A COMPARISON OF TWO PROGRAMS OF WEIGHT TRAINING UPON VERTICAL JUMP PERFORMANCE OF COLLEGE MALES

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CHAPTER I

INTRODUCTION

In the fields of physical education and athletics, there is a definite need for improving and measuring muscle strength. For excellence to be achieved in an athletic skill, muscle strength and its qualities must be improved. In the last decade two weight training programs, isometrics and isotonics, have emerged as being of great value for this strength improvement. Many experiments have been conducted that compare the effects of these two weight programs and several studies have concluded that isometric and isotonic training were not significantly different in their capacity to increase strength. However, all these studies have shown that both types of training improve strength.

To measure strength and specifically to measure leg strength, perhaps the oldest and most accurate method is the vertical jump. However, there have been relatively few studies that have dealt specifically with attempting to improve the vertical jump. Most studies have used the vertical jump as a measuring method for leg strength and have not been concerned with the specific muscles involved in performing this basic skill.

I. THE PROBLEM

Statement of the problem. The purpose of this study

was to investigate the effects of two programs of weight training upon the vertical jump performance of college males. Specifically this study investigated the (1) effect of training with the Exer-Genie machine upon leg strength, (2) the effect of the isometric training program upon leg strength, and (3) the comparative effects of the two programs of exercise.

II. DEFINITION OF TERMS

Big two. This was an exercise done with the Exer-Genie and is a combination squat and dead lift. Starting with the squat the legs of the subject are bent at a forty-five degree angle with the back straight, head up, and weight placed on the balls of the feet. From the squat position the ten second isometric is performed and the dead lift is started. (See Appendix). When this exercise is finished the subject should be on tiptoes with knees and arms straight. Emphasis should be placed on lifting with the legs, not the back.

Exer-Genie. The Exer-Genie is a machine that provides a method to start an exercise isometrically, to get the full benefit of the contraction, and then when the muscle is tired it goes through a complete isotonic movement against maximum resistance.

Ham exercise. This exercise was used with the Exer-Genie. It has the most effect upon the ham string, calf muscle, and lower back area. It is performed while lying on the back, with the foot placed in the handle grip of the Exer-Genie. (See Appendix). With the toe pointed and the knee locked, the ten second isometric is performed. The rope is then extended straight out and down away from the Exer-Genie.

Isometrics. Maximum muscle tension without muscle movement.

Isotonics. Maximum muscle tension with muscle movement.

Leg press. An isometric exercise performed while lying flat on the back, legs flexed at a forty-five degree angle, balls of the feet against the bar and pressing upward, for the ten second time period. (See Appendix).

Military press. An isometric exercise performed in a standing position, the shoulders placed against the bar, with the legs at a forty-five degree angle. (See Appendix). Emphasis was placed on shifting the weight of the body to the balls of the feet and pressing upward for the allotted ten seconds.

Quadra exercise. An Exer-Genie exercise accomplished by lying flat on the back with the rope around the ball of the foot and the leg in a doubled up position as if a high step was being taken. (See Appendix). After the ten-second isometric the leg is pushed straight away from the Exer-Genie.

Squat. An isometric exercise performed with the subject facing the bar, required the legs to be flexed at a forty-five degree angle and the hands placed upon the bar. (See Appendix). With the weight on the balls of the feet, press upward for the allotted ten-second time period, with emphasis on lifting with the legs, keeping the back straight and using proper breathing procedure.

Vertical jump. The vertical jump is a vertical leap into the air that is primarily a test of the ability of the body to develop power in relation to the weight of the individual.

CHAPTER II

REVIEW OF THE LITERATURE

There is much controversy today in the area of physical education and athletics about which methods of exercise are most beneficial in the development of muscle strength. It has been found that by doing isometric and isotonic exercises there is more of an increase in leg power than in the height of the vertical jump.

Leg power is defined by Burley and Anderson as "force times velocity". In the jump and reach test the power generated is dependent upon the amount of force applied and the speed with which it is applied. The distance jumped in the test will be determined by the amount of power which the individual can generate in relation to his weight, influenced to some extent by his coordination.[1]

There are many ways to build power and strength in the leg. Some of the most widely used methods are calisthenics, isotonic and isometric exercises, and the Exer-Genie machine.

Not many evaluations have been written specifically on programs of this nature. However, through investigations

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[1]Lloyd R. Burley and Ray Leonard Anderson, Jr., "Relation of Jump and Reach Measures of Power to Intelligence Scores and Athletic Performance," Research Quarterly, XXVI (March, 1955), 28.

of several sources, a review of literature concerning the vertical jump will be provided. This review will be found on the following pages and is divided into four specific areas: (1) vertical jump, (2) Exer-Genie, (3) isometrics, and (4) isotonics.

Literature concerning the vertical jump. Roloff, in measuring muscular power stated that jumping activities have been reported in literature as an accepted means of measuring power. The type of jumps used included the running and standing broad jumps for distance and the high and vertical jumps for height. Scores of these jumps were usually measured in units of distance or height achieved. In some cases this score was used to indicate the ability of the jumper to develop power relative to the weight of his body. The formula below illustrates the definition of power; that is, the rate of doing work.[2]

$$\text{Power} = \frac{1 \text{ body weight} \times \text{height or distance jumped}}{\text{time required to jump}}$$

In a research project by Van Dalen, in an attempt to study the validity of the Sargent jump as a test for

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[2]Harvey J. Roloff, "An Analysis of a Tentative Battery of Tests Selected to Measure Power, Work, and Motor Fitness in Relation to an External Criterion and Internal Criterion of Motor Fitness Aspects of Physical Fitness" (unpublished Master's thesis, University of Oregon, 1948), p. 9.

measuring the ability to develop power, senior high school boys were used as the subjects. They were taught the skills of six different forms of a vertical jump and were then tested in each of these forms. The tests are:

1. The vertical jump as defined in the terms.

2. The vertical jump with weights; this jump would use the same directions as in the vertical jump with the exception that they carried one-half pound dumbbells and a pound and a half dumbbells in their respective jumps.

3. The jump and reach; the individual was instructed that only the free arm be swung downward to the side as the top of the jump is approached.

4. The chalk jump; same as the vertical except that the jumper is to keep his free arm at his side while executing the jump.

5. The wall jump; the jumper faced the wall and kept his free arm at his side while executing the jump.

6. The belt jump; both arms are to be kept at his side while the jumper executes the jump.

The results were taken and applied to a classification index and a correlation index. Van Dalen made the following conclusion: "From the results presented, it would definitely indicate that the vertical jump, when standardized, practiced, and correctly administered is undoubtedly a valuable

test for predicting the ability to develop power."[3]

Smith designed a study to investigate the dynamometer as a measurement of leg strength as compared to the vertical jump. The leg strength of seventy college men was measured in a position designed to involve the power thrust of the major muscle group used in the vertical jump.[4] The key muscles in the vertical jump are the knee extensors (quadriceps femouris), ankle extensors (gastrocnemius solius), and the extensors of the hips (gluteus maximus). The flexors of the great toes (flexor hallucis longus) provide the final push off of the jump.[5] The subjects in Smith's study performed a modified vertical jump that used no arm snap. Although the reliability of all measurements was high, individual differences in the ratio of tested strength to body mass showed only a low and nonsignificant correlation with jumping performance. It was concluded that the vertical jump is a superior test because strength exerted against a

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[3]Deobold Van Dalen, "New Studies in the Sargent Jump," Research Quarterly, XI (May, 1949), 112-115.

[4]Leon E. Smith, "Relationship Between Explosive Leg Strength and Performance in the Vertical Jump," Research Quarterly, XXXII (October, 1961), 405.

[5]Gene Hookes, Application of Weight Training to Athletics (Englewood Cliffs, New Jersey: Prentice Hall, Inc.), p. 141.

dynamometer involves a different neuromotor pattern than strength exerted by the muscles during a movement.[6]

Literature concerning the Exer-Genie. The Exer-Genie is a resistive-exercise program based on the overload principle. The first step is to tire the muscle and step two is to make the tired muscle move through a complete range of motion. Isometrics are used to tire and strengthen the muscle and isotonics are used to build flexibility and endurance.[7]

The Exer-Genie consists of an alloy shaft, continuous filiment nylon rope, hardwood handles, and a metal sleeve that fits over the shaft and rope. The rope is wound around the shaft by turning the cylinder. It is the friction of the nylon rope being pulled around the shaft that creates the highly accurate resistance. The metal sleeve has holes placed in strategic positions and it is calibrated. Quickly and easily the exerciser can be manipulated so that the resistance can be dialed anywhere from no ounces to over four hundred pounds of resistance.

It is the contention of Glenn Tuckett, baseball coach at Brigham Young University that an optimum program should have three integral areas: (1) isometric contractions,

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[6]Smith, loc. cit.

[7]Arnie Friedman, "Wizard Muscle Maker for Conejo's Gridders," The News-Chronicle, August 7, 1966, p. 4.

(2) isotonic movement, and (3) functional overload. When he was first introduced to the Exer-Genie at the 1965 American Association of College Baseball Coaches' Convention in Chicago, he realized the machine could duplicate these three integral areas of his program in much less time.

For Coach Tuckett's program a six-station circuit was set up and it was found that the entire squad of thirty-five players could complete their workout in less than thirty minutes. Each exercise was performed three times with a ten second isometric contraction to begin each exercise. The workout was done in pairs, thus allowing for periods of recuperation and guaranteeing that each player would be working against maximum resistance.[8]

An experiment conducted by McKinney and Logan was concerned with the effect of resistance through a throwing range-of-motion on the velocity of a baseball. Members and potential members of the varsity baseball team were used as subjects.

Each subject was initially tested on the velocitimer, which measured the speed of the thrown baseball. The subjects were divided into three groups with the average speed per group being as near equal as possible.

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[8]Glenn Tuckett, "A Revolution in Body Conditioning," Coach and Athlete, (March, 1966), 31.

Group I pulled the ball through the Exer-Genie thirty times a day, five days a week, for six weeks. Group II threw a baseball thirty times a day in the regular throwing motion, not using the Exer-Genie. Group III did nothing other than take the first and last tests.

After the final test, Group III had shown virtually no change in throwing speed - from 75.159 miles per hour to 75.206 miles per hour. Group II had increased its speed from 75.895 miles per hour to 78.842 miles per hour. Group I had upped its speed from 75.895 miles per hour to 84.001 miles per hour.

It should be explained that the velocitimer is set up for exactly one-fourth of the regulation pitching distance, so the speeds would be faster than a ball pitched from a mound because of the slowdown by gravity over the full sixty feet six inches. The two investigators merely took the time and multiplied by four, hence the first fifteen feet, and the fastest part of the throw was used.

In contrast to the belief that the Exer--Genie may build up the speed of only slower subjects, it can be noted that the leading winner on the varsity staff last season and a hard-thrower, was able to increase his speed and threw two throws on the final test which were measured at 103.159 miles per hour. His average was 95.732 miles per

hour and these figures show than even a hard thrower improved.[9]

Due to the understanding of the physical needs of athletes, basketball players in particular, and because the Exer-Genie device can be used to isolate muscles and groups of muscles, an exercise program was set up by Fred Lewis, basketball coach at Syracuse University. The program was mandatory for every player and was carefully supervised.

The areas or parts of the body that were to be developed were the legs, abdominal muscles, back muscles, the upper shoulder girdle, and the arms with special emphasis on the triceps and the hands and fingers. The groups of muscles used in jumping were also isolated and a special exercise was set up to strengthen the feet, calves, and buttocks.[10]

Five specific exercises were executed by each player. Three repetitions of each set of exercises at each individual's maximum capacity were required. To avoid the time needed to readjust the resistance that would work each

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[9]Dave Schulty, "Exer-Genie Gives Fast Ball Boost," Sunday News and Leader (Springfield, Missouri), January 9, 1966, p. 42.

[10]Fred Lewis, "A Dynamic Approach to Body Conditioning," Athletic Journal, XLVI (June, 1966), 35.

individual to his capacity, each Exer-Genie in the circuit was set at twenty pounds resistance. Then, by working in pairs or using the buddy system, one player would exercise and his partner would handle the trailing rope controlling the amount of resistance needed to make him work at his capacity. The five exercises were: (1) Lats pull (latissimus dorsi), (2) Triceps pull (triceps), (3) Big four (all major muscle groups), (4) Sit-ups (abdominal), and (5) Rowing (all major muscle groups).

All of these exercises were executed in the following manner. The exercising player would assume the starting position for the specific exercise and start isometrically for ten seconds. His partner would secure the trailing rope. At the signal to start, ten numbers would be counted off. The exercising player was encouraged to hyperventilate (most people have a tendency to hold their breath while executing the isometric hold). At the count of ten, the exercising player would move isotonically through a full range of motion completing the exercise. The partner controlling the trailing rope would offer enough resistance so that the exercising player would be working at his full capacity.

After all the players completed the five sets at three repetitions, a regular practice session was held. At the conclusion of the practice period, the day's work would be finished by running against the fifty-foot long

line rope. Each player ran three trips forward, alternating with his partner and following the interval technique of training. Then he would run three trips backward, then three trips sliding in the defensive stance to the right, and finally three trips sliding in the defensive stance to the left. The coaches knew how hard the players had worked because they had set the resistance.

Through experimentation, shortly after the season began, another drill was discovered that increased the players' vertical jumping ability as individuals and as a team. By hooking the Exer-Genie by means of an "S" hook to the floorplate of the gymnasium floor, and using the long line rope and harness, the players put the harness on from the front allowing the rope to go down through the device and be controlled by the exercising player's partner. Taking a wide stance in a three-quarter squat position, the players would start isometrically for a count of ten, then rise to a straight leg position, and eventually all the way up to a full toe rise. At the same time, they would move their arms up and over their heads in a manner resembling a slow motion rebounding drill. This set was also repeated three times.[11]

As a result of the above exercises, Fred Lewis makes the following comment:

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[11] Ibid., 36.

> Some of our players improved their vertical jump as much as three inches in a four-week space of time they spent working with Exer-Genies. During four weeks of training before the 1965-66 basketball season, the players wore harnesses connected to Exer-Genies and practiced jumping against the resistance from the device.[12]

Literature concerning isometric exercise. Baley conducted a study using 104 male college students enrolled in physical fitness classes. The subjects participated in a four and one-half week program of isometric exercise done with an adjustable nylon belt which was stabilized against various body segments. The Monday, Wednesday, and Friday classes met for thirty minutes of isometric exercises for twelve class meetings. These classes were compared to the Tuesday and Thursday classes which met for sixty minutes with a total of eight class meetings. They did the same isometric program but in addition did stretching exercises and ran a mile.

It was concluded that the classes which did only isometrics for half an hour three times each week for four and one-half weeks made greater gains in the vertical jump than did the classes which met for the sixty-minute period twice a week for four and one-half weeks.

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[12]James E. Bylin, "More Pro Athletes Keep in Shape Toiling on Tiny 'Exer-Genie'," The Wall Street Journal, September 2, 1966.

The group meeting three times a week had an initial mean score of 20.8 inches (difference between standing reach and height of the vertical jump) and a final mean score of 22.1 inches. The mean difference was 1.3 inches and was significant at the .025 level. The group meeting two times a week had an initial mean score of 20.2 inches and a final mean score of 21.0 inches. The mean difference was .8 inches which was significant at the .10 level. Both groups showed a significant difference in initial scores and final mean scores but the mean difference scores of the two groups did not differ significantly.[13]

In another study sixty-three college men were divided into two equated groups on the basis of their initial ability to exert isometric force upward against shoulder pads of a specially constructed device. The experimental group trained on an overhead isometric apparatus three times per week for a six-week period exerting one maximum isometric effort of ten-second duration. The apparatus was designed to fit accurately on the shoulders and was adjustable to all heights. The control group did not participate in any type of training. Both groups were measured in the vertical

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[13]James A. Baley, "Effects of Isometric Exercises Done With a Belt Upon the Physical Fitness Status of Students in Required Physical Education Classes," Research Quarterly, XXXVIII (October, 1966), 291.

jump before the training started and again at the conclusion of the six-week period.

Prior to the strength test on the first and final days, three to five jumps were made by each subject, using the vertical jump meter (apparatus for measuring maximum effort of vertical movement). Three jumps were used except in those cases where some inconsistency in the three measures was found; in these cases two additional jumps were used to establish the maximum with certainty. The results of each of these jumps was recorded. The maximum jump in the initial test and in the final test were taken as the subjects' scores.

At the end of the six week period the experimental and control groups were again tested under identical conditions as at the beginning of the experiment. The two groups were tested both on maximum force exerted and maximum jump. The results were: the experimental group gained significantly in ability to exert force, having a mean of 391.2 pounds at the beginning and a final mean of 469.9 pounds. The scores of the control group did not change significantly. Under this experiment, gains in ability to exert isometric force as a result of isometric training were not accompanied by an increase in vertical jumping ability.[14]

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[14]Jerry R. Ball, George O. Rich, and Earl L. Wallis, "Effects of Isometric Training on Vertical Jumping," Research Quarterly, XXXV (October, 1964), 231.

In a study utilizing eighty-one volunteer male students enrolled in the service program of the School of Physical Education, two programs of weight training were investigated. The subjects were divided into groups according to the classes in which they were enrolled. The static group had thirty subjects, the isotonic group had twenty-four subjects and the control group had twenty-seven subjects. The two experimental groups were excused from tennis classes to participate in the study. The control group was not excused from tennis class since it was not considered an activity which might influence the outcome of the study.

The study consisted of an eight week period, which was utilized as follows: one week of pre-testing, six weeks of exercise, and one week of post-testing.

The control group participated only in the pre-test and post-test. The experimental groups exercised two times weekly with intervals of one and four days between periods. For the isotonic exercises the subject was seated on a table between two parallel steel shafts which were connected at the upper end. The connecting shaft rested in an insert bearing incased between two boards. The boards were attached by steel straps to the corner edge of a testing table and an adjustable steel rod was welded on each shaft for placement of the weight and to provide the subject a lifting surface. The weighted arm shaft had a friction

clutch to simulate the traditional method of exercising with an iron boot. The right foot was placed under the padded lifting rod connected to the lever arm. The rod was adjusted so it crossed the foot at the malleolus. The exercises consisted of lifting a weight from ninety to 180 degrees for ten maximal repetitions. In order to give the muscle maximum load, an increment of 1.5 pounds was added each exercise period.[15]

The isometric exercise was performed with a cable fitted with chain links attached for adjustment, which was fastened to a stationary strap. The cable ran perpendicular to the foot down to the floor and the chain links hooked to an iron hook in the floor. The exercise consisted of two six-second maximal contractions of the quadriceps, with a one munute rest interval between each contraction. The knee joint was held at a 165 degree angle. A tenseometer reading was taken during each contraction against the stationary strap in order to provide motivation for the subject and to indicate to the experimenter the intensity of the exercise. Strength of the right quadriceps, endurance of the right quadriceps, knee joint flexibility, and thigh girth measurement were the tests administered to each subject before and

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[15]George Morris Sullivan, "The Effects of Isotonic and Static Contraction of the Quadriceps on Strength and Endurance" (unpublished Master's thesis, Washington State University, Pullman, 1961), p. 31.

after the six week exercise program. Both static and isotonic knee strength was measured in tension-pounds being derived from a tenseometer reading. Endurance was measured by an ergograph in foot-pounds. The Leighton Flexometer was used in determining knee joint flexibility.

The static exercise group had a mean gain of seventy-six pounds in knee extension strength (tension pounds), while the isotonics group had a mean gain of forty-two pounds. The mean gain difference between the two exercise groups was thirty-four pounds. This gave a t ratio of 3.46 which is significant beyond the 0.01 level of confidence. The isotonic exercise groups had a mean gain of 540 foot pounds in knee extension endurance. The static group had a mean gain of 412 foot pounds. A mean difference of 128 foot pounds was found. The mean difference gave a t ratio of 2.39 which was significant beyond the 0.05 level of confidence.

A decrease was observed for both exercise groups in knee joint flexibility; however, the static exercise group's decrease was only slight. Although the two exercise groups showed some increase in thigh girth, it was not significant. The control group did not show any significant increase or decrease in any of the test items.

Mean differences of the static and isotonic groups were compared in strength and endurance. The static exercise

group showed a gain in strength over the isotonic group which was significant beyond the 0.01 level of confidence. However, the isotonic exercise group showed an endurance gain over the static exercise group which was significant beyond the 0.05 level of confidence.[16]

The conclusions were:

(1) Two consecutive six-second static contractions of the quadriceps twice weekly, for a six week period, produced significant gains in strength and endurance, and a significant loss in knee joint flexibility.

(2) The maximal isotonic contraction of the quadriceps twice weekly for a six-week period produced significant gains in strength and endurance, and a slight loss in knee joint flexibility.

(3) The subjects performing static exercises showed significantly better gains in strength than subjects performing isotonic exercise.

(4) The subjects performing isotonic exercises showed significantly better gains in endurance than subjects performing static exercise.[17]

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[16] Ibid., pp. 43-44.

[17] Ibid., p. 45.

The purpose of a study done by Berger and Henderson was to determine whether static or dynamic leg strength was more highly related to leg power.

Sixty-six male students enrolled in physical education weight-lifting classes were used as subjects. The average weight was 163 pounds and the standard deviation was thirty pounds. Three different tests were used: a dynamic leg strength test, a static leg strength test, and a leg power test. In order to control for the improvement in strength expected from taking the tests, the tests were administered in four different sequences. The sequences were as follows: (1) static strength, dynamic strength, and power; (2) power, static strength, and dynamic strength; (3) power, dynamic strength, and static strength; and (4) dynamic strength, power, and static strength. Each sequence of tests was followed by approximately one-fourth of the subjects and was administered during a fifteen day period.

The equipment for the static strength test was a standard leg dynamometer that was used to measure static leg strength. The starting position was to be seated with the back against a wall and the upper legs parallel to the floor. The feet were spaced about twelve inches apart and flat on the floor. In this position a leather strap was placed behind the neck and secured to the handle of the dynamometer. The length of the dynamometer chain was

adjusted so that the proper testing position could be maintained. The subject attempted to rise vertically keeping the back and shoulder against the wall. The subject was instructed not to begin with a sudden jerk but to exert a steady, even force.

The subjects warmed up by performing about twelve squats without weights before taking the test. Two trials were given, with a thirty second rest between trials, and the best score was recorded. To acquaint subjects with the correct performance of the tests, two practice trials were given two days prior to actual testing.

For the dynamic strength test the position was similar to that in the static strength test. The subject assumed a squatting position with the upper legs parallel to the floor and the feet shoulder width apart. A barbell was held behind the head and rested on the shoulders. From this position the subject attempted to extend the legs and attain a standing position.

Prior to the actual testing the subjects were instructed in the proper method of performing squats. Subjects were asked to determine as closely as possible the greatest amount of weight they could lift one time from a squatting position. Two thirds of this amount was used as the starting point during the actual testing. After each successful lift, weight was added, usually in ten pound increments. As the

subject approached his maximum lift, only five pounds were added to the bar.[18]

In the leg power test the subject stood sideways to a jump board with the preferred arm extended above the head and next to the board. The other arm was placed behind the back. The height of the extended hand was marked on the board while standing on tiptoe. Maintaining a straight back and the position of the arms, the subject adopted a full squat position. When stationary and balanced in this position, the subject sprang upward and marked the maximum height of the jump on the jump board by means of chalked fingertips. Each jump was scored to the nearest one-quarter of an inch.

Two days prior to the scheduled test all subjects practiced the power test. Each subject was required to jump several times in order to warm up the leg muscles before being tested. Three attempts were made and the best score recorded.

Static leg strength and dynamic leg strength were both related to leg power by the Pearson product-moment correlation coefficient in order to determine whether significant relationships existed. The two correlation

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[18]Richard A. Berger and Joe M. Henderson, "Relationship of Power to Static and Dynamic Strength," Research Quarterly, XXXVII (March, 1966), 10.

coefficients were then compared to determine whether they differed significantly from each other.[19]

The correlation coefficient found between static leg strength and leg power was .64, which was significant at the .01 level of confidence. A correlation coefficient of .71, which was significant at the .01 level was found between dynamic leg strength and leg power. These coefficients of .64 and .71 were analyzed to determine whether they were significantly different. Although dynamic strength appeared to be more highly related to power than static strength, the two coefficients were not found to be significantly different. Static leg strength was considered to be highly related to leg power as was dynamic leg strength. Although there was no significant difference in the relationship of static and dynamic strength to power, this would not indicate that static strength can be predicted with high accuracy from dynamic strength or vice versa. This was shown by the correlation coefficient of .60 found between static leg strength and dynamic leg strength which meant that the accuracy of prediction was only 36 per cent.[20]

From the results of the study the following conclusions were drawn:

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[19] Ibid., p. 11.

[20] Ibid., p. 12.

(1) Dynamic leg strength and static leg strength are both related to leg power.

(2) Neither dynamic leg strength nor static leg strength is more related to leg power than the other.[21]

Literature concerning isotonic exercise. In a study by Berger the effects of strength improvement on vertical jump ability was investigated. Four activity classes, consisting of eighty-nine male college students were employed in this study. Three classes participated in weight training and one class performed general conditioning skills. The three weight training classes consisting of twenty-nine, twenty, and twenty-one subjects were designed as Group I, II, and III. These groups were trained with a general program in addition to the experimental program. Group IV contained nineteen subjects who participated in a general condition program involving activities of running, calisthenics, weight training, and games. Group I trained dynamically with deep knee bends. One set was performed each training session using the 10-RM load for ten repetitions. It should be explained here that 1-RM is a load which can be lifted correctly one time only, using maximum muscular extension. When a subject was able to perform more than

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[21] Ibid., p. 13.

ten repetitions the load was increased to obtain the new 10-RM load.

Group II trained with the deep knee bend exercise by using 50-60 per cent of the 10-RM for ten repetitions of jumping squats once each training session. The 10-RM was determined every two weeks and adjustment made in training load.

Group III trained statically using two different positions of knee flexion. Position one was with the upper legs parallel to the ground and position two was with the legs flexed at approximately 135 degrees. A barbell was placed behind the neck and resting on the shoulders, as the subject attempted to extend the knees. The bar was secured so no upward movement was possible. One set was performed at each position every training session. A maximum contraction was held for six to eight seconds.

Group IV performed ten vertical jumps each session. Subjects in all groups trained for seven weeks, three times weekly, and were motivated to perform the exercise with maximum effort since they were told that part of their final grade was based on improved performance.

Before and after the seven weeks of training, vertical jumping height was recorded to the nearest .25 of an inch. The jumping height determined in this study was not the difference between reaching and jumping height but the

actual distance from the ground to the height jumped. This was done because of the greater ease in the administration of the test and the desire to determine only differences in jumping ability from beginning to end of training.[22]

The specific results of Berger's study show that only the groups that trained dynamically improved significantly in vertical jump. Group I, training with the 10-RM, showed an average improvement of .89 inches. Group II, using 50-60 per cent of 10-RM improved an average of 1.10 inches. Although static training indicated an improvement of .33 inches, in Group III, this amount was not considered significantly different from zero. The group that trained by jumping (Group IV) decreased significantly in vertical jump after seven weeks.[23]

Several studies have compared the strength improvement effects of various weight training programs, but training usually required the lifting of loads which were maximum for a designated number of repetitions. Only one study in this research, also done by Berger, has compared the effectiveness of increasing strength by reducing the

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[22]Richard A. Berger, "Effect of Dynamic and Static Training on Vertical Jumping," Research Quarterly, XXXIV (December, 1963), 420.

[23]Ibid., 421.

loads used in dynamic training so that maximum effort was not elicited every training session.

Berger compared two different weight training programs and found that training with 90 per cent of the 10-RM for ten repetitions twice a week and with the 10-RM once a week was just as effective for increasing strength as training with the 10-RM for ten repetitions three times weekly.

Other studies have compared different isometric training programs using various proportions of the 1-RM.

The purpose of Berger's study was to determine which proportions of maximum dynamic strength used in training were as effective for increasing strength as training with the 1-RM.

The following conclusions were drawn from the results of this study:

(1) Significant increases in strength will occur after two weeks of training twice weekly with two-thirds of the 1-RM, provided at least one maximum dynamic effort per week is performed or the third weekly training session is held.

(2) Training with two-thirds of the 1-RM for one set, three times weekly, will not increase strength in six weeks.

(3) Dynamic strength will not be reduced in six weeks of no training.

(4) The increase in strength resulting from a training program of one set with two-thirds of the 1-RM, twice weekly, and the 1-RM once weekly, is due primarily to the training with the 1-RM.[24]

Van Dalen (3) and Smith (4) in conducting studies which tested six different methods of the vertical jump concluded that the vertical jump was a very valuable test for predicting leg power.

When testing the Exer-Genie and its effect upon the velocity of a baseball, McKinney and Logan (9) found a significant increase. Lewis (10) stated that his basketball players increased vertical jump performance by three inches during a four-week period when using the Exer-Genie machine.

Baley (12) concluded that when testing isometrics for leg strength there was a significant improvement in vertical jump performance. Ball (13) found that by training with an overhead apparatus the experimental group significantly gained in ability to exert force but no significant gain was achieved in vertical jump performance.

Berger's (21,22) studies with weight training programs found that training with 90 per cent of the 10-RM for ten repetitions twice a week was just as effective as training with the 10-RM for ten repetitions three times weekly.

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[24]Richard A. Berger, "Comparison of the Effect of Various Weight Training Loads on Strength," Research Quarterly, XXXVI (May, 1965), 141-146.

CHAPTER III

PROCEDURES

The purpose of this study was to investigate the effects of two programs of weight training upon the vertical jump performance of college males. Specifically this study investigated the effect of training with the Exer-Genie upon leg strength, the effect of the isometric program upon leg strength, and the comparative effects of the two programs of exercise.

The study was conducted in Mason Gymnasium on the campus of The College of Emporia. Forty-six male students enrolled in a required physical fitness course were randomly divided into two groups; Group I was the Exer-Genie group and Group II was the isometric group. Both groups met for fifty minutes a day and performed three comparable exercises four times a week for five weeks.

Testing procedures included one week of pre-testing and demonstration, five weeks of training, and one week of post-testing. The pre-test and post-test scores were obtained by recording the best jump of three vertical jump performances.

The Exer-Genie group trained with nine Exer-Genie machines aided by three student supervisors and nine student instructors. The isometric group trained on three power

racks supervised by three student supervisors and one student instructor to keep time. These assistants were employed to insure correct performance of the exercises.

Nature of the class. The Physical Fitness classes at The College of Emporia are part of the physical education curriculum. These classes are electives and help to meet the physical education requirement for graduation from The College. The class used for this study met the last eight weeks of the second semester; four days a week, Monday, Tuesday, Wednesday, and Thursday; from 3:00 to 3:50 in the afternoon. The purpose of the class is to promote physical fitness and give the student an opportunity for participation in the Fitness Program which would give the students a fitness ranking in comparison to national norms.

Subjects. The subjects utilised for the study were students at The College of Emporia who were enrolled in Physical Fitness 113, Spring, 1967. In this particular class there were freshmen and sophomore students enrolled. All subjects were required to wear a physical education t-shirt, gym shorts, sweat socks, and gym shoes. For a valid random grouping of these subjects the students' class cards were used. They were shuffled thoroughly and placed in a large container. As each card was drawn the names were alternately placed in the Exer-Genie and isometric groups.

Facilities and Equipment. This study was conducted in Mason Gymnasium on the campus of The College of Emporia. In the Exer-Genie group the gymnasium located in the upstairs portion of the building was used. In setting up the three groups a total of nine Exer-Genie's were employed with three Exer-Genie's per group. In doing the ham and quadriceps exercises screw hooks were fastened into the baseboard of the floor into which the Exer-Genie machines were inserted. Gym mats were used for the subjects to lie on as they performed the exercise.

The isometric program was conducted in the downstairs portion of the gymnasium. Three power racks were built, one for each exercise. The racks for the military press and squat exercises were built outside but the rack for the leg press was built inside. This was done to insure some way to perform the exercises in case of bad weather. The power racks were constructed with holes drilled into the upright standards through which the bar was placed and then the holes were numbered. In this way each subject could place the bar into the same numbered hole without loss of time from day to day. The power rack for the leg press was a converted weight lifting station with a gym mat placed between the standards to give the subject support and comfort for his back. When doing the military press exercise the bar was wrapped in

sponge and two sets of football shoulder pads were employed to protect the subjects' shoulders.

A jump board was constructed of three-quarter inch plywood for testing the vertical standing jump. It was three feet and six inches long and eighteen inches wide; and was marked off in feet, inches, and half-inches. The face of the board was painted black with the inch marks indicated in white and the half-inch marks noted in red. On the back of the board two brackets were placed. The board was hung from a brace that extended away from the wall which also supported a basketball backboard. The bottom of this jump board was seven feet from the floor and the top was ten and one-half feet from the floor. By placing the board at this height the subjects would have ample room beneath the board to perform the jump correctly.

Initial Testing Procedures. The vertical jump ability was measured by the Vertical Jump test performed in the following manner. Both feet were placed shoulder width apart standing sideways to the board and the dominant hand with body powder placed on the finger tips, was next to the board. Subjects were instructed to crouch into a position which called for the legs to be flexed in about a forty-five degree angle and the weight balanced evenly on the balls of the feet. The arms were swung upward to aid in

propelling the body and a mark was to be made on the board at the highest point of the jump with the powdered hand. After the demonstration by one of the student supervisors each subject was given an experimental trial. When tested the subject was required to jump three times. All jumps were recorded and the best jump of the three was circled and used as the subject's vertical jump performance. For motivational purposes only, before the vertical jump test, each subject's right leg was measured around the quadriceps and gastrocnemius. The same procedure was followed in the final testing as was in the initial testing, with the exception of the demonstration of the vertical jump.

Training program. The Physical Fitness 113 class at The College of Emporia met for fifty minutes per day. The subjects that were in the Exer-Genie group at the start of the study took most of the allotted time to do the exercising but after learning how to work the machine the time was decreased to forty minutes. The isometric group took only about thirty-five minutes at the start of the study and decreased the time to twenty-five minutes by the end of the study. After each group had completed their exercises they were excused to leave in a group and no excess activities were allowed.

The procedures followed in the Exer-Genie section involved dividing the thirty subjects into three groups of

ten subjects each. Nine Exer-Genie's were used with three per group. Each group had three student instructors that helped regulate the resistance on the machine so that every subject could work their maximum on each exercise.

The program was set up according to weight with the ten heaviest in Group I, the next ten heaviest in Group II, and the ten lightest in Group III, with the heaviest man of each group doing the squat exercise first.

The Exer-Genie exercises were started promptly at 3:00 p.m. with the four heaviest men doing the squat exercise first, the next three on the quadra exercise, and the three lightest men performing the ham exercise. After completion of the exercise the subjects rotated to the left. By rotating, the machine was always dialed down until one revolution was completed. The diagram on the following page will illustrate the way in which the subjects were divided.

GROUP I

Squat	Quadra	Ham
X-Student Instructor	X-Student Instructor	X-Student Instructor
O (Heaviest man)	O	O
O	O	O
O	O	O
O		

XX-Student Supervisor

GROUP II

GROUP III

For the isometric group three stations were used. The first was the military press after which the subjects rotated to the squat exercise. The third exercise was the leg press and the rotation was then back to the military press. For operation of the program a student supervisor was assigned to every station, and a student instructor was to blow the whistle and keep the stop watch to time the subjects.

For ease and convenience all isometrics subjects were classified according to height; with this classification the parallel bars of the three power racks were moved continuously downward until one revolution was made. The ten tallest subjects performed the military press, the next ten in line were placed in the squat exercise, and the ten shortest were assigned to the leg press.

When the first whistle blew promptly at 3:00 it signaled the subjects to position themselves for the first exercise. The second whistle blew and the subjects were to begin the isometric contraction for the allotted ten second period. The third whistle indicated release and for the next subject to advance into position for the next exercise. The following diagram will illustrate.

Student Supervisor	Student Supervisor	Student Supervisor
X	X	X
_____Power rack	_____Power rack	_____Powe rac
(Military Press)	(Leg press)	(Squ
0 Tallest man	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

XX-Student Instructor
with whistle

Assistants. Six students were enrolled in Supervise Field Experience 317. This course gives the student practical experience in supervising physical education and recreation programs. It is only open to junior and senior class members and they must be working toward at least a minor in physical education. These six students were used student supervisors for the study; three in the Exer-Genie group and three in the isometric group. Their responsibility was to take attendance and insure that every subject performed all the exercises and did them in order. They we also responsible for setting up the Exer-Genie's for their particular group, and serving as general liaison between the group and investigator, as supervisor of the entire program. Nine athletes that were very well versed in the use of the Exer-Genie machine volunteered to help as studen instructors in the Exer-Genie group.

Limitations of the study. There was a possibility that this study was limited in two ways: (1) number of subjects and (2) time.

This study has been limited to the students enrolled in Physical Education 113 at The College of Emporia in Emporia, Kansas. The sampling was limited to the number of students enrolled in the class. The drop-out rate had some effect on the number of subjects that were enrolled in the class at the completion of the course.

Concerning the time element, an extended study would have logically provided more thorough results. However, the results that were obtained proved quite conclusive and could possibly prove to be of significant value in the future.

CHAPTER IV

ANALYSIS OF DATA

The one statistical procedure computed for this stu was the t test for significant gain made by the groups and the significance of the difference between the groups.

In Table I, significance of the mean gains made by both groups on the vertical jump test is shown. Also presented in Table I are the initial and final means and the standard errors of difference and t ratios. Only the isometric group improved significantly in vertical jump performance.

As shown in Table I, the Exer-Genie group, or Group I, had an initial mean of 110.68, a final mean of 111.29, and a mean difference of .61. The standard error of difference, when applied to a t test produced a score of .84. With twenty-two degrees of freedom, a t score of 2.07 was necessary at the .05 level, and a t of 2.82 was necessary to be reached for the .01 level of confidence. Thus, the t score of Group I was not significant.

The isometrics group, or Group II, had a mean diffe ence of 1.64; with an initial mean of 109.88 and a final mean of 111.52. With twenty-three degrees of freedom a t of 2.07 was necessary for significance at the .05 level of confidence; and a t of 2.81 was necessary at the .01 level

of confidence. For Group II a t of 2.38 was computed and was significant at the .05 level of confidence.

TABLE I

SIGNIFICANCE OF THE DIFFERENCE BETWEEN INITIAL AND FINAL VERTICAL JUMP TESTS FOR BOTH GROUPS

Group	N	Initial Mean	Final Mean	Mean Diff	SE of Diff	t	P
I	23	110.68	111.29	.61	.73	.84	-
II	24	109.88	111.52	1.64	.69	2.38	.05

t necessary for significance at .05 level of confidence with 23 df = 2.07

t necessary for significance at .01 level of confidence with 22 df = 2.81

The second computation was the t test for significance between the final means of the two groups. As presented in Table II the final mean of Group I, the Exer-Genie group was 111.29. The final mean of Group II, the isometric group, was 111.52. The mean difference was .23 with a standard error difference of 1.41. When applied to a t test, a t of .63 was computed. For significance at the .05 level with forty-six degrees of freedom a t of 2.02 was required. Therefore, the obtained t of .63 was not significant. With the nonsignificant t of .63 the null hypothes

is retained which states that a difference between the grou

does not exist as indicated by this study.

TABLE II

SIGNIFICANCE OF THE DIFFERENCE BETWEEN FINAL MEANS OF EXER-GENIE AND ISOMETRIC GROUPS

Group	N	Final Mean	Mean Diff	SE Diff	t	P
I	23	111.29	.23	1.41	.163	-
II	24	111.52				

t necessary for significance at .05 level of confidence with 46 df = 2.02

t necessary for significance at .01 level of confidence with 46 df = 2.69

CHAPTER V

SUMMARY, FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

I. SUMMARY

The purpose of this study was to investigate the effects of two programs of weight training upon the vertic jump performance of college males. Specifically this stud investigated the effect of training with the Exer-Genie, and an isometric training program upon the vertical jump performance of forty-seven college males, and the compar- ative effects of the two programs of exercise.

The study was conducted in Mason Gymnasium on the campus of The College of Emporia. Forty-seven male studen enrolled in a required physical fitness course were random divided into two groups; Group I was the Exer-Genie group and Group II was the isometric group. Both groups met for fifty minutes a day and performed three comparable exercis four times a week for five weeks.

Testing procedures included one week of pre-testing and demonstration, five weeks of training, and one week of post-testing. The pre-test and post-test scores were ob- tained by recording the best jump of three vertical jump performances.

The t test was used to determine the significance of the gains made for each group and for significance between the groups.

II. FINDINGS OF THE STUDY

The findings of this study were as follows:

1. The isometric weight training program over a five-week period did result in a significant improvement in vertical jump performance at the .05 level of confidence

2. The Exer-Genie weight training program over a five-week period did not result in a significant improvement in vertical jump performance.

3. No significant difference in vertical jump performance was found when the two weight training programs were compared.

III. CONCLUSIONS

Within the limitations of this study the following conclusions were made:

1. The vertical jump performance of college males can be improved through the use of five-week weight trainin programs.

2. Group I, utilizing the Exer-Genie training program, although not making a significant improvement showed an overall increase in vertical jump performance.

3. In using the isometric training program, Group II made a greater gain in vertical jump performance than did Group I; this increase was also found to be significant at the .05 level of confidence.

IV. RECOMMENDATIONS

The recommendations for further study are as follows

1. A study of initially identified strong and weak males exposed to isometric and Exer-Genie training programs done to investigate the effects upon vertical jump performance. After the initial testing for strength, two equated groups should be randomly established as the isometric and Exer-Genie groups.

2. A study utilizing a longer period of introductio into the techniques of the various devices used to investigate the effects on training.

3. A weight training program utilizing weights as opposed to Exer-Genie or isometrics.

4. A study testing other variables such as speed increase, flexibility, and agility as effected by Exer-Geni and/or isometrics.

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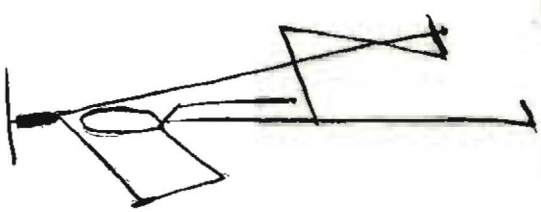
APPENDIX

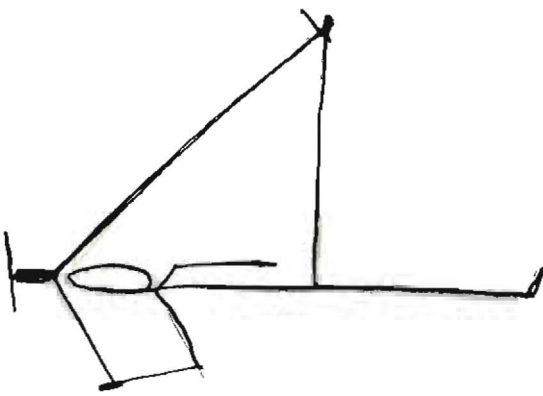
APPENDIX

Big two (Position 1)

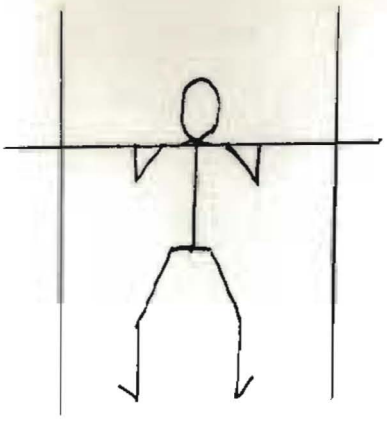
Big two (Position 2)



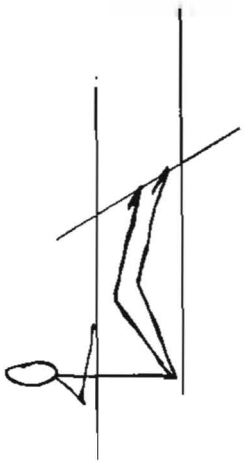
Quadra exercise



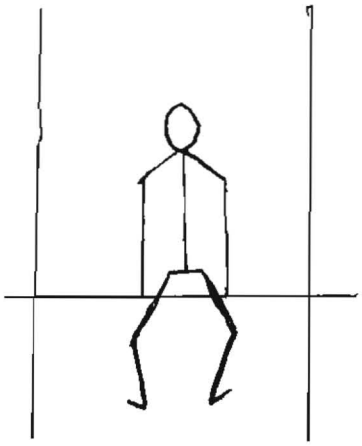
Ham exercise



Military press



Leg press



Squat