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ISOTONIC AND ISOKINETIC TRAINING EFFECT
ON VERTICAL JUMP PERFORMANCE

by

Sarah D. Novak

B.S., Baylor University, 1978

Presented in partial fulfillment of the requirements

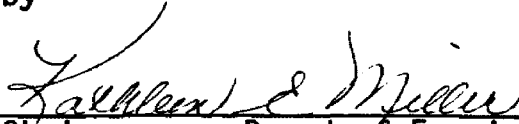
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Master of Science

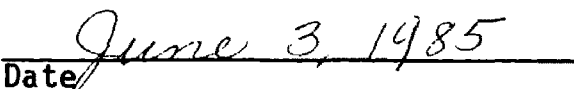
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Novak, Sarah D.

Physical Education

Isotonic and Isokinetic Training Effect on
Vertical Jump Performance (51 pp.)

Director: Dr. Kathleen Miller *Kem*

The purpose of the study was to compare isotonic and isokinetic weight training and their effect on leg power in women basketball players. A modification of the vertical jump and reach test was the instrument chosen to measure the vertical jumps of each subject in this investigation. Fourteen women basketball players of the 1983-1984 Cornell College intercollegiate team ranging in age from 18 to 21 years served as subjects.

Seven subjects were randomly selected for each experimental training group, isotonic and isokinetic. The programs were held over a consecutive six week period. Each subject's vertical jump height was obtained just prior to the start of the training period and again at the conclusion of the program. Six trials of vertical jump height for each subject were administered during the pre and post-test.

An average vertical jump (in inches) of the first three trials and the last three trials was used for computation of test-retest reliability. The correlation coefficient of the modification of the vertical jump and reach test was found to be significant.

A one-tailed t-test for dependent samples was used to compare mean vertical jump scores of both experimental training groups before and after the six week training period. No significant difference was found in the isokinetic group. A significant difference at the .05 level and greatest vertical jump gains were found in the isotonic exercise group. Each experimental exercise groups' mean vertical gains were compared to those of the group as a whole and no significant difference was found. A final statistical analysis showed no significant difference when the mean vertical jump gains of the training groups were compared.

The testing instrument was found to be a reliable measure of explosive leg power. Vertical jump gains were evidenced in both training groups. The greatest gains were found in the isotonic training group, but neither group was shown to be more effective in production of explosive leg power.

ACKNOWLEDGEMENTS

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CHAPTER I

INTRODUCTION

As the years progress and more people accept the fact that women can participate in a competitive manner in athletics, more interest is generated toward development of greater opportunities for participation. With the legislation of Federal Title IX, the initial funding was provided for these greater opportunities. This initial funding, consequently, increased opportunities and gave rise to public exposure and acceptance of women's participation in athletics. Research evidence has helped eliminate the early myths of physical inabilities, psychological characteristics, structural and behavioral differences, and cultural values that kept female athletes from their sporting activities.

These extended opportunities for highly skilled women in athletics require effective methods of training for competition at high levels (Van Oteghen, 1975). An increase in overall muscular strength at these competitive levels has been shown to improve performance. In addition to helping performance, continued interest in strength training offers: (1) a cosmetic value of a firmly muscled body; and (2) strength necessary for various tasks in day-to-day living (Hinson and Rosentswieg, 1972).

Until recent years there were two popular methods of resistive exercise, isometric and isotonic. Isometric or static contraction, means that tension is developed but there is no change in the external length of the muscle (Mathew and Fox, 1976). Isotonic or dynamic

contraction produces a muscle shortening while lifting a constant resistance with muscle tension varying somewhat over a full range of motion (Mathews and Fox, 1976). As each program has its advantages, it also has its disadvantages. The major concern with an isotonic program is that it is limited to a maximal tension demand on a muscle or muscle group, which can only occur at the extremes in the range of motion (Pipes and Wilmore, 1975). Isometric exercises permit the muscle to develop near maximum tension, but in only one position with no mechanical work being performed and the speed controlled at zero (Hislop and Perrine, 1967).

If the amount of resistance created is proportional to the amount of muscular force exerted throughout the full range of motion, isokinetic exercise is performed (Moffroid and others, 1969 and Van Oteghen, 1975). This allows for full muscular force potential throughout the range of motion, but without permitting acceleration (Hislop and Perrine, 1967). The amount of resistance created can occur at variable speeds. Research has shown that approximating the speed of power training to the speed of the athletic performance may prove important in terms of specificity of training. Most isotonic procedures rarely exceed 60 degrees per second, while most movements in athletic events require a limb speed in excess of 90 degrees per second (Pipes and Wilmore, 1975). The difficulty comes in trying to approximate speed of training to the speed of performance.

Most of the research comparing isometric, isotonic, and isokinetic training methods have shown strength gain in all three, with a preference for isokinetics (Rosentswieg and Hinson, 1972). Little

research has been completed with women as subjects utilizing the Universal Gym leg press and Mini-Gym Leaper equipment. There also has been limited data collected indicating that a specific performance task may benefit from power training, such as the vertical jump, which is important to many athletic events. The speed at which the task is performed in relationship to the training speed is also an area of limited research.

The purpose of this study is to compare isotonic and isokinetic weight training and their effect on leg power with the speed of both training programs approximating the speed of women performing the vertical jump.

Statement of the Problem

The purpose of this study was to compare isotonic and isokinetic weight training and their effect on leg power in women basketball players. The speed of both training programs approximates the speed of the women performing the vertical jump as if rebounding. This investigation sought to examine: Is the isotonic leg press performed on the Universal Gym or the isokinetic jumping exercise on the Leaper by Mini-Gym, Incorporated more effective in improving vertical jump?

Definition of Terms

The following terms with common definitions from relevant literature have been provided for clarity in the study:

1) Progressive Resistance Exercise - resistance against the muscle is increased throughout the course of the program as the muscle gains in strength and endurance.

2) Isometric Contraction - tension is developed but there is no change in the length of the muscle.

3) Isotonic Contraction - the muscle shortens with varying tension while lifting a constant load.

4) Isokinetic Contraction - the tension developed by the muscle while shortening is maximal over the full range of motion.

5) Eccentric Contraction - muscle lengthens while contracting.

6) Static Contraction - another term for isometric contraction.

7) Constant Resistance - resistance remains unchanged throughout the range of motion.

8) Accommodating Resistance - resistance is adjusted to equate the force applied by a muscle or muscle group throughout the range of motion.

9) Overload - progressively increasing the intensity of the workouts over the course of the training program as fitness capacity improves.

10) Specificity of Training - a training program developed to achieve a specific activity or skill and tax the energy systems involved during the performance.

11) Universal Centurion Multi-Station Machine - an apparatus containing a number of exercise stations designed to involve physical lifting or pulling of an object to a predetermined position and then returning it to its original position, thus producing isotonic contraction. The leg press is one such exercise.

12) Mini-Gym (MGI) 16XB Leaper - an apparatus designed for the development of leg drive and speed through isokinetic contractions.

13) Vertical Jump and Reach Test - a test of power measuring the difference between a person's standing reach and the height to which the individual can jump and reach.

14) Power - performance of work expressed per unit of time.

15) Absolute Strength - the measurement is scored in terms of the amount of weight lifted.

16) Set - a group of work and rest intervals.

17) Repetition - the number of work intervals within one set.

18) Repetition Maximum - maximal load that a muscle group can lift over a given number of repetitions before fatiguing.

The Hypothesis

There is no significant difference in vertical jump gains between the experimental isotonic training group and the experimental isokinetic training group of the 1983-84 Cornell College women basketball players.

Importance of the Study

Although strength gains have been shown to exist from both modes of training, no significant correlation has been found between the two modes as measured by vertical jump gains. The lack of research regarding training speed and the use of female subjects is also an issue to be examined.

The desire of the investigator was to make a significant contribution to the research of the area of weight training and its relationship to vertical jump gains in women. If a precise weight training program could be ascertained, including training speed and mode, profitable

gains in vertical jumping ability will materialize. This relationship may also allow for coaches and players to enhance the skill of rebounding in the game of basketball. An opportunity may also be provided for further research in the inconclusive area of training speed.

Limitations of the Study

The following limitations should be considered when interpreting the findings of this study:

1) The sample size was small in comparison to the total population of women basketball players.

2) The subjects' daily activities were not controlled.

3) The time and situation under which the vertical jump test was administered was not completely controlled. One subject was unable to meet at the prescribed time for the post-test. She was tested earlier that same day. The testing area was not closed to other occupants during both testing periods.

4) The subjects' actual workout period and the time in which it took place during the day was not controlled.

Delimitations of the Study

The study consists of the following delimitations:

1) The subjects were women basketball players who competed for Cornell College during the 1983-84 season (N=14).

2) Explosive leg power, evidenced by gains in vertical jumping ability, was measured by a modification of the vertical jump and reach

test.

3) The sample was limited to the 1983-84 women basketball players at Cornell College.

CHAPTER II

REVIEW OF LITERATURE

Advantages and Disadvantages of Isotonic and Isokinetic Contractions

As early as 1897 it was scientifically shown, by Morpurgo, that a direct relationship existed between increased muscle size and strength. Increases in strength and muscle size are regulated by stimuli of continued stress to the muscle groups. Stimuli of muscle contractions produced from normal daily activities may not be sufficient enough to maintain strength let alone aid in the development of maximum strength (Müller, 1970 and Hinson and Rosentswieg, 1972). This overload principle was encountered as early as 1919 by Lange.

The resistive load to develop maximum strength in an individual is adjusted according to the amount of weight that that specific individual can lift. Maximum strength is also influenced by the individual's demands of a job or daily living habits. This concept of specificity is also found in weight training. Specificity in strength building must simulate conditioning of the exercise program that will be encountered in athletic activity (Councilman, 1969). The importance of specificity is obvious because of the increase of functional capacities of fiber types as well as strength development specific to joint angle of trained muscle groups. "Specificity was further evidenced by the fact that isometric programs will increase isometric strength more than they will isotonic strength and vice-versa. The same applies to isometric versus isokinetic versus eccentric programs (Mathews and Fox, 1976)."

An isotonic program's major advantage to that of an isometric program is the effect of muscle shortening during contraction. The following are other noted advantages of an isotonic program:

- (1) More strength gains shown
- (2) Some aid to endurance performances
- (3) Strength built at all joint angles

(Corbin and others, 1981).

The newest type of weight training, isokinetic, appears to have a number of favorable advantages over its predecessor, isotonic. The major benefit is the accommodating resistance to muscular force. Others include:

- (1) Muscle soreness diminished
- (2) Mechanical device for immediate reward
- (3) Biomechanical factors
- (4) Physiological factors
- (5) Time saver

(Thistle and others, 1967).

In conventional strength training, or free weights, a person is limited to maximum resistance that can be lifted regardless of the angle of pull. Therefore, equal strength is not developed throughout a full range of motion. Variable isotonics provide additional resistance as one's skeletal leverage improves (MGI Strength/Fitness Systems, 1980). For example, the strongest range of the sitting leg press is the extended range. This concept provides little effect on strength development though, if the middle ranges are the strongest.

The greatest strength development and gains as a result of

resistive exercise have been shown to parallel functional activity. Too much emphasis has been on isotonic methods for development of absolute strength and not enough on isokinetic methods and the development of power (Halling and Dooley, 1979).

Strength gains are apparent in all the previously mentioned modes, but isokinetic helps diminish muscle soreness due to the lack of eccentric contraction allowing the muscles to relax between repetitions. The equipment is safe, as the built-in governor automatically adjusts to fatiguing muscles. It also saves time because little or no warm-up is necessary and everyone can progress quickly through a workout because no adjustment of resistance needs to be made.

Since strength is specific and not general, isokinetic exercise can be performed to simulate exact movements of one's sport activity. Every sport has a combination of endurance and speed. More than any other piece of training equipment, the MGI, with fast speeded work trains the muscle to react quicker and faster (MGI Strength/Fitness Systems, 1980).

Effects of Resistive Loads of Isotonic and Isokinetic Training on Strength Gains

The earliest and most successful attempt at organizing dynamic resistance training loads was by DeLorme and Watkins. It simply involved three sets of exercise at heavy resistance moved through a range of motion 10 consecutive times (DeLorme and Watkins, 1948, Pipes, 1977 and Sharkey, 1979). Several other investigators followed with supporting evidence as well as other effective means to further increase strength. One such author was Berger.

His study showed that strength can be significantly increased by a

progressive weight training program with maximum strength developed following six maximum repetitions for three sets, tri-weekly for 12 weeks (Berger, 1962). This suggests that the closer one works to his maximal strength, results in strength gains are greatly enhanced.

A major problem incurred by Berger was that most athletes were rarely able to maintain maximal contraction more than once. Therefore it became necessary to decrease resistance in order to increase repetitions to enable the movement of the constant resistance through the full range of motion. To date, a popular isotonic program is two-thirds to three-fourths of maximum for three sets of six to eight repetitions, three or four times per week which continues to provide maximal results (Hinson and Rosentswieg, 1972).

The accommodation resistance mode (isokinetic) combines the best of the other modes; maximal force and full range of motion (Sharkey, 1979). In addition, it provides the opportunity to overload the muscle or muscle groups near maximum resistance while controlling the velocity (Pipes, 1977). Both isotonic and isokinetic modes place demands on absolute strength while the amount of resistance is controlled in isotonic and speed is controlled in isokinetic. As mentioned earlier the speed of training needs to match the speed of performance (Pipes and Wilmore, 1975).

In conventional isotonic procedures, limb speed rarely exceeds 60 degrees of movement per second, while during most athletic events limb speed exceeds 90 degrees of movement per second and some events exceed 200 degrees per second. Isokinetic equipment provides degree of limb movement from zero to 270 degrees per second. A fast set on isokinetic

equipment is an approximate two second completion for an exercise and a slow set is approximately a four second completion (Van Oteghen, 1975). In terms of degrees of limb movement, a fast set is 136 degrees per second compared to 24 degrees per second (Pipes and Wilmore, 1975).

Since the isokinetic mode is fairly new, a lot of uncertainty still exists as to the number of repetitions and sets to be performed. Literature from the middle 1970's seems to indicate that fast speed sets demonstrate significant increases in the exercise performed, but resistive training loads are not as well defined. In Pipes' and Wilmore's 1975 study with isokinetic resistive training loads, the fast set group performed 15 repetitions for three sets while the slow group went eight repetitions for three sets tri-weekly. In one of the first studies to involve females, the two isokinetic training groups, slow and fast speed, performed three sets of 10 repetitions three days a week for eight weeks (Van Oteghen, 1975). An extensive study in 1977 involving females used a training program of eight repetitions for three sets three days a week (Copeland, 1977).

During a period from 1978-1980 a number of new studies were completed after using isokinetic equipment. The number of sets and weekly workouts remained similar to past studies, but the number of repetitions increased. Exercises were performed using 20 to 35 repetitions during a specified time frame (Spielman, 1978 and Helling, 1980). This is an indication of the difficulty in trying to approximate training speed of athletic performances.

Resistive training loads for the isotonic mode have brought forth increases in some athletic performances. Vertical jumping ability

demonstrated increases of one centimeter to 12 centimeters as measured by the standing Sargent Jump & Reach and one to 14 centimeter gains measured by the running Sargent (Chui, 1950). In 1963, two dynamically weight trained (isotonic) groups showed significant increases in vertical jumping ability as compared to a static or isometric, and control groups (Berger, 1963). By means of a series of exercises; bench press, biceps curl, leg press, and bent rowing, increases in isotonic static strength measurements were found in all exercise movements although there was no significant increase in motor performance (Pipes and Wilmore, 1975).

Isokinetic and isotonic training have shown increases in strength as well as motor performances. Strength gains, determined by electrical activity present in the muscle during contraction, on maximum performance of the bicep brachii indicated significantly more electrical activity during isokinetic contraction, implying that more muscle work was required to perform the exercise, therefore producing greater strength gains (Hinson and Rosentswieg, 1972). Another study measured total work of the quadricep femoris muscle. Results showed higher scores from accommodating resistive exercise than constant resistive exercise (Thistle and others, 1967).

Since speed is the most indefinite concept in isokinetic training a number of authors have looked at the idea in relation to motor performance. Based on a vertical jump test, the slow and fast mean measurements were not great enough to differentiate significantly in favor of one speed although the two groups showed significant superior gains to the control group (Van Oteghen, 1975).

A similar result was seen in a 1980 study where isokinetic torque at two speeds was related to the vertical jump. The group was tested on an Orthotron Cybex. Three trials were given at each speed, 30 degrees per second and 180 degrees per second, with 15 second recovery periods between trials. The best score was used for the statistical analysis. The following exercises were performed: leg extension followed by leg flexion, then plantar flexion. Each of these were performed at 30 degrees per second followed by 180 degrees per second. The highest correlations found between vertical jump and isokinetic torque involved the fast speed. On leg extension a correlation coefficient of .587 was found, .445 on leg flexion and .502 on plantar flexion. Even though these correlations were shown to be significant, Genuario and Dolgener questioned if torque was functionally related to vertical jumping ability (Genuario and Dolgener, 1980).

Pipes' and Wilmore's results showed all exercise movements were increased significantly at the .05 level in the high group (136 degrees limb movement per second) over the low group (24 degrees limb movement per second). The isokinetic high speed indicated a significantly greater increase in the leg press exercise and vertical jump. Kehl reaffirmed this concept in 1977 when he found 2.18 inches of increase in vertical jumping ability in a group performing two sets of 30 repetitions for a six week exercise period performing two feet per second compared to a 1.3 inch gain on two sets of 10 repetitions at one foot per second (Kehl, 1977).

High speed exercise produced increases in muscular force at all speeds of contraction unlike low speed (Moffroid and Whipple, 1970).

High speed isokinetic exercises increased strength at all limb speeds indicating that high speed appears to be the preferred method for maximizing change (Pipes and Wilmore, 1975). Although literature has shown significant strength gains and motor performance improvement with constant and accommodating resistance, larger gains have been accessed with accommodating.

Vertical Jump Test as a Measure of Power

Sargent, in 1921, developed a new test called "The Physical Test of Man". Sargent was concerned that the physical measure of man was not always an indication of his potential power (Sargent, 1921). Other contributing factors like the "unkown equation", as termed by Sargent, were found to influence The Physical Test of Man. Dr. Sargent defined his jump as the ability of one's body to develop power relative to the weight of the individual himself (McCloy, 1932). The scoring was based upon the amount of energy developed by man using the constant factors of height and weight.

In 1924, L.W. Sargent reviewed the Sargent Jump and found no significant relationship between various anthropometric measures and performance of the Sargent Jump, the height jumped, and the amount of squat or dip preceding the actual jump. A correlation coefficient of .39 was found between age (up to 16 and 17 years) and performance of the Sargent Jump.

The Sargent Jump was examined by Bovard and Cozens in 1928. They correlated the jump with four athletic events; the running high jump, standing broad jump, rope climb for speed and a 980 yard run. The

results showed a correlation coefficient of .55 between all variables, a reliability of .61, and a very small coefficient between age and the jump (Bovard and Cozens, 1928).

These were not the end of the investigations on the Sargent Jump. McCloy in 1932 became interested due to what he termed "the simplicity of the event, and the reasonableness of Dr. Sargent's arguments". Most of the arguments against the jump as a test in physical education were due to the lack of knowledge about the jump and its procedures. McCloy saw the test as an indication of how fast one can work. With sufficient rapidity the momentum of the body could cause it to leave the ground and move upward, thus the work was being done in a shorter time frame with greater power (McCloy, 1932). A number of athletic performances are power events, the Sargent Jump should be an excellent test designed to measure explosive leg power. McCloy felt that fault in previous testing was primarily due to the lack of skill, ability and coordination to perform the jump correctly and the potential for one to do his best at any given time (McCloy, 1932).

The Sargent Jump showed a reliability of .890 when associated with a test battery including the 100 yard dash, running high jump, standing broad jump and putting an eight pound shot. It also showed reliabilities from .65 to .80 when related to other track and field events. When each best jump of a two series of three jumps of the Sargent Jump, performed on different days, were correlated, the result was .854 (McCloy, 1932).

One of the early modifications of the Sargent Jump was the Chalk Jump. The subject in this jump reached his dominant arm and hand as

high as possible and marked the wall with a piece of chalk indicating his reach height. He then jumped vertically and at the peak of his jump he marked the wall. The major difference for the subject was learning to swing only one arm downward at the peak of the jump instead of two.

This modification was followed by another known as the jump and reach. In this particular jump the subject faced the wall and, with both arms and fingers stretched fully, marked his reach height with two pieces of chalk or later with chalked fingers. Again the individual was instructed that his free arm be swung downward at the top of the jump.

In 1940, VanDalen attempted to clarify and validate the various test types of jumps in use to date. He found, when correlated with four track events, the correlation coefficients were as follows: the Sargent Jump, .810; the Chalk Jump, .776; and the jump and reach, .780 (VanDalen, 1940).

As the years progressed the modifications continued, particularly with the jump and reach test. Gray, Start, and Glencross reported the test-retest reliability of the jump and reach test to be .954 in relation to inches of the jump and .973 in terms of work (Gray and others, 1962). The most common reported reliability and validity for the jump and reach test are .93 and .78 respectively (Johnson and Nelson, 1979 and Jensen and Hirst, 1980).

To date, variations of the jump and reach test are still being found. The change in protocol for determining reach height has found the subject facing the jump board, eyes straight ahead, with feet flat on the floor directly below the board. The arms are then extended upward and the height marked by how far one can reach. A number of

various approaches have been utilized as well, but the fundamental two foot take-off and arm swing remain relatively unaffected.

Many of the modifications found in recent literature relate to the areas of this study, mode of training, exercise protocol, criterion measure and subjects. Fifteen high school girl basketball players were tested using the Sargent Jump with a one-step approach following a six week weight training program. Their effectiveness in jumping and rebounding was increased by the weight training program as significant gains were shown in their mean height jumped (Callahan, 1965). A study involving different modes of training and their effect on the vertical jump with the use of a two-step approach to Gray, Start, and Glencross' jump and reach modification found improvement in vertical jumping ability (Helling, 1980).

As early as 1938, Carpenter found that power and muscular strength have the most influence on athletic performance of college women (Carpenter, 1938). Until 1973, leg strength and leg power were often used synonymously in the same sentence. In recent literature leg power has been shown to be a separate entity consisting of a number of factors, namely strength, but it is not the most prominent. Therefore, leg power and leg strength did not bear a high relationship when the vertical jump was utilized as the criterion measure for explosive leg power (Considine and Sullivan, 1973). Although the results indicated no significant relationship between the two, further literature to date has not supported those findings. The vertical jump test continues to be the criterion measure of leg power.

Effects of Isotonic and Isokinetic Training on Vertical Jump Performance

Many studies have shown an increased ability in performance of the vertical jump by the use of weight training programs. One such study by Holmes put 33 junior high school boys on a 10 week program. Group I performed a weight training program three days a week with normal physical education class participation on Tuesday and Thursday. Group II jumped at a basketball standard set two to three inches above their highest recorded vertical jump, and Group III participated in their regular physical education class. All three groups' mean scores showed gains in vertical jumping ability as measured by the Sargent Jump Test every two weeks. The largest gain was found in Group I with a mean increase of 3.01 inches, although there was no significant increase at the .05 level in jumping ability between groups (Holmes, 1962).

One of the first meaningful studies involving isokinetics, vertical jump and women was by Copeland. Forty subjects were divided into low and high jumpers. They were then randomly put into one control and two experimental groups. Each experimental group performed three sets of eight repetitions three days a week for five weeks on an Orthotron Exercise System.

The control groups were asked to refrain from weight training but continue with normal daily activities. The subjects were tested at the beginning and end of the five week period using VanDalen's modification of the Sargent Jump and Reach Test. Isokinetics improved the vertical jumping ability of the low jumping group, but did not improve that of the high group, therefore indicating that the effect was dependent on the initial jumping ability of the subjects (Copeland, 1977).

Another study involving the effectiveness of isokinetic training divided 48 male subjects into three groups. Group I performed isokinetic exercise on the Mini-Gym Model 16XB Leaper. Their program included three sets of 10 repetitions over an eight week period. Group II was involved with plyometric depth jumping. Each subject performed three sets of 10 repetitions from a 34 inch step with added resistance during the third, fifth and seventh week. Respectively, 10, 15 and 20 pounds were added. The last group was the control group. Following a brief warm-up period, six trials of the jump and reach test were administered. Each jump was separated by 30 seconds of rest. The mean score of the trials three through six were then used for statistical analysis. Both experimental groups showed significant improvement in vertical jumping ability. The greatest gain was found in the isokinetic group, 1.94 inches, but neither Group I or II were shown to be more effective (Blattner and Noble, 1979).

Haun investigated the effects of isotonic and isokinetic exercise on vertical jumping ability. His results indicated a significant increase in leg power in only the isokinetic group as measured by the modified vertical power jump. No significant increase was seen when the groups were compared (Haun, 1975). This study was later duplicated with minor alterations in the actual exercise program. Although minor gains were seen in vertical jumping abilities, unlike Haun's study, neither the isotonic or isokinetic separately showed a significant increase in vertical jump performance (Spielman, 1978).

Haun and Spielman's studies were conducted with male subjects. Through 1980 a very small number of studies were conducted with female

subjects. One such study by Ruley looked at the carry over value of the two modes of training. Five to seven repetition maximums (RM) were performed every 45 seconds by the isotonic group on the leg press. The isokinetic group worked at a fast speed doing three sets of 10 repetitions. Each of the experimental and control groups (field hockey) participated in an eight week program exercising alternate days. Pre- and post-tests were measured by the jump and reach test given multiple trials, three sets of three consecutive jumps, preceded by two warm-up jumps. No significant difference was shown between experimental groups in vertical jumping ability. Resistive training produced effective improvement in vertical jump with the most significant effects occurring during the first four weeks of the program. There also appeared a significant de-training effect within four weeks of post training (Ruley, 1979).

An early 1972 study by DeLateur and others was designed to assess whether isokinetic or isotonic exercise was superior in quadriceps strengthening. Forty-four female subjects were randomly selected for isokinetic or isotonic exercise. The program lasted for 18 sessions. One session was performed per day. The individual performed her exercise until fatigue, as defined in the pilot study. At the end of the 18 sessions, a set number from each exercise group changed roles. All subjects performed eight more test trial sessions to allow for any delay transfer between programs. The results indicated that both task groups improved in strength, but not significantly. Isokinetic exercise offered no particular advantage over weights with quadricep strengthening and the transfer of training programs was "immediate,

complete, and sustained throughout the transfer period (DeLateur and others, 1972)".

Until the time of Helling's 1980 study, the literature indicated no significant difference between the isotonic and isokinetic modes as measured by vertical jumping abilities found primarily in men. A six week, three day per week program was designed for two exercise groups. The DeLorme-Watkins progressive resistance program was contrived for the isotonic mode. First, the maximum amount of weight that each individual could lift 10 times was determined for each exercise. Then 50 and 75 percent of the maximum was figured. On exercise days, the subjects performed three sets of 10 repetitions at the various percentages of maximum weight and maximum weight on leg press, toe raises and double leg extension. The isokinetic group performed at a fast speed doing four sets of exercises with 30 repetitions within 30 seconds.

Two pre-tests and two post-tests were given on separate days establishing a reliability coefficient of .92 - .97. The instrument of measure was a modification of the vertical jump and reach test where a two-step approach was allowed. After three warm-ups the best of the following three trials was the score used for statistical analysis. The results of the study are critical as they give one of the first results that show the mean scores of the isokinetic group significantly higher than the isotonic group (Helling, 1980). A 6.5 percent increase in vertical jump was discovered with a 6.37 centimeter gain. Not only was this study important in establishing positive results about the effects of isotonic and isokinetic weight training, its subjects were female.

Summary

In summary, weight training has been shown to provide strength gains in muscle and muscle groups. This strength gain is not only beneficial in daily living routines, but once it is specified to an athletic activity the functional capabilities of the muscle are increased.

These strength gains are best met in the isotonic mode by the implementation of the DeLorme-Watkins progressive resistance program where four to eight repetitions for three sets are performed. Although the resistance load is not as distinct for the isokinetic mode, the speed of the activity should be approximated on the piece of equipment for the production of maximal results.

As Halling and Dooley reported, power is a product of strength, and training for an increase in power will also increase absolute strength (Halling and Dolley, 1979). For a number of years the emphasis in weight training was on absolute strength. The strength developed in the legs was measured by the Sargent Jump Test. This strength was later referred to as power and the Sargent Jump Test was modified to a jump and reach test which is the popular criterion measure for vertical jumping ability today.

Vertical jump gains are evident in both modes of weight training. Isokinetic vertical jump gains appear more rapidly during the program, are for greater distance and have a longer lasting affect than those gains from isotonic. "Power training meets the demands of the sport more specifically not only in terms of the required strength level but in the actual velocity that the strength is applied (Stevens, 1980)."

CHAPTER III

RESEARCH PROCEDURES

The purpose of this study was to compare two specific weight training programs, isotonic and isokinetic, and to determine if a significant relationship exists between these programs and vertical jump gains. Fourteen women basketball players served as subjects. The programs were conducted prior to the opening day of basketball practice, October 25, 1983, and were held over a consecutive six week period. Each subject's vertical jump height was obtained just prior to the start of the training period and again at the conclusion of the program.

Selection of the Subjects

The selection of the subjects in this study included those women basketball players who indicated a preference to play on the 1983-1984 Cornell College intercollegiate team prior to the start of practice. A total of 14 subjects, ranging in age from 18 to 21 years, were available for testing.

Seven subjects were randomly selected for each experimental training group. Six of the total number of subjects were also members of the intercollegiate volleyball team, three were randomly selected to each training group. One subject in the isokinetic training group was unable to complete the program due to an injury suffered during the volleyball season.

The subjects were oriented to the purpose of the project, testing procedures, and the importance for a maximal effort while training and

testing.

Selection of the Equipment

A modification of the vertical jump and reach test was the instrument chosen to measure the vertical jumps of each subject in this investigation. The modification was written to approximate the skill of rebounding in basketball and was based on the original vertical jump test by Sargent. Modifications of the Sargent Jump; the chalk jump, the jump and reach, the squat jump, the vertical power jump, and the modification of the vertical power jump have been reported as acceptable measures of leg power (Gray and others, 1962; VanDalen, 1940).

Test-retest reliabilities indicated that the modification of the vertical power jump had the highest reliability at .977 and the lowest was found in the squat jump at .940 (Gray and others, 1962). The squat jump, jump and reach, and modification of the vertical power jump were clarified and validated using the vertical power jump as the criterion measure. The highest validity, .989, was shown for the vertical power jump modification. The validities for the squat jump and jump and reach were .840 and .780 respectively. The chalk jump was validated to four track and field power events; a six second run, running high jump, standing broad jump, and the shot put. The reported validity coefficient was .776 (McCloy and Young, 1954).

On the basis that the skill of rebounding is a power event and the above mentioned modifications of the Sargent Jump have proven to be reliable and valid tests for leg power, the instrument of measure in this investigation had face and content validity.

A four foot by 20 inch piece of chalk board was marked off every inch with a felt marker. A hash mark was made between the inch lines to indicate every one-half inch. The chalk board was then backed by a piece of 1/4" plywood, five foot by 20 inches. The vertical jump board was placed on the backboard of a rectangular fiberglass basket. It was held in place by metal C-clamps and the bottom of the jump board hung 6'5" above the floor. This board was used to measure each subjects' reach height and their jumped height prior to and after the training program.

Testing Procedures

Once the instrument and subjects were chosen and the equipment and programs developed, a data card was constructed for each individual and used to record all test trials (Appendix A). The following data were obtained from each subject:

- 1) Reach height
- 2) Six trials of height jumped from pre-test
- 3) Six trials of height jumped from post-test

These data were collected on 13 subjects.

The study was explained and questions were answered at a pre-season meeting with the subjects. They were then notified by telephone and/or in person of the date and time of the pre-test. Once the subjects were assembled the following instructions were given for the modification of the jump and reach test:

The subject shall stand facing the jump board with her toes on a line directly below and parallel to the board. The middle fingers of both hands are chalked. The subject reaches as high as possible with both arms extended over the head, eyes fixed straight ahead, feet flat on the floor and makes a mark on the board with her chalked fingers.

She then assumes a position behind a prescribed starting line. The subject is allowed a one-step approach. This step is arbitrarily limited between a two and three foot step for consistency among subjects. If the foot of the first step should exceed the furthest line, or fall short of the two foot line, the subject shall be awarded another jump. If any part of the foot should fall on either of the lines, the jump shall continue.

The subject takes the first step drawing the trail foot forward gathering for a two-foot takeoff. A crouch position is assumed with knees bent approximately 90° and arms swung downward and backward. The subject then jumps vertically as high as possible swinging her arms forward and upward vigorously with legs stretched downward. At the peak of the jump the board is touched with the chalked fingers of both hands.

The measurement is taken to the nearest half inch with each subject executing six jumps, marking each time on the board, with a 20-30 second rest between jumps. Maximum effort is requested with each jump.

The instructions were posted near the testing site and the investigator demonstrated what had been described. The first two jumps were used as practice and the last four trials were averaged for the test score. If the marks by the fingers were of different heights, the highest mark was recorded. These marks were read by standing on a stepladder to avoid perceptual error.

Upon completion of the pre-testing each subject was informed of the training group for which she was selected. The investigator then met with each experimental group.

The isotonic experiment group members were instructed on the correct procedure for performance of the leg press on the Universal Gym. As the subject took her position on the chair, she was instructed to place the ball of her feet on the lower set of pedals. By glance, the chair was then adjusted so that flexion of the knee

joints approximated 90°. During the performance of the exercise, the knees were to be extended to a lock-out position. The weight was to be moved to the above position over a two second period. Shortening of the muscle by returning the weight to the starting position took place over a two to four second time frame. Subjects were reminded to keep their seats in the chair and cautioned not to hold their breath.

Instruction was also given to determine individual repetition maximum. Subjects were encouraged to determine their repetition maximum prior to their start of the six week training program. Repetition maximum (RM) was defined as the maximum load that could be lifted a given number of times. An approximate beginning load for the leg press was based on the subject's body weight. One-half to two-thirds was suggested as the portion of body weight for a beginning load for the exercise (Getchell, 1983). Once a suggested beginning load was determined they were then asked to perform 10 repetitions of the exercise. If the exercise could not be completed or was completed with ease, the equipment was calibrated in five pound increments, the correct adjustments were made. Upon determination of the working load, the subject then figured 50% and 75% of that maximum.

A program sheet was distributed to each subject (Appendix B). The program was administered three days a week for six weeks. At the beginning of each week the subjects rechecked their maximum. The goal was 10 repetitions at RM. After each check, they continued training according to the DeLorme principle as described on the program sheet. This allowed for muscle gains in strength and endurance throughout the

program.

The isokinetic training group also received a program sheet (Appendix C) and instructions on correct procedure for performance on the leaper. As the subjects took their position at the 16XB Leaper they were instructed to keep their feet shoulder width apart and in a straight line directly below their shoulders. The start of each set was from a squat position with knee flexion approximately 90°. The subjects were cautioned to keep their head up, back straight, and maintain pressure from the arms on the shoulder pad to one's shoulders to avoid loss of contact and eventual soreness due to forceful thrust into the apparatus. During each repetition the subject was to thrust from the squat position to full knee extension and plantar flexion of the foot. On completion of the eccentric contraction the starting position was resumed and the set completed according to the prescribed time.

The subject's training program was delineated each week as illustrated on the sheet. According to recent studies, speed of performance on isokinetic equipment should approximate that of the skill. The program was designed for high speed work with a high number of repetitions.

Subjects were required to date their program sheet on workout day and record the weight lifted for each set or pounds attained. Six weeks to the date of the pre-test the subjects reported for the vertical jump and reach post-test. The instructions were read and posted at the site. The trials were administered and recorded on the subjects' data cards.

Treatment of the Data

The purpose of the statistical treatment of the data included in this study was to determine if there was a significant relationship between the experimental training groups and vertical jump gains of the subjects of the investigation. It should be noted that the program studied is a non-athletic scholarship NCAA Division III school. The subjects' interests in participation on the women's basketball team were pleasure and personal. Program requirements include practice and participation in competitive contests. Many of the athletes in the program were two-sport athletes and any other demands are fulfilled on a personal preference.

There were five separate statistical treatments performed in this study. First, a Pearson product-moment correlation was computed to determine test-retest reliability. An average vertical jump (in inches) of the first three trials and the last three trials was obtained. Each subjects' average raw score was used for computation. The result of the group was tested for significance.

A Pearson product-moment correlation was also computed between the vertical jump averages of each experimental training group. The average raw scores were used in the computation. Results of each group were tested for significance.

A third statistical treatment, a one-tailed t-test for two dependent samples, was utilized to compare the mean vertical jump scores of the isokinetic and isotonic groups before training to the identical groups after the six week training period. A one-tailed t-test for two independent samples was used to compare mean vertical

jump gains established by the group as a whole. These results were also tested for significance.

In order to determine if vertical jump gains derived from isokinetic exercise differed significantly from those of isotonic exercise, a one-tailed t-test was used. The t-test tested for significance the mean scores of vertical jump gains between the two exercise groups. The resulting t-value was tested for significance.

CHAPTER IV

ANALYSIS AND INTERPRETATION

Analysis of Results

In analyzing the data of this investigation, the following questions were considered:

1) Does a significant correlation exist between the test-retest of the modification of the jump and reach test for the group as a whole?

2) Does the modification of the jump and reach test indicate a significant correlation between the test-retest method of establishing reliability within the experimental groups?

3) Is there a significant difference between the mean vertical jump gains and those subjects who performed isokinetic exercise on the 16XB Leaper?

4) Is there a significant difference between the mean vertical jump gains and those subjects who performed isotonic exercise on the Universal leg press?

5) Is there any significant difference between the mean vertical jump gains and the isokinetic and isotonic experimental exercise groups?

Mean scores were calculated and presented in Table 1 along with individual test scores and their gains, before and after the six week weight training program. The appropriate subscript, the letter a representing the 16XB Leaper and b the Universal leg press, identifies each subject's training program.

TABLE 1
Individual Test Scores, Gains, Mean Scores

Subjects	Vertical Jump (inches)	Vertical Jump (inches after 6 weeks)	Gain (inches)
A _b	14.125	16.250	2.125
B _b	15.625	16.375	0.750
C _b	14.375	16.125	1.750
D _a	14.750	14.250	-0.500
E _a	11.000	13.500	2.500
F _a	17.000	17.625	0.625
G _b	10.250	10.500	0.250
H _a	17.500	18.500	1.000
I _b	14.125	16.875	2.750
J _a	15.500	15.625	0.125
K _b	15.250	15.875	0.625
L _b	16.000	17.750	1.750
M _a	12.500	13.250	0.750
	$\bar{x}=14.462$	$\bar{x}=15.577$	$\bar{x}=1.115$
a 16XB Leaper	$\bar{x}_a=14.708$	$\bar{x}_a=15.458$	$\bar{x}_a=0.750$
b Universal Leg Press	$\bar{x}_b=14.250$	$\bar{x}_b=15.679$	$\bar{x}_b=1.429$

In response to the first of the above questions, the reliability of the modification of the jump and reach test for the group as a whole was obtained by administering a test-retest on the same day. A Pearson product-moment correlation was computed to test this hypothesis. An average was obtained from the first three trials. Each average raw score was rounded to the nearest one-half inch to comply with the procedure of recording the scores to the nearest one-half inch. The same procedure was followed with the last three trials. The Pearson product-moment correlation of .92 was tested for significance at the .05 level, for 11 degrees of freedom. In conclusion, the reliability of the vertical jump and reach modification for the group as a whole was significant. Test-retest of the modification within the experimental groups also indicated significance at the .05 level. Table 2 is a summary of the Pearson product-moment correlations of the test-retest reliability of the group as a whole and within the experimental groups.

A comparison of mean vertical jump scores of the isokinetic training group was made before and after the training period. The purpose of this comparison was to determine whether a significant difference existed among the vertical jump gains of the isokinetic exercise training programs. A one-tailed t-test involving means from two dependent samples was utilized to compare the mean jump scores before the isokinetic program with those scores at the end of the six week training period. The same statistical procedure was utilized to compare the mean jump scores before the training period

to the mean jump scores at the end of the training period for the isotonic experimental group. Table 3 shows the results of the t-tests.

TABLE 2
Pearson Product-Moment Correlations for Whole Group
and Each Experimental Group:
Test-Retest

Test Group	N	Test-Retest	t
Whole Group	13	0.92	7.79*
Experimental Group a	6	0.94	5.51*
Experimental Group b	7	0.96	7.67*

Whole Group: * $t \geq 1.796$ significant at $\alpha = .05$
 Experimental Group a: * $t \geq 2.132$ significant at $\alpha = .05$
 Experimental Group b: * $t \geq 2.015$ significant at $\alpha = .05$

TABLE 3
t-test Comparing the Mean Vertical Jump Scores of Isokinetic
and Isotonic Experimental Groups Before Training Period to
Same Experimental Groups After Training Period

Subjects	N	\bar{x} (inches)	S	t
Experimental Group a (before)	6	14.71	2.32	1.82
Experimental Group a (after)	6	15.46	1.99	
Experimental Group b (before)	7	14.25	1.77	4.61*
Experimental Group b (after)	7	15.68	2.18	

Experimental Group a: * $t \geq 2.015$ significant at $\alpha = .05$
 Experimental Group b: * $t \geq 1.943$ significant at $\alpha = .05$

The next comparison of mean vertical jump scores was between each experimental group's gains after the six week training period and all

of those who participated in the study at the end of the six week period. Again, a one-tailed t-test involving the means from two independent samples was utilized. Table 4 presents the results of the t-tests.

TABLE 4

t-test Comparing the Mean Vertical Jump Scores of Each Experimental Group's Gains After Training Period to the Gains of the Group as a Whole After Training Period

Subjects	N	\bar{x} (inches)	S	t
Experimental Group a	6	0.750	0.92	0.750
Whole Group	13	1.115	0.94	
Experimental Group b	7	1.429	0.85	-0.699
Whole Group	13	1.115	0.94	

Experimental Group a: *t \geq 1.740 significant at $\alpha = .05$
 Experimental Group b: *t \geq 1.734 significant at $\alpha = .05$

A one-tailed t-test involving means from two independent samples was also used to compare the mean vertical jump gains of the isokinetic group and those subjects who belonged to the isotonic experiment group. The result of this t-test showed a non-significant difference between vertical jump gains between experimental training groups as presented in Table 5.

TABLE 5

t-test Comparing Vertical Jump Gains of Isokinetic Experimental Group and Isotonic Experimental Group

Subjects	N	\bar{x} (inches)	S	t
Experimental Group a	6	0.750	.920	1.280
Experimental Group b	7	1.429	.850	

* $t \geq 1.796$ significant at $\alpha = .05$

Interpretation

All testing for the modification of the vertical jump and reach test was administered on the same day. The original vertical jump and reach test has been shown to be reliable in past research.

Reliability coefficient of the group as a whole, .92, was similar to that reported by Johnson and Nelson and Jensen and Hirst of .93. Each experimental group's reliability coefficient was slightly higher, .94 and .96. Consequently, measurements generated by the jump and reach test modification were unquestionably consistent.

At the .05 level of significance, the t-value comparing the mean vertical jump score before and at the end of the training period of the experimental group that trained on the leaper, was found to be non-significant. Those in the experimental group that trained on the leg press evidenced a t-value that was significant at the .05 level. Although vertical jump gains were found in five of the six subjects on the leaper and in all seven subjects training on the leg press, the greatest gains and significant difference in vertical jump gains was only found with the isotonic experimental training group. This may be

attributed to the implementation of the DeLorme-Watkins progressive resistance program.

These results are contradictory to those reported by Blattner and Noble, and Haun. Significant improvement in vertical jumping ability with greatest gains, and significant increase in leg power were all found with isokinetic exercise. Spielman found no significant increase in vertical jump performance in either isotonic or isokinetic exercise programs. Results reported by Holmes are similar to those found in this investigation. The largest vertical jump gains were found in isotonic weight training, but no significant increase in jumping ability between experimental groups. Either isokinetic or isotonic training will increase vertical jumping ability but the greatest significant gains, almost twice those found from isokinetic training, were found with isotonic training.

The t-value comparing mean vertical jump scores of each experimental group to the group as a whole were found to be non-significant at the .05 level. The isokinetic group's results showed a non-significant trend in the same direction as the mean score compared before and after training. This indicates that the gains resulting from isotonic training exceeded the gains of the isokinetic training group and those of the group as a whole.

The results of the final t-test showed non-significance at the .05 level. This result agrees with those reported by Spielman, Haun, and Ruley, who found no significant difference between experimental training groups in increasing vertical jump performance. But, it contradicts Helling who found mean vertical jump scores of the

isokinetic group were significantly higher than the isotonic group. In this study, the null hypothesis stated is retained. There is no significant difference in vertical jump gains between the experimental isokinetic and isotonic training groups. Neither group was shown to be more effective in improving vertical jumping ability.

Summary of Results

The results of the investigation may be summarized as follows:

1) The reliability correlation coefficient was found to be similar to those previously reported for modified vertical jump and reach testing for the whole group.

2) The correlation between the test-retest method of establishing reliability within each experimental group was found to be slightly higher than others previously reported.

3) There was no significant difference found among the mean vertical jump gains and those subjects who performed isokinetic exercise on the 16XB Leaper.

4) There was a significant difference found among the mean vertical jump gains and those subjects who performed isotonic exercise on the Universal Leg Press.

5) There was no significant difference between the mean vertical jump gains and the isokinetic and isotonic experimental exercise groups of the 1983-84 Cornell College women's basketball team.

CHAPTER V

SUMMARY, CONCLUSIONS, RECOMMENDATIONS

The purpose of this investigation was to examine the relationship between two distinct weight training modes, isokinetic and isotonic, as measured by vertical jump gains of the 1983-84 Cornell College women basketball players. Subjects (N=14) were basketball players who indicated a preference during pre-season to compete on the intercollegiate team for the 1983-1984 season.

A modification of the vertical jump and reach test was used as the instrument to measure vertical jump gains. Guidelines were established for testing procedures of the modification in a pilot study. Exercise protocol guidelines for each training program were constructed, distributed and interpreted to the subjects. The subjects were tested prior to their training program and again at the conclusion of the six week program.

Summary

One of the results of this study indicated that a significant reliability correlation exists between test-retest of the modification of the jump and reach test for the group as a whole. After the first three trials and last three trials were averaged and correlation coefficient computed, the result was a significant t-value at the .05 level. Following the same procedure for each experimental group, it was also found that a significant t-value at the .05 level existed. The modification of the jump and reach test used as the instrument in this investigation was found to be reliable. The very high

reliability coefficients may have occurred because of same day testing, the delay between the two administrations not of sufficient time to nullify the recall effect, or a combination of these two factors.

Vertical jump gains were evident in both exercise groups. When mean vertical jump scores of the isokinetic training group before and after the training period were compared, no significant difference was found. Absence of significant differences at the .05 level may be the smallness of sample size, sampling error, and/or chance.

A self-reporting statement by subjects E and H of the isokinetic group expressed extreme fatigue the last two weeks of the training period. Each subject indicated that the pounds attained on the 16XB Leaper declined. This may be attributed to the production of gains more quickly than isotonic training and the subjects were experiencing a plateau or de-training effect. Studies suggest that isokinetic equipment reduces the chance of muscle soreness due to the lack of performance of eccentric contraction. None of the six subjects reported any muscle soreness.

When the mean vertical jump scores of the isotonic training group before and after the training period were compared, a significant difference at the .05 level was found. Nearly double the gain (in inches) was seen in the isotonic training group. This may be attributed to the established progressive resistance exercise protocol for development of leg strength and power by DeLorme-Watkins. The greatest gains might also be accredited with specificity of training. The isotonic training procedure more closely resembled the

modification of the vertical jump and reach test.

Each experimental groups' mean vertical jump gains were compared to those of the group as a whole. The results indicated no significant difference between either the isokinetic or isotonic training group and the group as a whole. These non-significant t-values were assumed to be due to sampling errors and sampling size. Another possible reason for the absence of significant differences may be the lack of diversity in the samples being compared. Women basketball players in either experimental training group did not differ greatly from each other in vertical jumping ability. Perhaps differences will appear at a significant level when vertical jump gains of subjects from a major Division I or II program are compared to those of a Division III program.

A statistical analysis comparing the mean vertical jump gains of the isokinetic training group and the isotonic training group was also computed. Again, no significant difference between the means of the two training modes was found.

If the subjects and results of this study are representative of the general population of intercollegiate women basketball players, it appears that neither weight training mode is superior in production of explosive leg power as measured by vertical jump gains using a modification of the vertical jump and reach test. Although vertical jump gains were evident in 12 of the 13 subjects tested at the conclusion of the training period, a significant difference between the means did not exist. Acceptance of the null hypothesis indicates evidence that comparative research is neither substantiated nor

unsubstantiated.

Conclusions

Based on the results obtained from this study, the following conclusions were made:

1) The vertical jump and reach modification was a reliable testing instrument to measure explosive leg power with this particular investigation and sample.

2) Vertical jump gains were evident in both exercise groups. Greater vertical jump gains can be obtained from isotonic exercise.

3) There was no significant difference between the mean vertical jumps when the correlations were computed within the training group before and after the training period of those subjects who performed isokinetic exercise on the 16XB Leaper. Therefore, isokinetic exercise has no advantage in increasing explosive leg power as measured by vertical jump gains.

4) There was a significant difference between the mean vertical jumps when the correlations were computed within the training group before and after the training period of those subjects who performed isotonic exercise on the Universal leg press. Isotonic exercise improves explosive leg power as measured by vertical jump gains.

5) Practical significance of isokinetic exercise from self-reporting, discloses maximal vertical jump gains established in a shorter length of time and muscle soreness diminished.

6) Isotonic equipment offers visual feedback as the exerciser can see the amount of weight being lifted, therefore serving as a motivational stimulus.

7) There was no significant difference between mean vertical jump gains by isotonic exercise and mean vertical jump gains by isokinetic exercise when correlations were computed between the training groups after the training period. Neither isokinetic exercise nor isotonic exercise appears to be superior in developing explosive leg power.

Recommendations

As a result of the implications and conclusions of this study, the following recommendations have been made:

- 1) Replication of this study with a larger sample.
- 2) Replication of this study using samples from different levels of collegiate women's basketball programs and investigations where the single sport athletes (basketball) are the subjects.
- 3) Place more emphasis on maximum effort for each trial.
- 4) Control the circumstances surrounding the subjects' actual workout period and the time of day it took place to encourage maximum effort and reduce errors in exercise technique.
- 5) Check vertical jump gains during designated periods of the training session to help determine length of time necessary for maximal gains.
- 6) Repeat a similar investigation with only isokinetic exercise, emphasizing exercise protocol and speed of activity to help formulate conclusiveness in the area of training speed.

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Appendix A

NAME: _____

VERTICAL JUMP AND REACH PRE-TEST

Reach Height: _____

Jumped Height: Trial One: _____ Two: _____ Three: _____
Four: _____ Five: _____ Six: _____

AVG: _____

VERTICAL JUMP AND REACH POST-TEST

Jumped Height: Trial One: _____ Two: _____ Three: _____
Four: _____ Five: _____ Six: _____

AVG: _____

Appendix B

DATE	PROGRAM	NAME
ACTIVITY: LEG PRESS		
W E E K	_____	1 Set/10 reps @ 1/2 10RM
	_____	1 Set/10 reps @ 3/4 10RM
1	_____	1 set/10 reps @ 4/4 10RM
		2 min. rest between sets
<hr/>		
W E E K	_____	PROGRESSIVE RESISTANCE
	_____	Check Maximum every week
2	_____	1 1/2 min. rest between sets
<hr/>		
W E E K	_____	PROGRESSIVE RESISTANCE
	_____	Check Maximum every week
3	_____	1 min. rest between sets
<hr/>		
W E E K	_____	PROGRESSIVE RESISTANCE
	_____	Check Maximum every week
4	_____	45 sec. rest between sets
<hr/>		
W E E K	_____	PROGRESSIVE RESISTANCE
	_____	Check Maximum every week
5	_____	45 sec. rest between sets
<hr/>		
W E E K	_____	PROGRESSIVE RESISTANCE
	_____	Check Maximum every week
6	_____	30 sec. rest between sets

Appendix C

DATE	PROGRAM	NAME
ACTIVITY: LEAPER		
W E E K	_____	3 sets/10 reps @ 35 sec.

1		2 min. rest between sets
<hr/>		
W E E K	_____	3 sets/20 reps @ 35 sec.

2		2 min. rest between sets
<hr/>		
W E E K	_____	3 sets/30 reps @ 45 sec.

3		1 1/2 min. rest between sets
<hr/>		
W E E K	_____	4 sets/30 reps @ 40 sec.

4		1 1/2 min. rest between sets
<hr/>		
W E E K	_____	4 sets/35 reps @ 35-45 sec.

5		1 min. rest between sets
<hr/>		
W E E K	_____	4 sets/35 reps @ 30-40 sec.

6		1 min. rest between sets