72 school year. Each subject was tested before the weight training program with the cable tensiometer for leg strength and with the Dekan Timer for speed in the forty yard-dash. They were also tested the third and fifth weeks of the weight training program. The final test was made at the end of the six weeks training period.

---

[3]David Costill, S. J. Miller, W. M. Hoffman, "Relationship Among Selected Tests of Explosive Leg Strength and Power," Research Quarterly, 39:785, October, 1968.

[4]Jim Murray and Peter V. Karpovich, Weight Training in Athletics (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1959), p. 46.

Chapter 2

REVIEW OF RELATED LITERATURE

Only a limited number of individuals trained with resistive weights prior to the 1940's. Literature of the early 1900's indicated that a person who lifted weights would become muscle-bound. Athletes were cautioned about using weights, if they desired, to retain their muscle-co-ordination. These beliefs prompted many coaches to disregard weight training for their athletes.

Nevertheless, in the last twenty-five years there has been a large amount of material published concerning weight training. Ample research has been completed to indicate that weight training has significance in the field of physical education and athletics. Recently, controlled studies and experiments have been conducted in an effort to investigate the effects of weight training on athletics. This chapter will be concerned with reviewing some of these studies on the effects of weight training in athletics.

Capen undertook a study at the University of Tennessee to determine the effect of systematic weight training on strength, athletic power, and muscle endurance. The control group were students consisting of twenty-nine members of a conditioning class involved in conditioning, tumbling and gymnastics, running, and combatives. Forty subjects of a

weight training class made up the experimental group. Tests were given at the beginning and ending of an eleven-week period for both groups. Both groups were tested on gripping, running, and tests of performance. The conclusions of the study indicated that weight trainers showed greater increase in muscular strength and increased more in speed exercise. There was no sizeable difference in the muscular endurance of the two groups.[5]

Chui engaged in a study to determine the effect of systematic weight training on athletic power. Chui used subjects who were enrolled in required physical education classes at the University of Iowa to form a controlled group of twenty-two and an experimental group of twenty-three. Weights were lifted by the experimental group for fifty minutes, three times a week, for a three-month period. The controlled group continued to participate in the required physical education classes. Data was from a pretest and a final test at the end of the three-month period concerning body weight, Sargent jump standing and running, standing broad-jump, eight and ten pound shot put, and a sixty yard sprint. The results from this study showed no significant improvement for the control group; whereas the experimental group increased considerably in potential power, and they indicated

---

[5]Edward K. Capen, "The Effect of Systematic Weight Training on Power, Strength, and Muscular Endurance," Research Quarterly, 21:83-94, May, 1950.

the probability of increasing speed through systematic weight training.[6]

Masley, Hairbedian, and Donaldson conducted a study to determine the effects of weight training on speed and muscle-co-ordination as compared to the effects of volleyball and a program of inactivity. Three groups were used for the experiment. The first group engaged in a weight training program, the second group in a volleyball class and the third group in a lecture class. No attempt was made to limit activities outside the class. These students were tested at the beginning and at the conclusion of the program. Results of the tests demonstrated that greater speed and muscle co-ordination were developed by the weight training program and that this increase in speed was directly related to the strength gained.[7]

Zorbas and Karpovich undertook a study involving six hundred persons. These persons, ranging from eighteen to thirty years of age, were tested. Three hundred men had engaged in weight training for six months. The other half of them had never engaged in weight training. These men were on a machine which recorded the speed of rotary movement on an arm. Each individual was required to complete twenty-four

---

[6]Edward Chui, "The Effect of Systematic Weight Training on Athletic Power," Research Quarterly, 21:193-194, October, 1950.

[7]John W. Masley, Ara Hairbedian, and Donald N. Donaldson, "Weight Training in Relation to Strength, Speed and Co-ordination," Research Quarterly, 24:308-315, October, 1953.

rotations as rapidly as possible. According to the findings of this study, weight trainers were significantly faster on rotary movement than were nonlifters.[8]

A short while later Wilkins demonstrated experimentally that training in weight lifting does not slow speed.[9]

Reade and Alley undertook a study to determine the effect of weight training upon starting speed. After two weeks of early fall practice, twenty-two football players were tested on how rapidly they could charge from a four-point stance one yard away and hit a blocking dummy. An electrical device was used to time this maneuver. After the test, a control group and an experimental group were selected at random. The experimental group took part in a weight training program in addition to the regular football practice. At the completion of the season, the twenty-two players were again tested. Analysis of data showed that weight trainers increased starting time significantly as compared to the controlled group.[10]

O'Shea conducted a study to determine the effects of a six-week progressive weight training program on the

---

[8]William S. Zorbas and Peter V. Karpovich, "The Effect of Weight Lifting Upon the Speed of Muscular Contractions," Research Quarterly, 22:145-148, May, 1951.

[9]Bruce M. Wilkin, "The Effect of Weight Training on Speed of Movement," Research Quarterly, 23:361-369, October, 1952.

[10]Robert Reade and Louis E. Alley, "A Weight Training Program for Improving Speed of Charge of Football Linemen," Journal of the Coaching Profession, 7:11,15,24, April, 1962.

development of strength and muscle hypertrophy, using one exercise, the deep-knee bend, with varying repetitions. Thirty students were chosen by random from beginning weight lifting classes at Michigan State University. Following a two-week conditioning period the subjects were divided into three groups of ten each for the controlled training period. The effectiveness of the program was determined by three measurements: (a) thigh girth, (b) dynamic strength as measured by one RM on the deep-knee bend, and (c) static strength as measured on the dynamometer. The results were graphically analyzed and percentages were calculated. The data was also statistically treated using analysis of covariance. No significant differences were found between the three systems of training. All training programs resulted in the improvement of static and dynamic strength.[11]

Experiments with various weight-training programs and their effect upon performance in various skills and activities have been steadily increasing.

A study by Clarke and Henry has been reported in which the relationship of speed to the development of strength was investigated. Two groups of subjects were tested.[12]

---

[11]Patrick O'Shea, "Effects of Selected Weight Training Programs on the Development of Strength and Muscle Hypertrophy," Research Quarterly, 37:95-101, 1966.

[12]David H. Clarke and Franklin M. Henry, "Neuromotor Specificity and Increased Speed from Strength Development," Research Quarterly, 32:315-325, October, 1961.

Thirty-one subjects were in the experimental group and thirty-one subjects in the control group meeting in a class twice a week. Three strength tests were performed and the strength-mass ratios were computed for each subject. The tests were repeated later. The experimental groups worked with weights. The net time of active exercise was thirty-five minutes per class period. The control group remained in athletics, or physical education classes. These investigators studied the possibility that the speed of a movement can be increased by strengthening the muscles which cause the movement. Clarke and Henry found no slowing effect on speed by the use of weight-training but that a semester of weight-training did not increase the speed of movement significantly more than of beginning golf or swimming.[13]

Hooks points out that weight training can possibly improve strength and speed simultaneously. He suggest that

> a weight training program that overloads the muscle with enough weight to ensure strength gains, and at the same time, enables the muscles to contract successfully with a burst of speed, will produce increased strength and speed.[14]

Hooks conducted experiments at Wake Forest University with boys from all skill levels, ranging from groups of the very poorest physical specimens in the freshman physical education classes to the most advanced varsity athletes. No conclusive

---

[13] Ibid.

[14] Gene Hooks, Application of Weight Training to Athletics (Englewood Cliffs, New Jersey: Prentice-Hall, Incorporated, 1962), pp. 21-24.

results have been established, but on the basis of completed tests a speed increase appears to be associated with a concentrated weight training program.

In one experiment, a class of twenty-seven of the poorest students was tested on the sixty-yard dash, after which they participated in a supervised weight training program for three days a week for six weeks. During this time they were encouraged to do no running. At the end of the six week period, they were retested on the sixty-yard dash. The mean score for the first test was 8.58 seconds, and the mean score for the second was 8.30 seconds a decrease in time of .28 seconds.[15]

In another experiment, the varsity football team did not register the same dramatic results, but did show a marked increase. They were tested on the forty-yard dash in order to approximate desirable football speed. They then participated in a six-week program of weight training, after which they were retested on the dash. The mean score for the first test was 5.68 seconds. The mean score for the second test was 5.46 seconds, an improvement of .22 seconds.[16]

In reviewing the related literature, it was noted that increased strength developed by weight training increases speed and muscle co-ordination. Investigation also has indicated that weight training does not slow muscular contractions, nor is it detrimental to the weight-lifter.

---

[15] Ibid. [16] Ibid.

Chapter 3

METHOD

The purpose of this study was to determine the effect of a specialized weight training program for the development of the lower limbs on lower leg strength and the effect of the same weight training program on speed; and a further purpose was to try to determine a correlation between the change in strength, if any, and the change in speed, if any. A review of related literature was conducted to lend insight into the proper procedure and tools available for the strength measurement in conjunction with weight training. In addition, several coaches and trainers acted as consultants to both the design and procedures of this investigation.

NATURE OF THE SELECTION OF SUBJECTS

The subjects for this study were drawn from a population of students enrolled in physical education three (3) and four (4). These students are juniors and seniors at Topeka High School who had previously enrolled in physical education one (1) and two (2) and passed the requirement in that area. Physical education is required during their sophomore year.

Students were screened through individual personal interviews to see if they would be willing to participate in such a study. During the interviews, they were informed of

what the program would consist and they were checked according to absentee records. After interviewing these students, a parent permission slip was sent home to be returned signed by the parent before the testing period began. A copy of the permission slip may be found in Appendix A.

Ages of the subjects ranged from fifteen to seventeen years, with the average age being sixteen years, while the weight of the subjects ranged from 112 pounds to 227 pounds, with an average weight of 154.8 pounds. The average height was 5'10" with a range from 5'3" to 6'4". Twenty-five subjects took the first test, twenty-four completed the second test. One of the subjects was forced to drop out of the study due to a badly sprained ankle.

EQUIPMENT AND FACILITIES

Equipment used in this study consisted of: 1) one Continental adjustable weight and height scale; 2) one fiberglass 165 foot tape; 3) one can of spray paint; 4) two volleyball standards; 5) one 150 foot extension cord; 6) one 4' x 8' sheet of plywood, 3/4" thick; 7) four 1/8" cable clamps; 8) one 3' x 1/8" cable; 9) one 1/4", 7 1/2" long turnbuckle; 10) one 5/16" x 1 3/8" x 3 3/4" U bolt; 11) four number 10-1" wood screws; 12) one 1 3/4" x 1 3/8" plate staple; 13) one cable tensiometer; and 14) one Dekan Timer, using the stop switch attachment. Due to a malfunction in the pretest Dekan Timer, a different Dekan Timer was used for the post-test. As they were not synchronized, there was a possibility of a slight variation in the results.

Lane two at the southeast end of the Topeka High School track was used for running the forty-yard dash. The lane was forty-two inches wide. The weight room of Topeka High School was used for the resistance work as it contains the universal gym unit. Although in most cases a universal gym may be considered a piece of equipment rather than a facility, for the purpose of this study it was considered a facility due to the present lack of mobility. A Gladiator Model 10 Universal Gym, with fifteen stations, was the unit used for the weight training program and the testing. The knee-thigh machine and the low pulley station were used specifically. Some improvision was used on the low pulley station in the area of the program concerned with leg adduction and leg abduction. Four twenty inch nylon straps, two inches wide attached to a snap ring were used. One five pound weight was used on the knee and thigh machine and another on the lower pulley station. Five pound weights were used to increase the weight at five pound intervals.

TESTING PROCEDURE

All subjects were first weighed on the Continental scale and their weight was recorded to the nearest pound. Also measured, to the nearest inch, was their height. The first test administered was the forty-yard dash with the Dekan Timer. To prepare for the dash, the subjects did the following four warm-up exercises: jumping jacks, sit ups, wind mills, and mountain climber. When they completed the

indoor warm-ups, they were instructed to jog one-half lap around the track. The purposes of this particular warm-up was twofold, in that, 1) if the body was warmed-up there was less chance of pulled muscles in the dash, and 2) the weather at pretest time was a cool 50 degrees.

In order to avoid outside influences, the pretest was conducted at 7:45 a.m. before school started. Therefore, the subjects came to the locker room at 7:30 a.m., got dressed, did their warm-up exercises, and were on the track and ready to begin the forty-yard dash at 7:45 a.m. They were then placed in alphabetical order to run the dash one at a time. They were instructed to "go" on the buzzer. The exact wording of the command was, "Go to your mark, get set," and then the buzzer would sound. They were allowed to use either the standing start or the track start, whichever they preferred. Very few used the track start but all starts were recorded. Whichever start each chose for the pretest, he also used in the post-test, in order to be consistent. After every subject had completed his first trial, two more trial runs were made, for a total of three trial runs; the best was recorded. One senior leader reset the stop switch after each run and another senior leader reset the Dekan timer, while this investigator recorded the trials. It took a total of twelve minutes to run every boy through the first trial. The second trial took ten minutes and thirty-two seconds, while the third trial took ten minutes and eighteen seconds. After completing all three trials, the subjects returned to

the weight room where they received specific instructions on the weight program.

Leg curls were tested the following day, first demonstrated to the group by one of the helpers and this researcher. With the use of the cable tensiometer, the right leg was tested first. Subjects would lie flat, prone position; turn ankles in slightly, not jerk; raise the leg with a slow even pressure, as hard as possible; hold five seconds; release and record the poundage. Each subject took his turn, with the others looking on. It took fifteen minutes to test the twenty-five subjects on the pretest. The same procedure was conducted for the left leg. Leg extensions followed.

The next day, the subjects were tested on leg abduction and adduction. To begin with, the maximum strength for each subject was determined. Then each subject was programmed in the following manner. Once the maximum strength of the subjects was determined by the use of the cable tensiometer, the subjects were programmed. A subject would start out at fifty per cent of his maximum and increase ten per cent each week for the following six weeks. The number of repitions was five. If the subjects had difficulty in performing the exercise as he came close to his maximum he would hold in an isometric position.

Subjects would work out three days a week, in two groups. Group I consisted of thirteen members and Group II had the remaining twelve members. The exercise program was

set up so that the first week, Group I would go outside and play touch football for twenty minutes while Group II did their exercising. At the end of the twenty minutes, the two groups would switch. The second week, Group II played touch football first while Group I did their exercises, then switch at the end of twenty minutes. This procedure was followed throughout the six week weight training period.

Six weeks later, the post-test was administered. The temperature was thirteen degrees cooler on the day of the post-test forty yard dashes and could have had a definite bearing on the results. Also, the abduction and adduction testing was eliminated in the post-test due to the time element.

STATISTICAL PROCEDURE

Following the test period, the information was transferred from the 4 x 6 cards to a chart. Pertinent information consisted of the weight, height, pre- and post-strength in right and left leg curls and right and left leg extensions, and the pre- and post-scores of the forty-yard dash of each subject. This information was then programmed for the 1401 computer which is located on the Kansas State Teachers College campus.

Following computer analysis, the coefficient of correlation was employed to determine if there was a relationship between the specialized weight training program and leg strength and speed. See chapter four, Analysis of Data, for specific data.

PROCEDURES FOR RESISTANCE EXERCISES

Abduction. The resistance is attached to the ankle or foot. The starting position is with the leg to be exercised across the front of the stationary leg. The athlete then brings the leg back across the body and out to the side as far as possible. Upon reaching this point, he returns to the starting position.

Adduction. The resistance is attached to the ankle or foot. The leg to be exercised is to be adducted to approximately a forty-five degree angle. The foot is brought across the front of the body and then returned to the starting position. The knee of the leg to be exercised should be slightly bent. The foot of the exercised leg should be rotated inward and maintained in this position throughout the exercise.

Leg curl. The athlete lies in a prone position, and the resistance is placed against the back of the leg as close to the foot as possible. The foot is turned inward and is maintained in this position throughout the exercise. The task is to bring the foot slowly towards the buttocks as far as possible and then returning to the beginning position or the straight leg position.

Leg extension. The athlete is in a seated position with the resistance placed at the lower part of the leg. The foot of the leg to be exercised should be rotated inward, and

the exercise should be done with the foot in this position. The task is to bring the leg up gradually to a straight leg position and then lower the weight to the starting position or ninety degree angle.

Chapter 4

ANALYSIS OF DATA

The purposes of this study were threefold: (1) to investigate the effect of a specialized weight training program for the development of the lower limbs on leg strength, (2) the effect of the same weight training program on speed, and (3) try to determine a correlation between the change in strength, if any and the change in speed, if any.

Analysis of strength was based upon gains made in the test performance of the group involved with the specialized weight training program. The analysis of speed was based upon gains made in the forty-yard dash performance.

The statistical procedure computed for this study was the t test of significance for the group and the significance of the difference between the pretest and the post-test scores.

Table 1 represents the results of the pretest and the post-test of strength. The t score of 5.3502 indicates the change in strength was significant at both the .05 and the .01 level of significance.

Table 1

t-Table for the Results in Strength Test

Group	df	SD	Mean	*t*
Pretest	23	39.0312	168.7500	5.3502
Post-test	23	41.2810	232.2917	

t-value needed with 46 degrees of freedom at .05 level of significance is 2.021.

t-value needed with 46 degrees of freedom at .01 level of significance is 2.704

Table 2 represents the results of the pretest and the post-test of speed. The *t* score of -0.9403 indicates that the change in speed was not significant at either the .05 or the .01 level of significance.

Table 2

t-Table for the Results in Speed Test

Group	df	SD	Mean	*t*
Pretest	23	30.0148	604.1667	-0.9403
Post-test	23	24.3531	596.5833	

t-value needed with 46 degrees of freedom at .05 level of significance is 2.021

t-value needed with 46 degrees of freedom at .01 level of significance is 2.704

In Table 3, variables one and two are the pretest and post-test of the right leg curl exercise. The

correlation value of 0.5651 indicates a significant relationship between the pretest and post-test at the .01 level of significance.

Variables three and four are the pretest and post-test of the left leg curl exercise. The correlation value of 0.6056 indicates a significant relationship between the pretest and post-test at the .01 level of significance.

Variables five and six are the pretest and post-test of the right leg extension exercise. The correlation value of 0.5042 indicates no significant relationship between the pretest and post-test at the .01 level of significance. However, a significant relationship was indicated at the .02 level of significance.

Variables seven and eight are the pretest and post-test of the left leg extension exercise. The correlation value of 0.7044 indicates a significant relationship between the pretest and post-test at the .01 level of significance.

Variables nine and ten are the pretest and post-test measures of speed used in this study, the forty-yard dash times. The correlation value of 0.7690 indicates a significant relationship between the pretest and post-test at the .01 level of significance.

In summary of Table 3, all of the correlations between pretests and post-tests of strength indicated a significant relationship at the .02 level of significance and all but one of them indicated a significant relationship at the .01 level of significance. The correlation between the

pretest and post-test of the forty-yard dash times also indicated a significant relationship at the .01 level of significance in speed.

Table 3

Correlation between Pretest and Post-Test Scores

Variables	Correlation	Level of Significance
1 v 2	0.5651	.01
3 v 4	0.6056	.01
5 v 6	0.5042	.02
7 v 8	0.7044	.01
9 v 10	0.7690	.01

A correlation value of .462 was necessary to be significant at the .02 level of significance with 23 degrees of freedom

A correlation value of .505 was necessary to be significant at the .01 level of significance with 23 degrees of freedom

Table 4 indicates the mean gains between pretests and post-tests of both strength and speed, as well as the mean gain in each area tested.

Table 4

Summary of Pretest and Post-Test of Strength and Speed

Event	Pretest Mean	Post-test Mean	Mean Gain
Right Leg Curl	37.6 pounds	48.3 pounds	10.7 pounds
Left Leg Curl	40.0 pounds	47.2 pounds	7.2 pounds
Right Leg Extension	44.0 pounds	69.4 pounds	25.4 pounds
Left Leg Extension	45.0 pounds	68.3 pounds	23.3 pounds
40 yard-dash	6.04 sec.	6.00 sec.	.04 sec.

Chapter 5

SUMMARY, FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

SUMMARY

The purpose of this investigation was to make a comparative study of the effects of a specialized weight training program for the development of the lower limbs on leg strength and speed. It was also the investigators intention to look for a possible correlation between the two changes.

Prior to the weight training program, the group of twenty-five high school boys were given the previously described test for strength and the forty-yard dash tests for speed.

The group trained with the specialized weight program for a twenty minute period three days a week for six weeks in addition to a regular scheduled physical education activity program. At the completion of the weight training period, the subjects were administered the post-test for strength and the forty-yard dash test for speed.

The t test of significance was used as the statistical computation.

FINDINGS

The findings of this study follow:

1. The group showed significant increases in strength at both the .05 and the .01 level of significance.

2. The group showed no significant increase in the forty-yard dash times at either the .05 or .01 level of significance.

3. Since there was no significant change in speed, there can be no correlation between the change in strength and the change in speed; however, a significant relationship was reported at the .02 level of significance.

CONCLUSIONS

Within the limits of this study the following conclusions are justified:

1. The specialized weight training program will improve the strength performance of the individuals lower limbs.

2. The specialized weight training program will not make a significant improvement in the speed of the individual.

3. There is no correlation, with this particular weight training program, between the change in strength and the change in speed.

RECOMMENDATIONS

The following recommendations are made for further study:

1. The training period of the weight training program may be extended up to twelve weeks.

2. Highly skilled or "known" performers are recommended as subjects for the training program.

3. It is recommended that the same test be administered to the same subjects six months from the date of completion of the study.

4. A larger sample group might effect the outcome of the specialized weight training program.

5. This study could be a more thorough investigation into or research study of other qualities that are possibly related to speed.

6. This study might be conducted in the spring in a more stable, warmer temperature. It would effect the results if all of the testing could be done inside, where temperature would be eliminated as a determining factor.

BIBLIOGRAPHY

Capen, Edward K. "The Effect of Systematic Weight Training on Power, Strength and Muscular Endurance," Research Quarterly, 21:83-94, May, 1950.

Chui, Edward. "The Effects of Systematic Weight Training on Athletic Power," Research Quarterly, 21:193-194, October, 1950.

Clarke, David H., and Franklin M. Henry. "Neuromotor Specificity and Increased Speed from Strength Development," Research Quarterly, 32:315-325, October, 1961.

Costill, David, S. J. Miller, and W. M. Hoffman. "Relationship Among Selected Tests of Explosive Leg Strength and Power," Research Quarterly, 39:785, October, 1968.

Fischer and Yates. Statistical Methods for Research Workers. Edinburgh: Oliver and Boyd Limited.

Hooks, Gene. Application of Weight Training to Athletics. Englewood Cliffs, New Jersey: Prentice-Hall, 1962.

Kennedy, Frank T. "Substitution of the Tensiometer for the Dynamometer in Back and Leg Lift Testing," Research Quarterly, 30:187, May, 1959.

Klafs, Carl E., and Daniel D. Arnheim. Modern Principles of Athletic Training. Saint Louis: C. V. Mosby Co., 1969.

Masley, John W., Ara Hairbedian, and Donald N. Donaldson. "Weight Training in Relation to Strength, Speed, and Co-Ordination," Research Quarterly, 24:308-315, October, 1953.

Murray, Jim and Peter V. Karpovich. Weight Training in Athletics. Englewood Cliffs, New Jersey: Prentice-Hall, 1956.

O'Shea, Patrick. "Effects of Selected Weight Training Programs on the Development of Strength and Muscle Hypertrophy," Research Quarterly, 37:95-101, 1966.

Reade, Robert and Louis E. Alley. "A Weight Training Program for Improving Speed of Charge of Football Linemen," Journal of the Coaching Profession, 7:11,15,24, April, 1962.

Wilkin, Bruce M. "The Effect of Weight Training on Speed of Movement," Research Quarterly, 23:361-369, October, 1952.

Zorbas, William S. and Peter V. Karpovich. "The Effect of Weight Lifting Upon the Speed of Muscular Contractions," Research Quarterly, 22:145-148, May, 1951.

APPENDIX

APPENDIX A. Parent Permission Slip

Topeka High School
December 1, 1971
Robert M. Gay

Dear Parent,

Your son has been chosen to take part in a study which will be conducted at Topeka High School during his regular physical education class. This particular study will be done to try and determine the effects of a six-week specialized weight training program on leg strength and speed. The students taking part in the study will work out on the universal gym equipment at school. They will be doing four leg exercises, which are generally used to help strengthen legs after knee injuries have occurred. The participants will be tested at the beginning and at the end of the six-week program. The forty yard dash will be the measure of speed.

I am conducting this study as partial fulfillment for my Master of Science in Education degree for Kansas State Teacher's College of Emporia.

Your son's help in this study will be greatly appreciated. If you have any questions, feel free to call me either at school, CE 2-0483, Ext 73, or at home, 862-2412. Thank you for your help in this matter.

Thank you,

Robert M. Gay
Boys Physical Education
Instructor,
Topeka High School

- -

My son, _____, has my permission to participate in the specialized weight training program being conducted at Topeka High School by Mr. Robert M. Gay. I understand this study will take place over a six-week period.

_____
(Parent's Signature)

APPENDIX B. Program Card

NAME_____ DATE OF BIRTH_____ PRESENT AGE _____

CLASS JR. SR. WT._____ HT._____

PROGRAM	PRETEST	1 WEEK	2 WEEK	3 WEEK	4 WEEK	5 WEEK	6 WEEK
RIGHT LEG CURLS							
LEFT LEG CURLS							
RIGHT LEG EXTENSION							
LEFT LEG EXTENSION							
RIGHT LEG AWAY ABDUCTION							
LEFT LEG AWAY ABDUCTION							
RIGHT LEG IN ADDUCTION							
LEFT LEG IN ADDUCTION							

PRETEST DATE_____ TIME_____
HAM-STRINGS R_____ L_____
40 YD. DASH_____ DATE_____ TIME_____ WEATHER_____
STANDING START_____ SPRINTERS START_____ TEMP_____

POST-TEST DATE_____ TIME_____
HAM-STRINGS R_____ L_____
40 YD. DASH_____ DATE_____ TIME_____ WEATHER_____
STANDING START_____ SPRINTERS START_____ TEMP_____

APPENDIX C. Exercise Techniques (Figures 1-9)

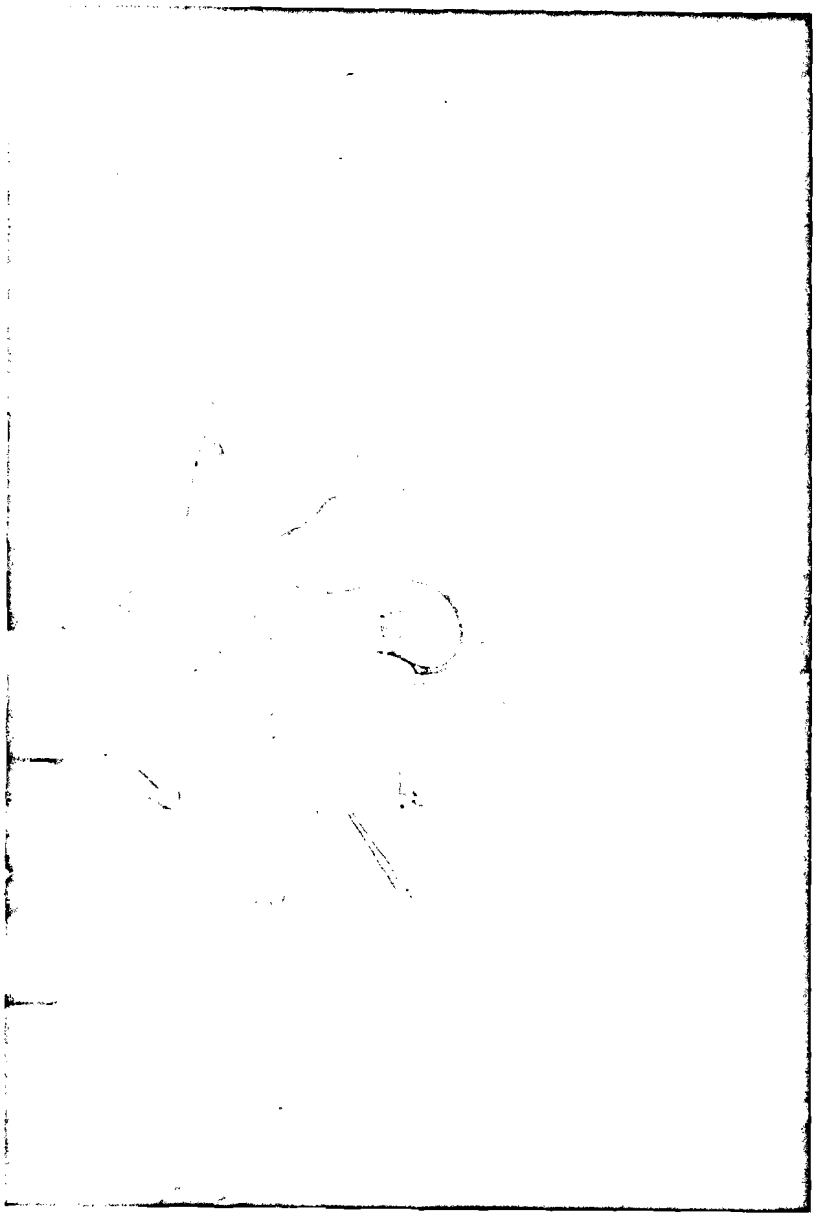

Figure 1

Right Leg Testing using Cable Tensiometer
in Prone Position on Knee Machine
of Universal Gym

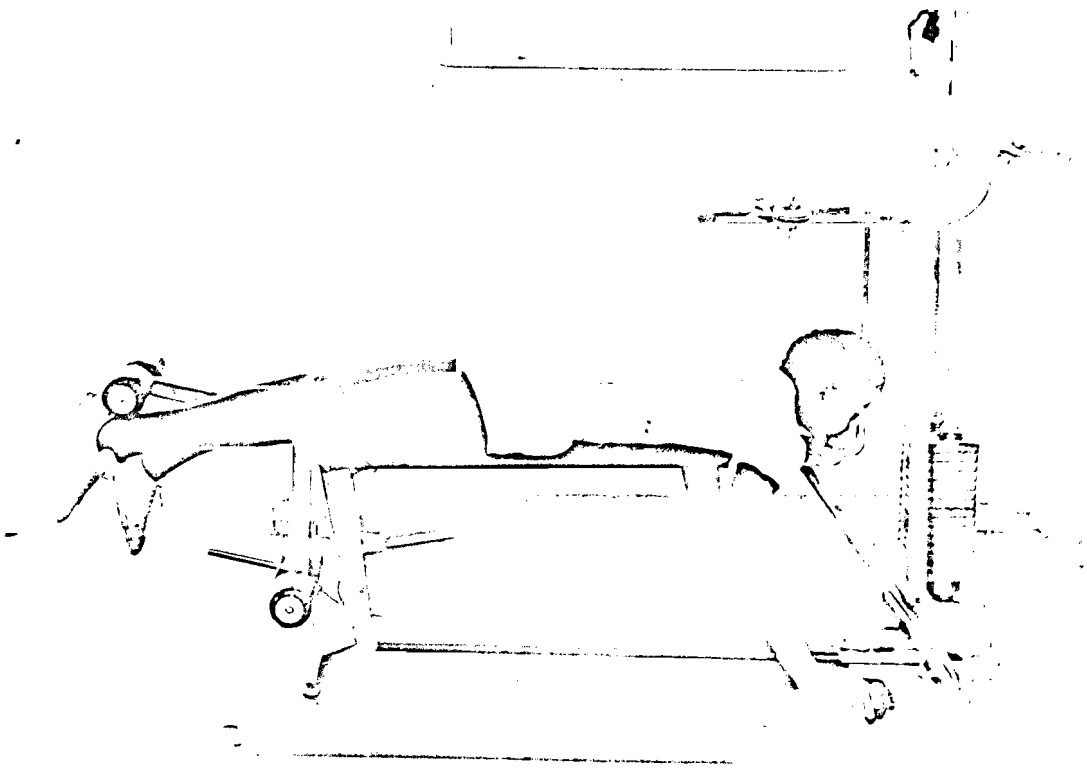

Figure 2

Right Leg Curl

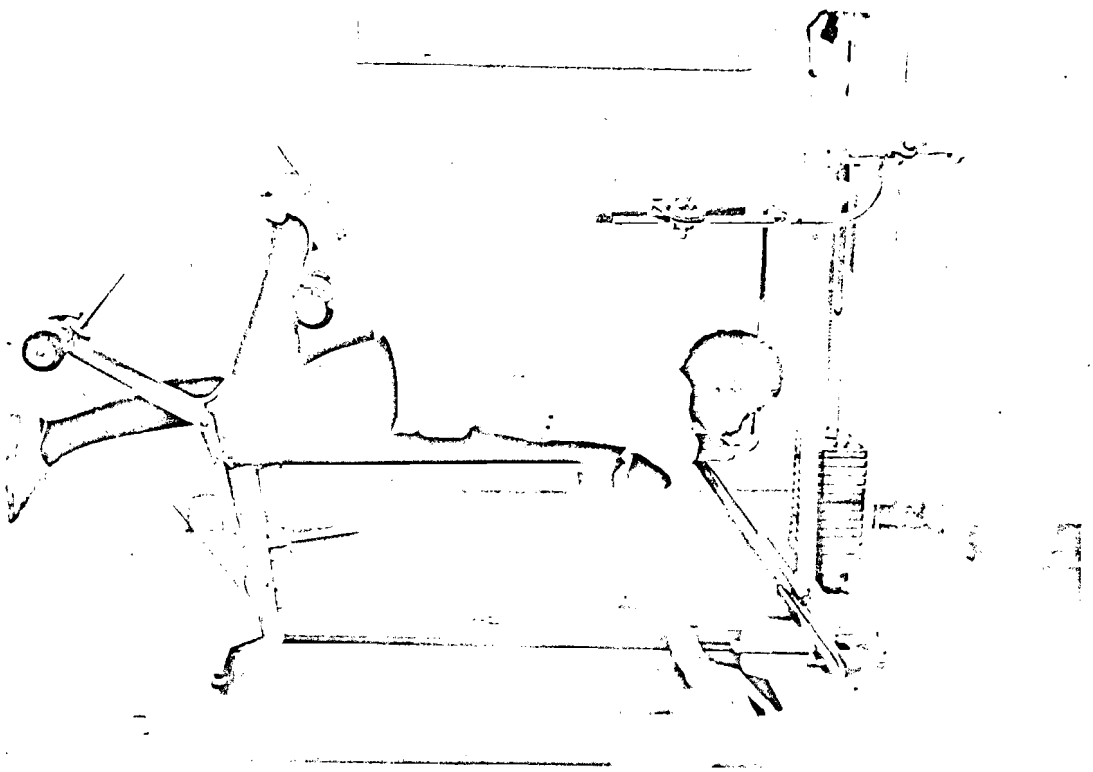

Figure 3

Right Leg Curl

Figure 4

Left Leg Extension

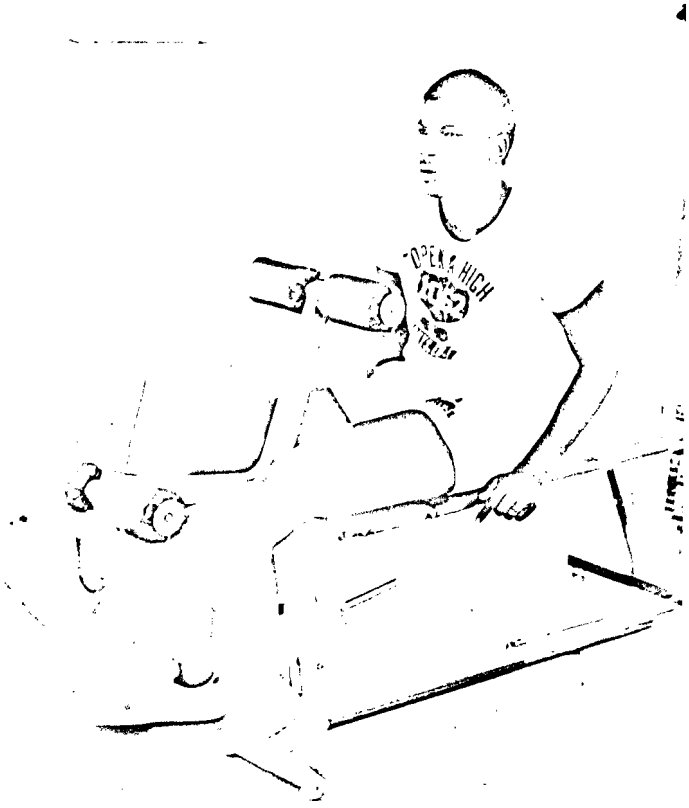

Figure 5

Left Leg Extension

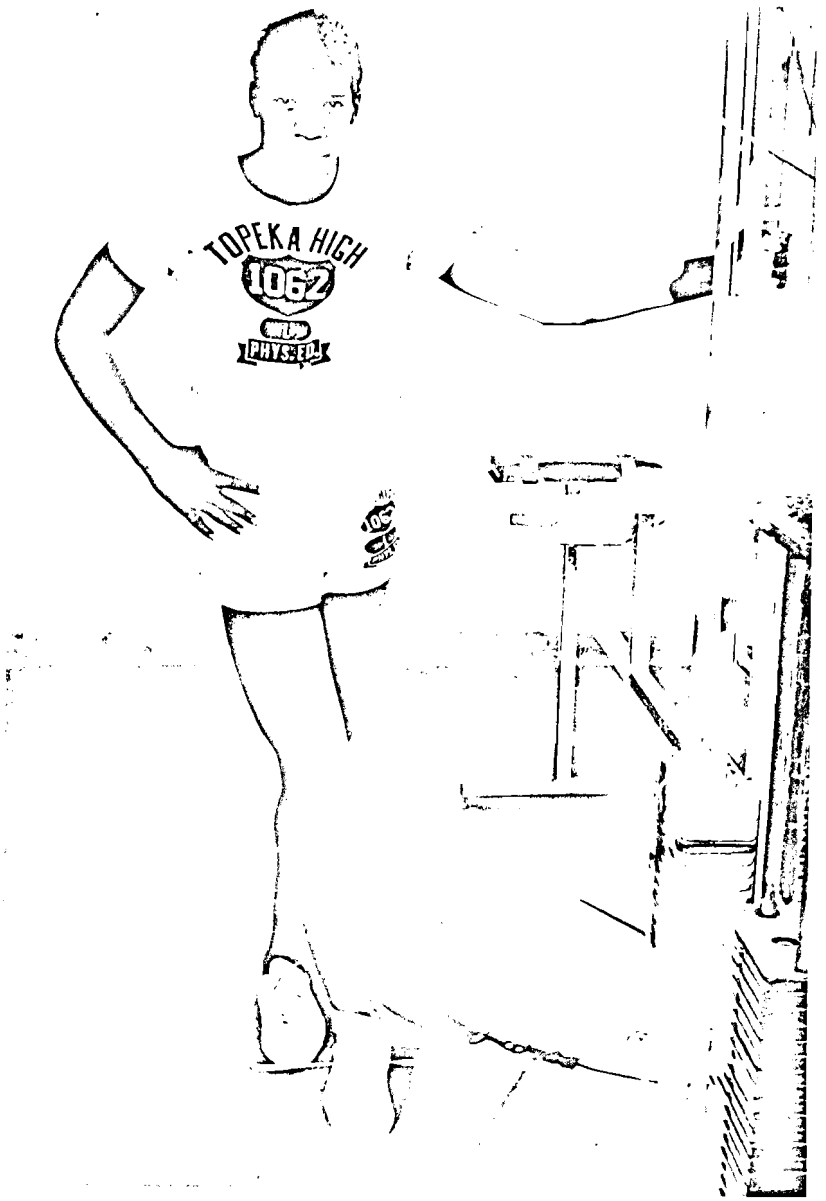

Figure 6

Right Leg Abduction

Figure 7

Right Leg Abduction

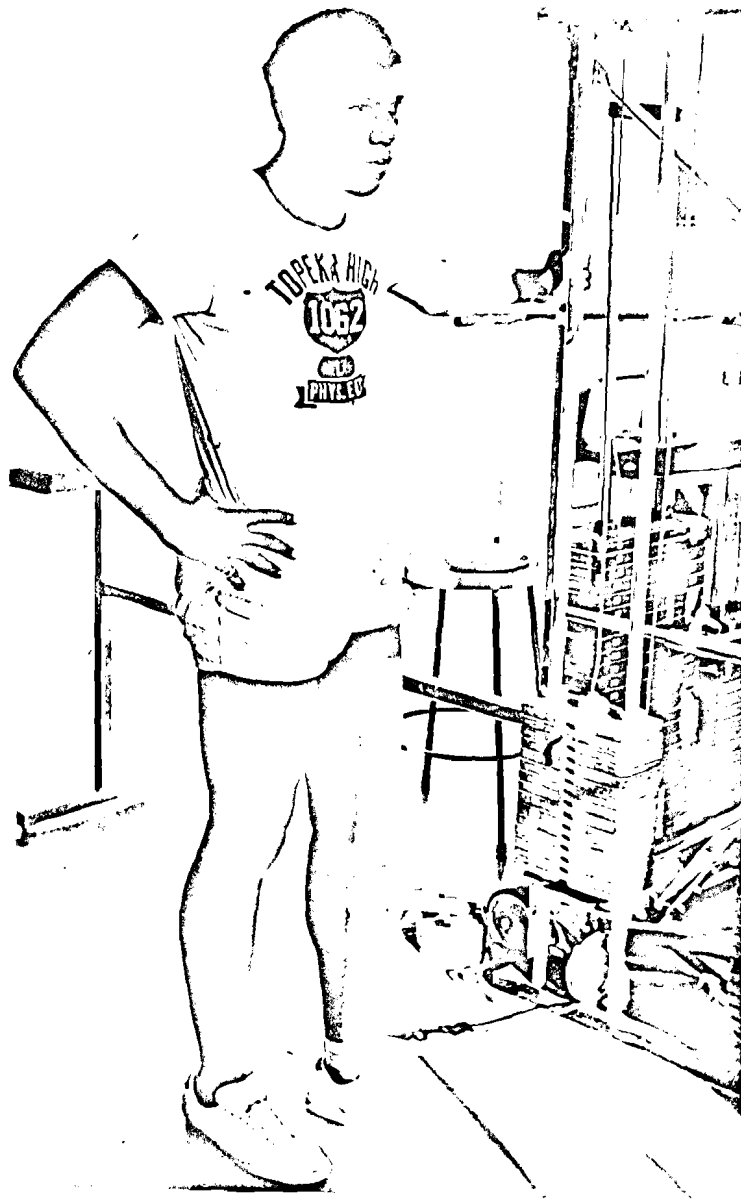

Figure 8

Left Leg Adduction

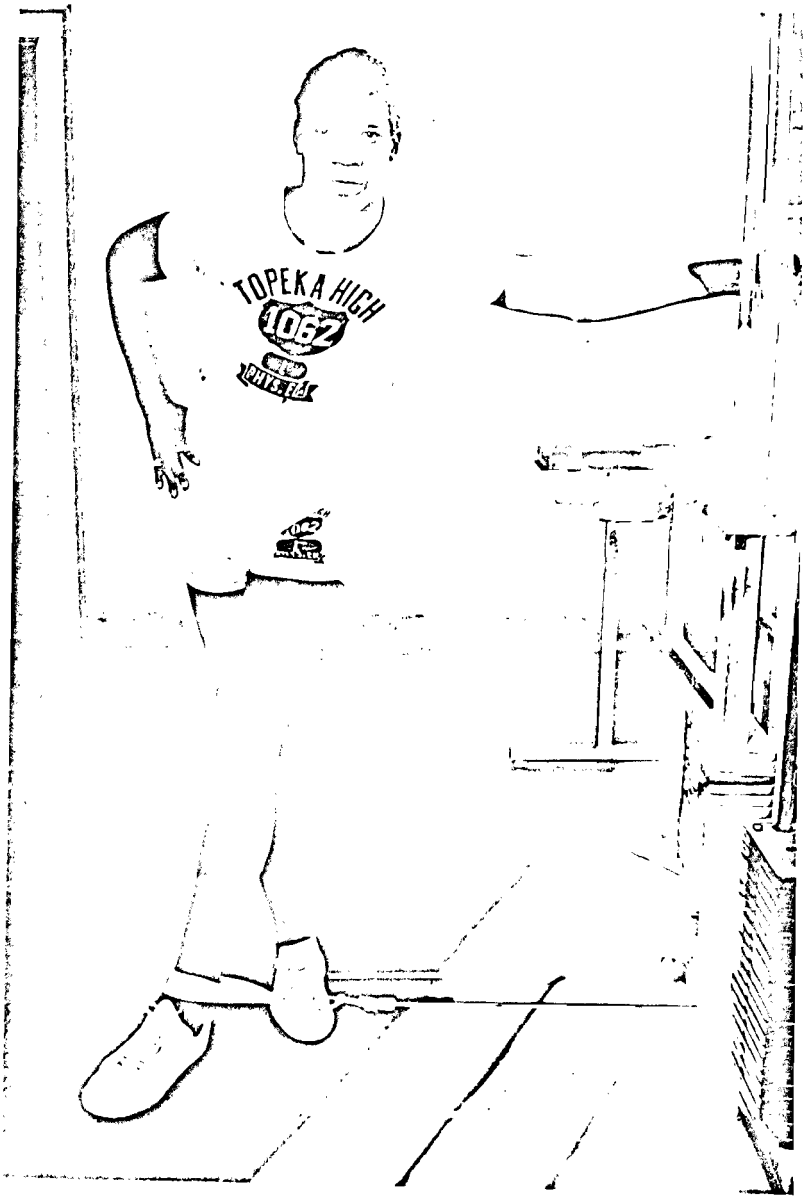

Figure 9

Left Leg Adduction