A COMPARISON OF TWO PLYOMETRIC TRAINING TECHNIQUES

THESIS

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The purpose of this study was to investigate two different plyometric training techniques for increasing vertical jumping ability. Twenty-four female high school volleyball players were matched for height and weight and distributed equally among three groups. Each subject performed a vertical jump test, Margaria power test, Wingate bicycle test, and an isokinetic leg strength test prior to and following six weeks of training. Plyometric training significantly ($p < .05$) improved vertical jumping ability and some indices of leg strength and power. Weighted plyometrics did not enhance performance more than plyometrics alone. These data support the view that plyometric training with or without added weights enhances vertical jumping and leg power.

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CHAPTER I

INTRODUCTION

Explosive leg power is a necessary component of many sport skills, including the volleyball spike, the basketball "slam-dunk", and the running long jump in track and field. Various techniques have been proposed over the years to improve explosive power and athletic jumping performance. Plyometric training represents one such technique to improve the vertical jumping ability required for successful performance in volleyball, basketball, track and field and other competitive sport activities (Brzycki, 1984). Plyometric training, as a conditioning technique, has also received a great deal of recent attention in the strength training profession (Costello, 1984).

Plyometric drills (syn. plyometric training) are exercises in which the athlete, using a forced eccentric contraction (such as a drop from height), attempts to increase vertical jumping performance (Bedi et al.,1987). Plyometric training may thus represent a possible link between absolute strength and explosive power. The term plyometrics has been applied to those drills or exercises whereby the muscle is forcefully pre-stretched prior to a concentric contraction (Chu, 1983).

The term plyometrics is believed to be derived from the Greek word "pleythyein" meaning to augment or to increase. It may also have originated from the Greek root words "pilo" and "metric", meaning more and measure, respectively (Hatfield, 1983). Plyometric training was first popularized in the Soviet Union in the 1960's (Costello, 1984). In the USSR, it is commonly held that in order for an athlete to be able to apply force rapidly, training should be conducted at speeds that simulate actual performance velocities. Soviet sport scientists and coaches have thus concluded that an exercise which places the muscle group in forceful eccentric contraction, immediately followed by a concentric contraction, would develop the athlete's ability to produce greater muscular power (Hatfield, 1983).

Depth jumping is one of many plyometric training techniques. To execute a depth jump, the athlete steps to the ground from a shelf generally 0.2 m or higher. Immediately upon landing, the athlete performs a maximal effort vertical or horizontal jump (Bedi et al., 1987). Athletes participating in training programs in which depth jumps were included, have been reported to have markedly increased their vertical jumping ability (Blattner and Noble, 1979; Polhemus, 1981; Steben and Steben, 1981; and Clutch et al., 1983). The gain "is supposed to be due to an improvement in mechanical output of muscles, triggered by overload of the muscles during the execution of the drop jumps" (Bobbert et al., 1987a, p.332). The improvements associated with depth jumping have been attributed to the myotatic (stretch) reflex (Thomas, 1988). The stretch reflex acts as an involuntary defense mechanism resulting in muscular contraction, as the body attempts to protect the muscle from a sudden forceful stretch. Training effects brought about by the myotatic reflex have been vigorously debated. Brown et al. (1986) proposed that depth jumping appeared to train the muscle to contract faster, perhaps in response to an augmentation of the myotatic reflex. However, Grillner (1975), demonstrated that physical activity utilizing the stretch reflex must be timed (between 140 and 260 milliseconds) to make the best use of this reflex. Based on that finding, Steben and Steben (1981) suggested that whatever occurred internally following plyometric training had to happen faster than the time required for a potentiation of the reflex arc. They supported the viewpoint that performance enhancement facilitated by plyometric training, was due to an elastic recoil rather than a reflex phenomenon. Their rationale was based upon the premise that part of the energy used during the negative phase of work may be used in the positive work phase. Further, the return of energy, augmented by the skill of the athlete, made available additional energy for the subsequent contraction. Elastic recoil, according to

Cavagna et al. (1968), occurs when a muscle is pre-stretched and then immediately contracted. The muscle then produces a greater force than a muscle which contracts without such pre-stretch.

The effectiveness of training by depth jumping depends on the height of the descent, number of repetitions per set and the number of sets per routine. Novkov (1987) suggested that the optimal jump height should be 0.7 m for an athlete whose body mass was 70 to 90 kilograms. If the athlete's mass was greater than 100 kilograms, the distance should be reduced to 0.5 m (this lower height would help prevent injuries). Novkov also recommended that jumps should be performed every other day, building to four sets of 10 repetitions, with rest periods of up to 4 minutes between sets.

It has been previously demonstrated that depth jumping exercises would improve performance of vertical jumping ability (Scoles, 1978; Grigas, 1982; Miller, 1982). Strength training allows muscles to apply large amounts of force, but such training alone will not necessarily improve vertical jump performance (Semenick and Adams, 1987). Empirical evidence suggests that a progression which includes a strengthening of the muscles of the "jumping chain" (gluteals, quadriceps, hamstrings, gastrocnemius, soleus, trapezius and deltoids) together with regular jump training may also help the athlete maximize jumping ability

(Stone and Obrien, 1984). Jump specific drills teach the athlete to apply the force achieved through strength training over a shorter period of time. This force, applied faster, generally permits more powerful muscular contractions (Semenick and Adams, 1987). Therefore a combination of plyometric training performed with added weights should contribute to increased leg strength, as well as to vertical jump performance. Many researchers have examined the benefits of strength training alone but few have investigated the benefits of strength training together with plyometric training.

Need for the Study and Research Questions

Plyometric jumping is a training method which improves the vertical jumping ability of its practitioners. The improvement in vertical jumping performance is critical in sports that utilize repetitive jumping such as volleyball, basketball, track and field or gymnastics. Previous studies (Bosco and Komi, 1980; Clutch et al, 1983, and Costello, 1984) have examined the peak power and concentric force development in response to plyometric training or to changes in jumping technique. Weight training has been thoroughly investigated by several researchers (Berger, 1962; Berger, 1963; and Delorme and Watkins, 1948), but few studies have investigated plyometrics alone versus weighted plyometrics.

This study focused on the following research questions:

1. Would participating in a depth jumping program with hand-held weights improve vertical jump ability more than depth jumping without weights?

2. Would a weighted depth jumping program improve leg strength and leg power more than a non-weighted plyometric program?

Statement of Hypothesis

The purpose of the present study was to investigate two different plyometric training techniques for increasing vertical jumping ability. One method employed depth jumping while holding weights. The other method involved traditional depth jumping without weights. Accordingly, the null hypotheses adopted under the present design were:

1. There would be no statistically significant differences in vertical jumping ability of subjects performing plyometric training with added weights versus subjects training without weights.

2. There would be no statistically significant differences of the leg power, as assessed by the Margaria-Kalamen Power Test (Margaria, 1966), of the weighted versus non-weighted groups.

3. There would be no statistically significant differences of leg strength, as measured by isokinetic knee

flexion and extension (Omnitron; McArdle et al., 1981) of the weighted versus non-weighted groups.

4. There would be no statistically significant differences of anaerobic power or capacity, as assessed during a 30 second all-out bicycle test (Wingate Test; Bar-Or, 1977) of the weighted versus non-weighted groups.

Definitions and/or Explanations of Terms

For the purpose of clarification, the following definitions and/or explanations of terms have been established for the proposed study.

Plyometric drills (syn. Plyometric Training)

"Also known as stretch-shortening cycle drills, are exercises in which the athlete, by forced eccentric contraction, such as a drop from height, attempts to increase the following exercise performance" (Bedi et al., 1987, p.11).

Depth Jumping

A type of plyometric exercise that utilizes body weight and the force of gravity to exert force against the ground. Depth jumps are usually performed by stepping off a box from heights of 0.2 to 1.1 m. Upon making contact with the ground, the body is forcefully moved upward (Chu, 1984).

Myotatic Reflex (syn. Stretch Reflex)

A myotatic reflex occurs when the muscle is stretched rapidly and with a large amount of force. Muscle spindles inside the muscle respond to the sudden stretch by sending afferent neural signals to the spinal cord, resulting in a muscular contraction to resist the sudden stretch (deVries, 1977).

Amortization Phase

The first phase of a depth jump. It occurs as a result of yielding work, forcing a rapid stretch of the lower body extensor muscles, and includes the time from ground contact to reversal of movement (Verhoshanski, 1969).

Stored Elastic Energy

It is related to elastic recoil and it occurs when a muscle contracts immediately after being stretched. The stored energy can be dissipated as heat or re-used for contraction (Thomas, 1988 and Cavagna, 1977).

Isokinetic Strength

During an isokinetic contraction the tension developed by the muscle, as it shortens at constant speed, is maximal at all joint angles throughout the full range of motion (Fox et al., 1988).

Anaerobic Power

Also known as explosive power, it is directly related to the utilization of the ATP-PC system (Fox et al., 1988).

Anaerobic Capacity

Anaerobic capacity is a function of the ability of the ATP-PC and lactate systems to produce energy (Noble, 1986).

Leg Power

The term explosive power has been associated with anaerobic metabolism. Power is performance of work expressed per unit of time. Thus leg power represents the ability of the legs to convert energy to power (Fox et al., 1988.)

Concentric Contraction

A type of muscle contraction whereby shortening occurs. (deVries, 1977.)

Eccentric Contraction

A type of muscle contraction whereby lengthening occurs. (deVries, 1977.)

Delimitations of the Study

This study was subject to the following delimitations:

1. Participation was restricted to female, high school, volleyball players ranging in age from 14 to 16 years.

2. Depth jump training was limited to six weeks, training three times per week.

3. Strength and power tests included computerized isokinetic measurements of lower leg flexion and extension, and the Margaria-Kalamen Power Test.

4. Anaerobic power was determined by the Wingate Test.

5. The vertical jumping performance was assessed using a modification of the Sargent Test.

Limitations of the Study

This study was subject to the following limitations:

1. Any training effect the subjects might have gained in vertical jumping performance from practicing volleyball skills and/or participating in another sport such as basketball, was beyond the control of the investigator.

2. General health and/or sickness that may have affected the subject's performance or effort during the six weeks was beyond the control of the researcher.

3. Developmental differences that may have effected the subjects' performance or skill level was beyond the control of the investigator.

4. The subject's motivation level during pre-testing, training, and post-testing was beyond the control of the investigator.

CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

Plyometric training is a technique of conditioning muscles to perform more effectively, develop greater power, and improve the vertical jumping performance of athletes. When this technique is properly employed, a muscle is forced to lengthen immediately prior its concentric contraction. Several investigators have noted the benefits of plyometric training with respect to improvements in vertical jumping height (Scoles, 1978; Grigas, 1982; Miller, 1982; and Brown et al., 1986). Previous studies have also examined the influence of the height of drop jumping on vertical jump performance (Bobbert, et al., 1987b) and the type of jumping technique on the biomechanics of jumping (Bobbert, et al., 1987a). Other researchers have compared the benefits of weight training to plyometric training (Parcells, 1976; Blattner and Noble, 1979; Polhemus et al., 1980; Ford et al., 1983; and Clutch et al., 1983). More research is needed examining the combined effects of weight training with plyometric training, versus plyometric training alone.

Background to Depth Jumping

Depth jumping is a method of training and developing the explosive strength and reactive ability of the neuromuscular system. In a depth jump, the subject steps or jumps off a platform and immediately after landing, executes a vertical jump. In a discussion of plyometric exercise, Verhoshanski (1969), divided depth jumps into three phases. The first phase, referred to as amortization, occurs as a result of yielding work forcing a rapid stretch of the lower body extensor muscles. In the second phase, the muscles perform a reactive switch from yielding work, to overcoming work, to initiate a positive vertical velocity. Third, is the phase of active takeoff. The extensor muscles contract to perform the jump. The first phase stretches the extensor muscle groups, the second is a reactive recovery, and the third utilizes the benefit of a reciprocal increase of force during contraction.

There seems to be a disagreement as to what accounts for gains in performance due to plyometric drills. Practitioners (Ozolin, 1973 and Wilt, 1975) feel that performance is enhanced by utilizing the stretch-reflex, while researchers (Cavanaugh and Kaneko, 1977; Cavagna, Komarek and Mazzoleni, 1971; and Cavagna, Thys, and Zamboni, 1976) attribute the immediate return of mechanical energy to an elastic rather than reflex phenomenon. Steben and Steben (1981), in their study on the validity of stretch shortening cycle (plyometric) drills, suggested that the improvements due to plyometric training were facilitated by an increase of stored elastic energy. They further added that training was performed at maximum velocity suggesting there was too little time for a reflex mechanism to contribute to gains in performance. In contrast, Brown et al.(1986) concluded that gains brought about through plyometric training were in response to the myotatic reflex. Approximately 57% of the vertical jump gain in their plyometric training group was due to jumping skill improvement. Thus plyometric training appears to maximize the coordination of neuromuscular skills.

Plyometric Training

Individuals who have participated in depth jump training programs have consistently been reported to increase their vertical jumping height (Scoles, 1978; Grigas, 1982; Miller, 1982; and Brown et al., 1986). The effects of depth jumping on the vertical jumping ability of male college basketball students was initially studied by Grigas (1982). Thirty-one students were assigned to two groups. One group participated in an intermediate basketball class and was not involved in a depth jumping program. The other group participated in class activities along with depth jump training. Heights of the depth jumps progressed from 0.76 m to 1.11 m over an eight week period. Grigas concluded that the depth jumping group showed a significant increase in vertical jump performance, whereas the "activities" group displayed no significant increase in their vertical jumping height.

A similar study demonstrated significant improvements in female subjects' vertical jump height (Miller, 1982). Subjects in a plyometric training group performed five sets of 10 repetitions of depth jumps, once a week, for eight weeks. Another group served as a non-training control. The depth jump group improved their vertical jump performance by more than 0.05 m, a significant increase, while the control group showed no appreciable change.

Brown et al. (1986) used male high school basketball players as subjects. Their study resulted in gains of 0.07 m and 0.03 m in the plyometric and basketball training groups, respectively.

Scoles (1978) conducted a study to compare the effects of depth jumping and flexibility training on jumping performance. The depth jumping group performed jumps from a height of 0.75 m, for eight weeks, twice a week. The investigation revealed that depth jumping had no significant effect on increasing the vertical jump and standing long jump scores. However, he added that greater jumping heights were recorded by the depth jumping group than from the stretching group.

Weight Training and Plyometric Training

Weight training programs have also been used to increase leg power necessary for improving jumping performance. In studying improvements in vertical jump height, researchers have compared weight training to plyometric training. Blattner and Noble (1979) compared the effects of isokinetic training and depth jumping training on vertical jumping performance. The authors believed that the advantage of isokinetic exercise over traditional concentric training was that isokinesis permitted the muscles to work at maximal force throughout the entire range of motion thereby providing a greater training stimulus. Yet, they found no significant difference between the groups in terms of jumping performance. Both programs resulted in dramatic improvements of jumping ability of 0.049 and 0.053 m for isokinetic and plyometric programs, respectively. However, it was pointed out that, while both methods involve similar expenditures of time and effort, isokinetic training requires the use of expensive equipment, which may make plyometric training more attractive to the coach or trainer.

Clutch et al. (1983) investigated the effects of depth jumps and weight training on leg strength and vertical jump height. Group I trained by executing maximal vertical jumps; Group II performed depth jumping from a height of 0.3 m; and Group III employed a depth jumping program of 0.75 and 1.1 m. All three groups also participated in a conventional weight training program. The results showed that all three training groups increased their one repetition maximum squat strength, isometric knee extension, and vertical jump. There was no significant difference in improvements by the three groups.

Parcells (1976) assigned 45 college males to one of three groups: a depth jumping, weight training, and a control group. The depth jumping program included exercises performed two times a week for six weeks. The weight training group performed half-squat knee bends into heel raises. The control group was not allowed to participate in either a weight training or depth jumping program. Parcells concluded that the depth jumping program increased vertical jumping ability, while the weight training program did not.

Ford et al. (1983) studied the effects of three combinations of plyometric and weight training programs on selected physical fitness test items. Ford's five test items included sit-ups, 36.5 m [40 yard] dash, shuttle run, pull-ups, and vertical jump. One group participated in units of wrestling and softball in combination with plyometric training. Another group participated in a weight training program. A third group participated in a combined program of weight training and plyometrics. Both plyometric training groups performed depth jumps while wearing 9 kg weighted vests. All groups improved significantly on the vertical jump, but the mean scores of the weight training and weight training-plyometrics groups were substantially better than the wrestling-softball-plyometric group. Ford and his colleagues concluded that weight training and plyometrics in combination with other activities will improve physical fitness. They also suggested that further research should include a control and a training group using plyometrics only.

Similarly, Polhemus et al. (1980) investigated the effects on women basketball players and swimmers by comparing a combination of weight training and plyometric training with ankle and vest weights to a conventional weight training program. Three events were studied: vertical jump, standing long jump and 36.5 m [40 yard] dash. One experimental group combined weight training with a plyometric program using ankle and vest weights. A control group performed the same weight training but without plyometrics. After a six week training period, the control group improved from an average of 0.45 m to 0.49 m. A significant increase of 0.04 m. The test group improved 0.10 m, from an average of 0.43 m to 0.53 m. According to the authors, plyometric drills made a "considerable positive change".

Another study (Blakey, 1984) resulted in significant increases in leg strength and power through combined weight training and plyometrics. The author indicated that the study did not enable separation of contributions due to weight training or depth jumping, and suggested the need for further research to determine the effects of depth jumping alone.

Current Theory of Plyometric Training

The researchers in the foregoing studies provide little or no explanation for the physiological adaptations which might permit a subject to increase vertical jump height as a result of weighted plyometric training. However, there are currently two theories that may contribute to these improvements.

The first theory is the theory of stored elastic energy. Strength training has been shown to increase the speed and power of muscle contractions (Berger, 1963) concommittant with hypertrophy which occurs as a result of overloading the muscles. This hypertrophy allows the muscle to produce more force. The greater the force, the more the elastic elements can be stretched, thus storing elastic energy (Cavagna, 1977). Fox et al.(1988) theorizes that an athlete, through training, could learn to better time their voluntary muscle contractions in order to match up with any release of stored energy.

The second theory that may contribute to improved performances as a result of weighted plyometric training is neuromuscular facilitation via the myotatic reflex. Strength training may in some way change the recruitment pattern and synchronization of motor units (Fox et al., 1988). During the myotatic reflex golgi tendon organs are activated by the sudden stretch placed upon them by the contraction of the muscles, in whose tendons they lie. They send information to the spinal cord causing the contracted muscle to relax. Stimulation of the tendon organs results in inhibition of the muscles in which they are located. Fox et al. (1988) suggests that a reduction in inhibition by the central nervous system with concommittant increases in strength would also seem to be a reasonable change that could be learned through strength training programs. As a result of the removal of reflex inhibition of motor units, there could be an expansion of the recruitable motor neurons. That would translate into a greater increase in strength performance following plyometric training.

Methods of Design

Various training methods have been employed in researching the benefits of plyometric training. Although depth jumping seems to be universally accepted as a training method for improving the vertical jump, the search for the optimum drop height continues. Greenwood and Hopkins

(1976), in studying the soleus during landings from heights of 0.2 - 0.95 m, showed an increase in the electromyographic tracings just prior to impact, indicating that more activity (tension) was present when landing from a higher elevation. Greater tension development leads to a faster absorption of impact momentum. They further suggested that a faster propulsive impulse, with a higher peak force, could be expected because of the influence of pre-stretching on the subsequent concentric muscle contraction.

Verhoshanski (1969, 1973, 1983) experimented with depth jumps as a training method to increase speed-strength abilities of Soviet jumpers. He recommended using a height of 0.75 m to achieve maximum speed and 1.1 m to bring about maximum dynamic strength. Verhoshanski (1969, 1973) also recommended two 40-jump training sessions per week, broken into four sets of 10 repetitions per session.

In agreement with the previous study, another Soviet "expert" on depth jumps (Novkov, 1987), advised jumping every other day from an optimal drop height of 0.7 m, building to four sets of 10 repetitions. Differing drop heights seem to vary with respect to the end result desired. If strength is desired, a higher drop height (up to 1.1 m) is suggested. If speed is the desired goal, smaller heights are recommended.

In addition to speed and strength considerations, gender also seems to play a role in depth jump gains. Komi and Bosco (1978) compared both sexes in depth jumping performance. They found that for males, the maximum vertical height was achieved when the depth jumps were made from 0.26 m to 0.62 m. The females' maximum was from 0.2 m to 0.5 m. Bobbert et al. (1987b) studied the influence of dropping height on the biomechanics of drop jumping. Subjects executed bounce drop jumps from heights of 0.2 m, 0.4 m, and 0.6 m. During a bounce drop jump, the downward velocity is reversed into an upward one as soon as possible after landing. Since the peak force during a drop jump from 0.6 m is reached in such a short time, Bobbert and his colleagues suggested that joints regularly placed under great impact forces will eventually suffer degenerative changes in articular cartilage and subchondral bone. For this reason, the authors saw no advantage in performing bounce drop jumps from heights of 0.6 m or more. They advised a limit of 0.4 m.

Brown et al.(1986) verified the findings of the previous study and found that the greatest myoelectrical activity and jumping height resulted after depth jumping from heights of 0.4 m.

In summary, at dropping heights much greater than 0.4 meters, too much force is required to counteract the fall. At lower heights, insufficient training stimulus is applied to the muscle (Bosco et al., 1982).

Measurement Procedures

In determining gains in the vertical jumping ability of subjects, it is necessary to determine their strength, power and capacity for short term maximal exercise. Tests are often used to develop standards by which to compare results at the beginning and end of a training cycle. The emergence of microprocessor technology has made possible a rapid way to accurately quantify muscular strength (McArdle, Katch and Katch, 1981). This technology is known as computer-assisted isokinetic assessment. Using this methodology, a subject pushes vigorously, throughout the flexion and extension movement, and an electronic sensor records the force generated. Several studies have validated the use of isokinetic techniques (Davies and Gould, 1982; Marras et al., 1986; and Rowe, 1969).

In a study on lift testing using computerized isokinetic assessment Porterfield et al. (1987) recognized that this method of testing allows a muscle to be loaded to its maximum at all points throughout the range of motion. They also listed benefits such as variable speed settings and a safety control factor that assures the resistance is equal to the force applied. For these reasons, computerized isokinetics is often the method of choice to determine strength values.

Performance tests that cause maximal activation of the ATP-CP energy system have been developed to provide practical "field tests" to evaluate energy transfer (Saltin, 1973). One such test is the Margaria Power Test. During this test, a subject stands 6 meters away from a flight of stairs, then runs as rapidly as possible up the stairs, two steps at a time. The time required to cover the distance between stair 2 and stair 6 is recorded to the nearest .01 seconds (Matthews and Fox, 1976).

Another valid estimate of the capacity to develop power through anaerobic sources is the Wingate Test. The Wingate Test consists of 30 seconds of exhaustive cycling against a resistance relative to body mass. The Wingate Test has been used by a growing number of laboratories (Evans and Quinney, 1981; Inbar and Bar-Or, 1975). Its reliability and relationship to short-time field performance have been validated time and again (Bar-Or et al., 1977 and Inbar et al., 1981). The highest five-second power output of the Wingate Test was found to correlate with power output during the Margaria test, and the mean 30 second power output correlates with maximal oxygen debt (Bar-Or et al., 1977). Consequently, it has been hypothesized by Bar-Or et al. (1977) that the highest five-second power output reflects maximal anaerobic power generated by the intramuscular phosphogen stores. Bar-Or also hypothesized that the mean 30-second power output represents the overall anaerobic capacity (composed predominately of glycogenolytic components) leading to lactate formation.

Summary

The recent research literature indicates that the improvements associated with depth jumping are numerous. Various aspects of the jump from prestretch (eccentric phase) to the concentric contraction, employ neuromuscular facilitation via the myotatic reflex and/or stored elastic energy. Yet, few researchers have directly examined the underlying hypotheses surrounding the physiological bases for the gains in vertical jumping height after plyometric training. Theoretically, explosive power should be enhanced because of the combination of stored elastic energy and/or increased recruitment of facilitated motor neurons and their associated motor units. Plyometric training studies reveal that both males and females improve their vertical jumping performance by depth jumping. Although few studies have investigated the optimal dropping height for depth jumps, present research suggests optimal heights are from 0.2 to 0.5 meters for females and 0.26 to 0.62 meters for males, with best results from heights of around 0.4 meters. Most studies which found significant improvement in vertical jumping height, employed training units between six and eight weeks, with sessions every other day, using four sets of 10 repetitions in each session. In comparing weight training programs and plyometric programs, a combination of weight training with plyometrics will improve vertical jumping ability more than weights alone. One study compared plyometrics improved vertical jumping performance, while weight training did not (Parcells, 1976). However, no studies were found that compared a combination of weight and plyometric training with plyometrics alone.

CHAPTER III

METHODS AND PROCEDURES

Overview

The purpose of the present study was to investigate the effects of two dissimilar plyometric training programs evaluated against a nontraining control group. One experimental group performed depth jumps while holding weights. The other experimental group performed depth jumps without any additional weights. Depth jump training required, subjects to step off benches 0.45 m high and immediately upon landing perform a maximal vertical jump.

Subjects

The subjects for this study consisted of 24 female high school volleyball players, ranging in age from 14 to 16 years. The subjects were matched on the basis of body mass, and as a result there were also no statistical differences in height. The subjects were then randomly assigned to three groups and the groups were randomly assigned to three conditions:

1. An experimental group that performed depth jumps while holding weights that were proportional to their

body mass (.075 kilograms per kilogram of body mass). The mass was rounded to the nearest 2.2 kg.

2. An experimental group that performed depth jumps in an identical fashion to the preceding group without additional weights.

3. A control group that performed the pre-tests and post-tests, but while participating in volleyball or basketball practice, did not perform additional plyometric training.

Any subject who missed a training session due to illness was required to make up that session. Subjects and their parent/guardian were required to sign a consent form prior to their participation in the study.

Testing Procedures

Vertical Jump Test

The vertical jump was assessed using the Sargent's Jump and Reach Test (Sargent, 1921). The Sargent Test is scored as the difference between a person's standing reach, and the maximum jump and touch height. The subjects were tested before and after the training period. During the test subjects stood on a flat surface, feet parallel to the wall, with both heels contacting the ground. They were instructed to reach their hand straight up along a scale. The scale was marked in centimeters, and was used to record the distance from the floor to the top of the longest finger. During the jump, subjects were allowed to flex the knees and jump as high as possible, using a two step approach, touching the scale. The height was recorded to the nearest centimeter. Three trials were performed. The criterion measure was an average of the three trials. The same procedure was used during both the pre and post-tests. The subjects were given a verbal explanation and demonstration on how to perform the jump. Two practice jumps were performed by each subject.

Power Test

Muscular power was assessed with the Margaria-Kalamen Power Test (1966). During this test, the subjects ran up a staircase as quickly as possible, taking two steps (0.3 m) at a time. The time to cover the distance between stair 2 and stair 6 was recorded to the nearest 0.01 second. The vertical distance was also calculated. The power output was computed as follows:

P= alactic power in Watts

9.8= normal acceleration of gravity in meters per second squared

M=mass of subject (kg)

D=vertical height between first and second switch mat (m)

T=time from first to second switch mats

$$P = \frac{M \times 9.8 \times D}{T}$$

Each subject was allowed three practice trials. During the actual test three trials were performed and an average of the trials was recorded to the nearest 0.01 seconds.

Strength Test

Strength was assessed using an Omnitron computer-assisted isokinetic device. Before the test each subject performed 5 repetitions, against a resistance of 5, on each leg. To test the strength of the knee flexors and extensors, the subject pushed as hard as possible throughout the flexion and extension movement (McArdle et al., 1981). Three tests were performed on each leg, at "slow", "medium" and "fast" velocities (5 reps against a resistance of 10, 10 reps against a resistance of 5 and 20 reps against a resistance of 2). The resistance was determined by the amount of hydraulic fluid that was forced through an orifice within a metal cylinder. The resistance settings ranged between 1 and 10, 1 represented the least resistance to movement and

10 represented the highest resistance. An electronic sensor recorded the movement of the fluid. Electronic signals were picked up and transferred to a readout box. A printout then compared individual values for peak torque, power and velocity during 5, 10 and 20 repetitions at each of the three velocities, respectively. As each subject performed the test verbal encouragement was given by the non-performing subjects.

Anaerobic Test

The Wingate Test was used to estimate anaerobic power. Each subject listened to the instructions for the test before mounting the bicycle. They also watched a demonstration of the test. There were no practice trials, however each subject pedalled the bike so as to familiarize themselves with the equipment. The test consisted of 30 seconds of exhaustive cycling on a Monark bicycle, against a resistance of .075 kilograms per kilogram of body mass (Bar-Or et al., 1977). Subjects were instructed to pedal as fast as possible for 30 seconds. The resistance was adjusted in the first 3-5 seconds and at that time the clock and the electronic counter were activated. The number of pedal revolutions was recorded every five seconds. The maximum power observed in a five second period represented the subject's peak power and the mean 30s power output represented the overall anaerobic capacity.

Depth Jump Training Procedures

Benches 0.45 m high served as jumping platforms. The subjects stood on the bench with their feet shoulder width apart. Knees were kept slightly flexed and the arms remained at the sides. Upon executing a depth jump, subjects dropped (not jumped) off the benches landing on both feet, with knees bent to absorb the shock. Immediately after landing they performed a maximal vertical jump. The six week study consisted of three training sessions per week, with four sets performed each session. Ten repetitions per set were followed by a rest period of 30 seconds between sets.

Statistical Procedures

The statistical methods utilized in the treatment of data were as follows:

1. The mean (*M*) and standard deviation (*SD*) for all measured variables were calculated.

2. The research design used was a 3 x 2 repeated measures ANOVA (Figure 1).

	Pre-Training	Post-Training
Control	n=8	n=8
Weighted	n=8	n=8
Non-Weighted	n=8	n=8

<u>Figure 1.</u> Research design of 3 x 2 repeated measures ANOVA

3. An alpha level of .05 was adopted to determine where significant differences occurred when significant F ratios were reported.

4. An ANOVA was used to compare all groups in terms of pre and posttest mean scores for vertical jump, anaerobic power (Margaria-Kalamen test), isokinetic strength and anaerobic power and capacity (Wingate test) ($p < .05$).

CHAPTER IV

RESULTS

Introduction

The purpose of this chapter is to present the results obtained from this study and in doing so, accept or reject the null hypotheses. As previously presented, the four primary hypotheses adopted under the present design were:

1. There would be no statistically significant differences in vertical jumping ability of subjects performing plyometric training with added weights versus subjects training without weights.

2. There would be no statistically significant differences of the leg power, as assessed by the Margaria-Kalamen Power Test (Margaria, 1966) of the weighted versus non-weighted groups.

3. There would be no statistically significant differences of leg strength, as measured by isokinetic knee flexion and extension (Omnitron; McArdle et al., 1981) of the weighted versus non-weighted groups.

4. There would be no statistically significant differences of anaerobic power or capacity, as assessed during a 30 second all-out bicycle test (Wingate Test; Bar-Or, 1977) of the weighted versus non-weighted groups.

Statistical Analysis

The mean ($\underline{M}$) and standard deviation for all measured variables were calculated and are presented in Tables 1-9. The repeated measures analysis of variance indicated significant main effects for five variables: namely, two leg strength scores (peak torque during right leg extension at a fast velocity and peak torque during left leg extension at a slow velocity); two Margaria-Kalamen power test scores (peak power and peak power per kilogram of body mass); and the vertical jump test.

Vertical Jump Test

Both plyometric training groups improved their vertical jumping height significantly, over the six weeks of conditioning. There were significant within-subject effects for both trials, $\underline{F}(1,21)=88.02$, $\underline{p}<.05$ and interactions, $\underline{F}(2,21)=26.40$, $\underline{p}<.05$ (Figure 2). There were no significant training effects noted for conditions. The weighted plyometric group showed a gain in vertical jumping height of 11.4%, from a pretest mean score of .34 m to a posttest mean score of .38 m. The non-weighted plyometric group improved 11.0%, from a mean of .32 m to a mean of .36 m. The control group decreased slightly in vertical jumping height from .357 m to .355 m, from pre to posttest, respectively.

Table 1

Physical Characteristics of Subjects

	Pre-training	Post-Training
AGE, yr		
Control	14.4 ± 0.5	
Non-weighted	14.5 ± 0.9	
Weighted	14.0 ± 0.0	
Total	14.3 ± 0.6	
HEIGHT, cm		
Control	163.6 ± 6.2	
Non-weighted	162.2 ± 4.7	
Weighted	167.4 ± 4.4	
Total	164.4 ± 5.4	
MASS, kg		
Control	64.0 ± 16.3	63.8 ± 16.6
Non-weighted	63.3 ± 15.4	63.4 ± 15.0
Weighted	64.5 ± 15.3	63.2 ± 13.5
Total	63.9 ± 15.0	63.5 ± 14.4

Note. Values are means ± S.D.

Table 2

Wingate Anaerobic Power and Capacity Test

	Pre-training	Post-Training
Peak Power, W		
Control	497.8 ± 192.8	435.7 ± 76.3
Non-weighted	398.8 ± 67.8	446.0 ± 105.4
Weighted	450.4 ± 129.9	434.2 ± 102.5
Total	449.0 ± 139.8	438.6 ± 91.5
Peak Power, W·kg^{-1}		
Control	7.71 ± 1.95	7.04 ± 1.65
Non-weighted	6.39 ± 1.36	7.04 ± 1.42
Weighted	7.36 ± 2.07	7.12 ± 1.88
Total	7.15 ± 1.83	7.07 ± 1.59
Anaerobic Capacity, W		
Control	363.8 ± 89.4	330.9 ± 40.0
Non-weighted	316.1 ± 38.0	324.2 ± 61.0
Weighted	353.9 ± 88.4	325.7 ± 73.0
Total	344.6 ± 78.6	326.9 ± 59.6
Anaerobic Capacity, W·kg^{-1}		
Control	5.71 ± 0.93	5.36 ± 1.12
Non-weighted	5.09 ± 1.07	5.13 ± 0.90
Weighted	5.74 ± 1.45	5.29 ± 1.37
Total	5.52 ± 1.16	5.26 ± 1.10

Note. Values are means ± S.D. W represents watts. W·kg^{-1} represents watts per kilogram of body mass.

Table 3
Vertical Jump and Margaria-Kalamen Anaerobic Power Tests

	Pre-training	Post-Training
Vertical Jump, cm		
Control	35.8 ± 6.6	35.5 ± 6.5
Non-weighted	32.1 ± 10.6	36.1 ± 11.6*
Weighted	33.8 ± 7.1	38.1 ± 8.9*
Total	33.9 ± 8.1	36.6 ± 8.8*
Peak Power, W		
Control	649.4 ± 162.8	709.4 ± 148.4
Non-weighted	610.6 ± 146.0	686.9 ± 148.9
Weighted	652.6 ± 127.3	725.8 ± 155.1
Total	637.6 ± 141.0	707.4 ± 145.0
Peak Power, $W \cdot kg^{-1}$		
Control	10.20 ± 1.44	11.22 ± 1.38
Non-weighted	9.60 ± 1.86	10.78 ± 1.87
Weighted	10.46 ± 1.32	11.57 ± 1.17
Total	10.08 ± 1.54	11.20 ± 1.47

Note. Values are means ± S.D. Cm represents centimeters. W represents watts. $W \cdot kg^{-1}$ represents watts per kilogram of body mass. * $p<.05$ pre-training vs post-training.

Table 4
Isokinetic Leg Strength Test (Knee Extension at Slow Velocity)

	Control	Non-weighted	Weighted	Total
Left Leg				
Velocity, deg·s⁻¹				
Pre	81.0 ± 15.1	83.6 ± 10.4	89.3 ± 10.2	84.6 ±12.1
Post	85.0 ± 12.8	84.8 ± 8.0	87.6 ± 6.3	85.8 ± 9.2
Peak Torque, Nm				
Pre	51.3 ± 14.1	51.5 ± 8.6	59.4 ± 12.5	54.1 ± 12.1
Post	54.1 ± 15.2	53.8 ± 8.0	60.8 ± 13.2	56.2 ± 12.3
Peak Power, W				
Pre	89.4 ± 43.5	93.9 ± 23.4	115.0 ± 33.6	99.4 ± 34.9
Post	102.3 ± 40.3	100.8 ± 22.2	109.6 ± 25.6	104.2 ± 29.1
Right Leg				
Velocity, deg·s⁻¹				
Pre	87.8 ± 16.9	88.1 ± 8.3	94.4 ± 8.9	90.1 ± 11.9
Post	95.3 ± 14.1	90.4 ± 10.2	91.5 ± 10.9	92.4 ± 11.5
Peak Torque, Nm				
Pre	56.8 ± 11.9	57.5 ± 8.3	62.8 ± 12.2	59.0 ± 10.8
Post	57.5 ± 12.8	58.8 ± 7.7	63.6 ± 12.1	60.0 ± 10.9
Peak Power, W				
Pre	108.6 ± 53.1	108.6 ± 23.9	125.9 ± 31.9	114.4 ± 37.6
Post	129.0 ± 42.1	116.0 ± 25.6	125.4 ± 41.2	123.4 ± 35.9

Note. Values are means ± S.D. Pre refers to per-training. Post refers to post-training. Deg·s^{-1} is degrees per second of angular knee extension. W is watts. Nm is newton meters.

Table 5
Isokinetic Leg Strength Test (Knee Flexion at Slow Velocity)

	Control	Non-weighted	Weighted	Total
Left Leg				
Velocity, $deg \cdot s^{-1}$				
Pre	79.3 ± 10.8	82.0 ± 7.5	83.8 ± 9.5	81.7 ± 9.1
Post	81.4 ± 14.1	78.9 ± 9.5	83.5 ± 8.2	81.3 ± 10.6
Peak Torque, Nm				
Pre	38.7 ± 10.9	41.2 ± 7.9	42.3 ± 9.2	40.8 ± 9.1
Post	39.4 ± 11.9	38.3 ± 7.9	43.2 ± 8.3	40.3 ± 13.8
Peak Power, W				
Pre	79.3 ± 31.2	80.6 ± 21.6	90.1 ± 29.8	83.3 ± 27.0
Post	82.3 ± 37.4	76.1 ± 20.9	87.9 ± 24.3	82.1 ± 27.6
Right Leg				
Velocity, $deg \cdot s^{-1}$				
Pre	81.0 ± 9.8	88.1 ± 7.0	86.8 ± 7.4	85.3 ± 8.4
Post	82.3 ± 37.4	76.1 ± 20.9	84.9 ± 8.4	85.5 ± 10.0
Peak Torque, Nm				
Pre	40.4 ± 9.9	43.7 ± 9.7	44.6 ± 7.6	42.9 ± 8.9
Post	41.5 ± 11.0	40.1 ± 5.4	42.2 ± 9.1	41.3 ± 8.5
Peak Power, W				
Pre	81.8 ± 29.7	92.1 ± 22.8	92.9 ± 19.1	88.9 ± 23.7
Post	93.3 ± 38.0	82.5 ± 18.4	99.0 ± 36.3	91.6 ± 31.6

Note. Values are means ± S.D. Pre refers to per-training. Post refers to post-training. $Deg \cdot s^{-1}$ is degrees per second of angular knee extension. W is watts. Nm is newton meters.

Table 6

Isokinetic Leg Strength Test (Knee Extension at Medium Velocity)

	Control	Non-weighted	Weighted	Total
Left Leg				
Velocity, $deg{\cdot}s^{-1}$				
Pre	208.5 ± 27.0	201.5 ± 23.9	220.0 ± 23.6	210.0 ± 25.0
Post	208.4 ± 26.9	204.9 ± 22.2	223.3 ± 20.8	212.2 ± 23.8
Peak Torque, Nm				
Pre	80.0 ± 27.8	85.7 ± 31.7	94.1 ± 29.9	86.6 ± 29.1
Post	84.8 ± 28.3	79.1 ± 17.5	97.9 ± 26.3	87.3 ± 24.7
Peak Power, W				
Pre	108.4 ± 37.7	116.1 ± 42.9	127.6 ± 40.6	117.4 ± 39.5
Post	115.0 ± 38.4	107.3 ± 23.7	132.8 ± 35.6	118.3 ± 33.5
Right Leg				
Velocity, $deg{\cdot}s^{-1}$				
Pre	209.3 ± 31.3	204.8 ± 25.0	226.5 ± 26.0	213.5 ± 27.9
Post	215.0 ± 26.4	209.8 ± 23.3	222.0 ± 20.2	215.6 ± 23.0
Peak Torque, Nm				
Pre	31.8 ± 9.8	28.8 ± 4.1	35.5 ± 12.4	32.2 ± 9.6
Post	29.2 ± 6.4	28.1 ± 5.4	32.6 ± 8.5	30.0 ± 6.9
Peak Power, W				
Pre	112.8 ± 45.6	105.9 ± 20.3	120.6 ± 30.4	113.1 ± 32.8
Post	118.6 ± 42.8	111.0 ± 26.3	122.1 ± 26.6	117.3 ± 31.7

Note. Values are means ± S.D. Pre refers to per-training. Post refers to post-training. $Deg{\cdot}s^{-1}$ is degrees per second of angular knee extension. W is watts. Nm is newton meters.

Table 7
Isokinetic Leg Strength Test (Knee Flexion at Medium Velocity)

	Control	Non-weighted	Weighted	Total
Left Leg				
Velocity, deg·s^{-1}				
Pre	233.4 ± 39.6	234.9 ± 30.7	250.8 ± 31.6	239.7 ± 33.6
Post	242.5 ± 40.9	231.3 ± 37.7	254.6 ± 19.7	242.8 ± 34.0
Peak Torque, Nm				
Pre	23.1 ± 5.4	23.0 ± 3.5	25.4 ± 6.6	23.8 ± 5.2
Post	24.3 ± 7.6	23.7 ± 5.1	26.7 ± 5.6	24.9 ± 6.1
Peak Power, W				
Pre	114.3 ± 46.8	108.5 ± 29.6	127.1 ± 43.6	116.6 ± 39.7
Post	121.1 ± 51.8	112.5 ± 35.1	132.5 ± 31.2	122.0 ± 39.5
Right Leg				
Velocity, deg·s^{-1}				
Pre	249.5 ± 26.9	233.5 ± 30.2	255.9 ± 26.6	246.3 ± 28.4
Post	248.3 ± 36.1	237.4 ± 41.4	256.0 ± 27.9	247.2 ± 34.8
Peak Torque, Nm				
Pre	24.4 ± 6.2	27.2 ± 3.5	26.2 ± 5.5	24.4 ± 5.2
Post	24.6 ± 7.6	24.4 ± 4.6	26.7 ± 6.4	25.2 ± 6.2
Peak Power, W				
Pre	125.6 ± 42.4	105.8 ± 29.8	131.1 ± 36.9	120.8 ± 36.9
Post	124.0 ± 49.4	117.5 ± 40.5	132.5 ± 37.5	124.7 ± 41.4

Note. Values are means ±S.D. Pre refers to per-training. Post refers to post-training. Deg·s^{-1} is degrees per second of angular knee extension. W is watts. Nm is newton meters.

Table 8

Isokinetic Leg Strength Test (Knee Extension at Fast Velocity)

	Control	Non-weighted	Weighted	Total
Left Leg				
Velocity, $deg \cdot s^{-1}$				
Pre	250.6 ± 41.8	237.9 ± 26.0	275.9 ± 33.9	254.8 ± 36.7
Post	244.4 ± 38.0	245.1 ± 28.3	251.6 ± 49.1	247.0 ± 37.8
Peak Torque, Nm				
Pre	15.0 ± 4.9	13.7 ± 2.5	15.6 ± 3.2	15.1 ± 3.7
Post	14.9 ± 4.1	14.9 ± 3.5	19.5 ± 8.5	16.4 ± 5.9
Peak Power, W				
Pre	55.8 ± 17.6	62.3 ± 13.6	78.5 ± 19.8	68.8 ± 17.9
Post	67.3 ± 18.4	68.1 ± 17.9	87.3 ± 26.4	74.2 ± 22.4
Right Leg				
Velocity, $deg \cdot s^{-1}$				
Pre	249.0 ± 39.2	242.0 ± 28.5	268.8 ± 33.1	253.3 ± 34.4
Post	252.1 ± 24.7	246.6 ± 24.0	255.6 ± 56.4	251.5 ± 36.7
Peak Torque, Nm				
Pre	15.5 ± 4.1	14.0 ± 2.2	16.8 ± 5.1	15.4 ± 4.0
Post	14.9 ± 3.4	15.5 ± 3.9	23.4 ± 12.1	17.9 ± 8.3
Peak Power, W				
Pre	67.1 ± 19.8	63.8 ± 12.3	74.0 ± 16.3	68.3 ± 16.3
Post	69.5 ± 19.8	70.8 ± 20.0	88.9 ± 21.5	76.4 ± 21.5

Note. Values are means ±S.D. Pre refers to per-training. Post refers to post-training. $Deg \cdot s^{-1}$ is degrees per second of angular knee extension. W is watts. Nm is newton meters.

Table 9

Isokinetic Leg Strength Test (Knee Flexion at Fast Velocity)

	Control	Non-weighted	Weighted	Total
Left Leg				
Velocity, deg·s⁻¹				
Pre	317.3 ± 70.8	312.8 ± 44.4	337.0 ± 34.1	322.3 ± 50.9
Post	281.0 ± 73.6	300.8 ± 67.7	331.6 ± 58.9	304.5 ± 67.5
Peak Torque, Nm				
Pre	12.9 ± 2.4	11.6 ± 1.5	13.5 ± 2.3	12.7 ± 2.2
Post	16.7 ± 10.1	14.7 ± 7.1	15.1 ± 3.5	15.5 ± 7.1
Peak Power, W				
Pre	82.5 ± 35.2	74.5 ± 18.4	89.0 ± 22.9	82.0 ± 26.0
Post	91.5 ± 46.2	85.3 ± 28.7	95.5 ± 19.0	90.8 ± 32.1
Right Leg				
Velocity, deg·s⁻¹				
Pre	328.9 ± 57.4	312.5 ± 44.7	339.6 ± 40.4	327.0 ± 47.3
Post	289.5 ± 59.2	293.8 ± 70.7	334.1 ± 58.9	305.8 ± 63.8
Peak Torque, Nm				
Pre	14.6 ± 3.1	12.8 ± 1.1	12.1 ± 2.1	13.4 ± 2.3
Post	18.0 ± 10.5	14.7 ± 6.5	16.2 ± 3.7	16.3 ± 7.2
Peak Power, W				
Pre	88.1 ± 32.6	74.9 ± 16.3	91.0 ± 22.8	84.7 ± 24.8
Post	97.6 ± 50.1	70.3 ± 32.4	100.6 ± 30.2	89.5 ± 39.4

Note. Values are means ± S.D. Pre refers to per-training. Post refers to post-training. Deg·s⁻¹ is degrees per second of angular knee extension. W is watts. Nm is newton meters.

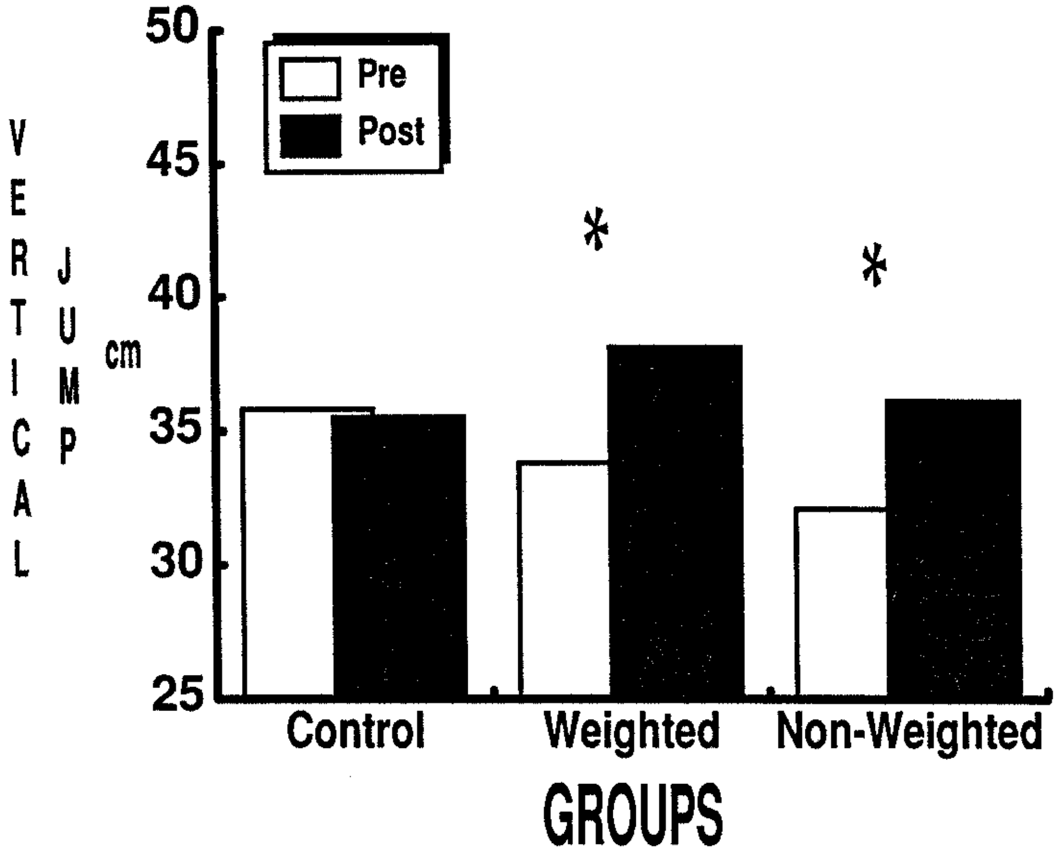

Figure 2. Vertical jump (Note: cm is centimeters, * p<.05 pre-training vs post-training).

Anaerobic Power as Assessed by the Margaria-Kalamen Power Test

All three groups (control, non-weighted plyometric and weighted plyometric) improved their anaerobic power significantly from the pretest to posttest trials. The Margaria-Kalamen peak power scores are displayed graphically in Figure 3. Statistical analysis of pre and posttest means demonstrated a significant within-subject effect for trials, $\underline{F}(1,21)=23.25$, $\underline{p}<.05$. The non-weighted training group demonstrated the lowest pretest mean score of 610.6 W and improved to a posttest value of 686.9 W (an 11% increase). The weighted training group improved from a pretest mean score of 652.9 W to a posttest value of 725.8 W (a 10% increase). The control group improved from a pretest mean score of 649.3 W to a posttest mean score of 709.4 (an 8% increase). No significant main effects were found for conditions, or interactions.

In a similar fashion to the previous results, the differences between pre and posttest peak power per kilogram of body mass scores also resulted in significant within-subjects effects for trials, $F(1,21)=.89$, $p<.05$ (Figure 4). The non-weighted training group improved 11% from a pretest mean value of 9.6 $W \cdot kg^{-1}$ to a mean value of 10.8 $W \cdot kg^{-1}$ in the posttest. The weighted training group improved 10% from 10.5 $W \cdot kg^{-1}$ to 11.6 $W \cdot kg^{-1}$

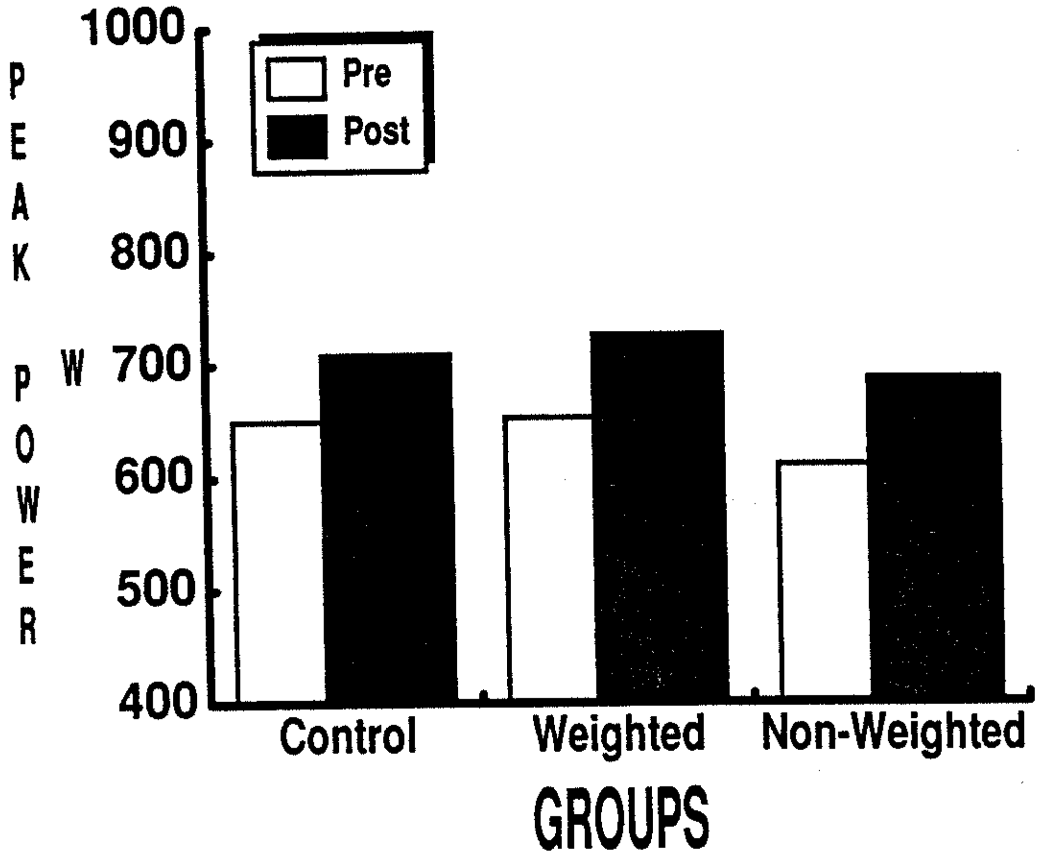

Figure 3. Margaria-Kalamen anaerobic peak power (Note: W is watts).

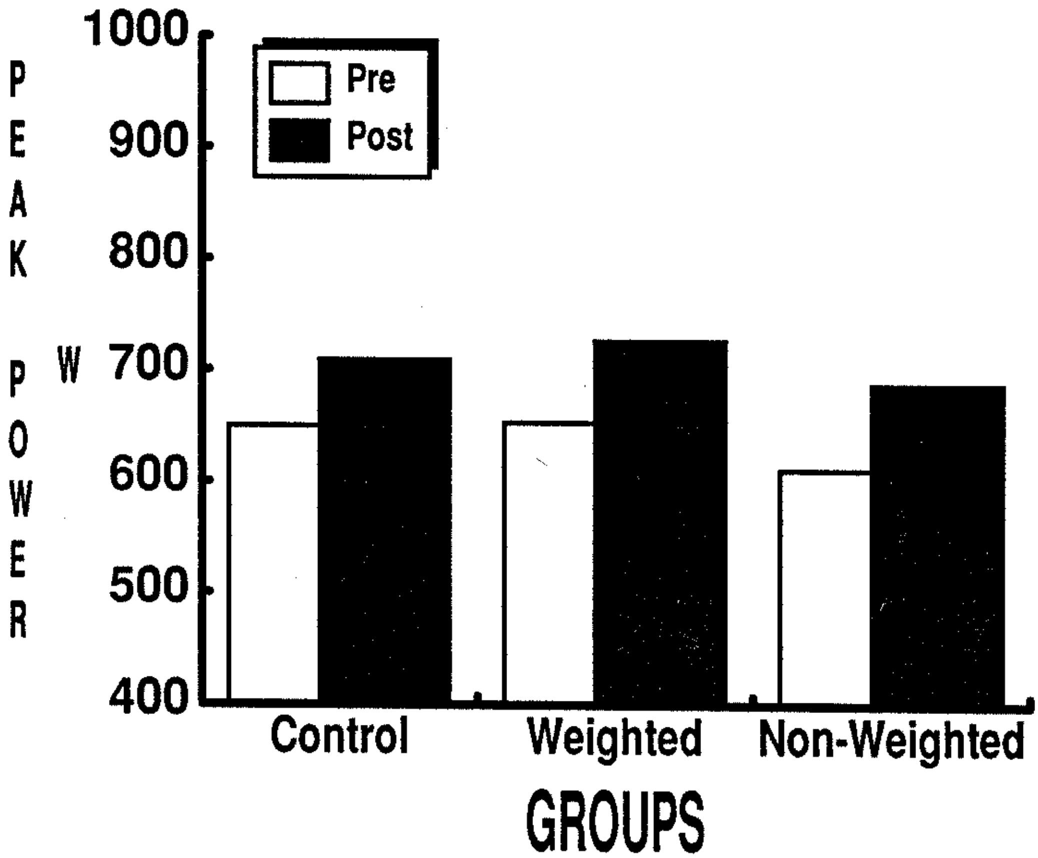

Figure 4. Margaria-Kalamen anaerobic peak power per kilogram body mass (Note: W/Kg is watts/kilogram).

in the pre and posttests respectively. The control group also significantly improved with an 8% increase, from a pretest to a posttest mean score of 10.1 $W \cdot kg^{-1}$ to 11.2 $W \cdot kg^{-1}$. No significant main effects were noted for conditions, or interactions.

Isokinetic Strength Changes During Knee Extension

Peak torque at fast velocity. The ANOVA for differences between pre and posttest Omnitron leg strength scores for the right knee revealed significant between-subject effects for conditions, $F(2,21)=3.88$, $p<.05$ (Figure 5). The control group decreased in strength from 15.5 Nm to 14.8 Nm, after six weeks. Both the non-weighted and weighted plyometric groups increased their strength from a mean score of 14.0 Nm to 15.5 Nm (10% increase) and 16.8 Nm to 23.4 Nm (28% increase) respectively. However, there were no significant main effects for trials or interactions.

Peak torque at a slow velocity. The ANOVA for differences between pre and posttest scores for the left knee revealed significant within-subject effects for trials, $F(1,21)=10.20$, $p<.05$. All groups showed an increase of strength, with the control group demonstrating the greatest increase from 51.2 Nm, during the pretest, to 84.8 Nm during the posttest (an increase of 40%; Figure 6). The weighted plyometric group improved 39%, from 59.4 Nm to 97.9 Nm in the pretest and posttest respectively. The non-weighted

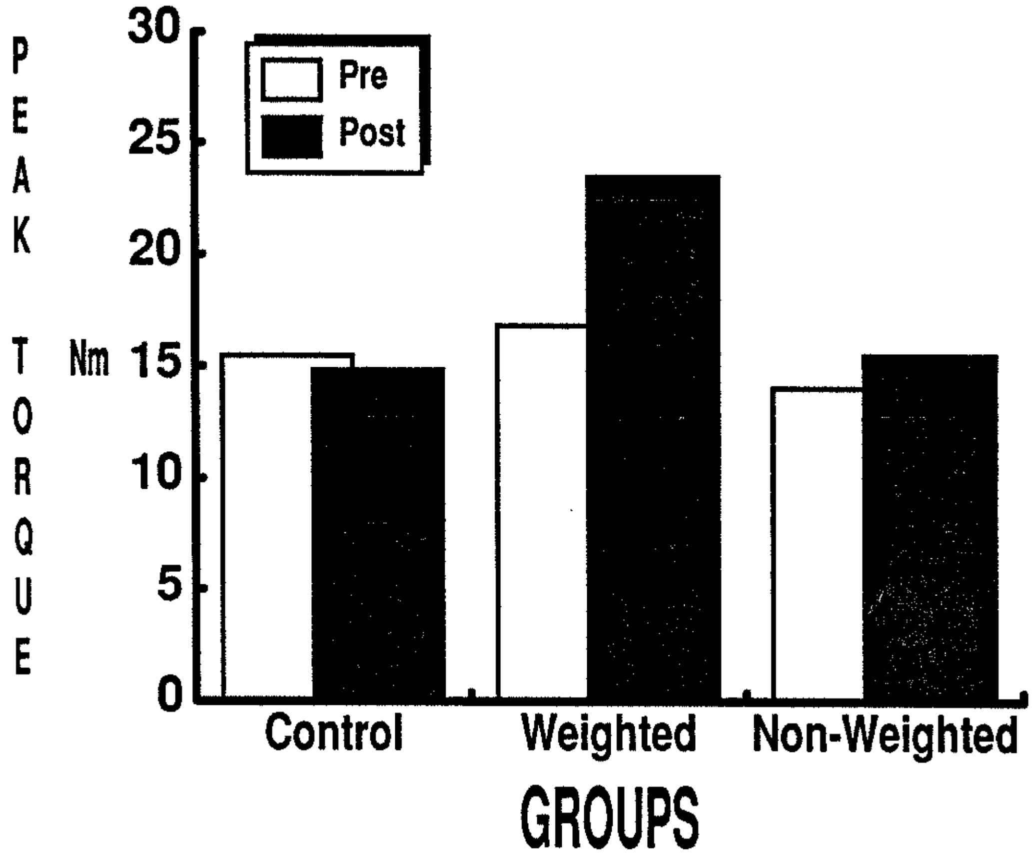

Figure 5. Peak torque during right knee extension at fast velocity (Note: Nm is newton meters).

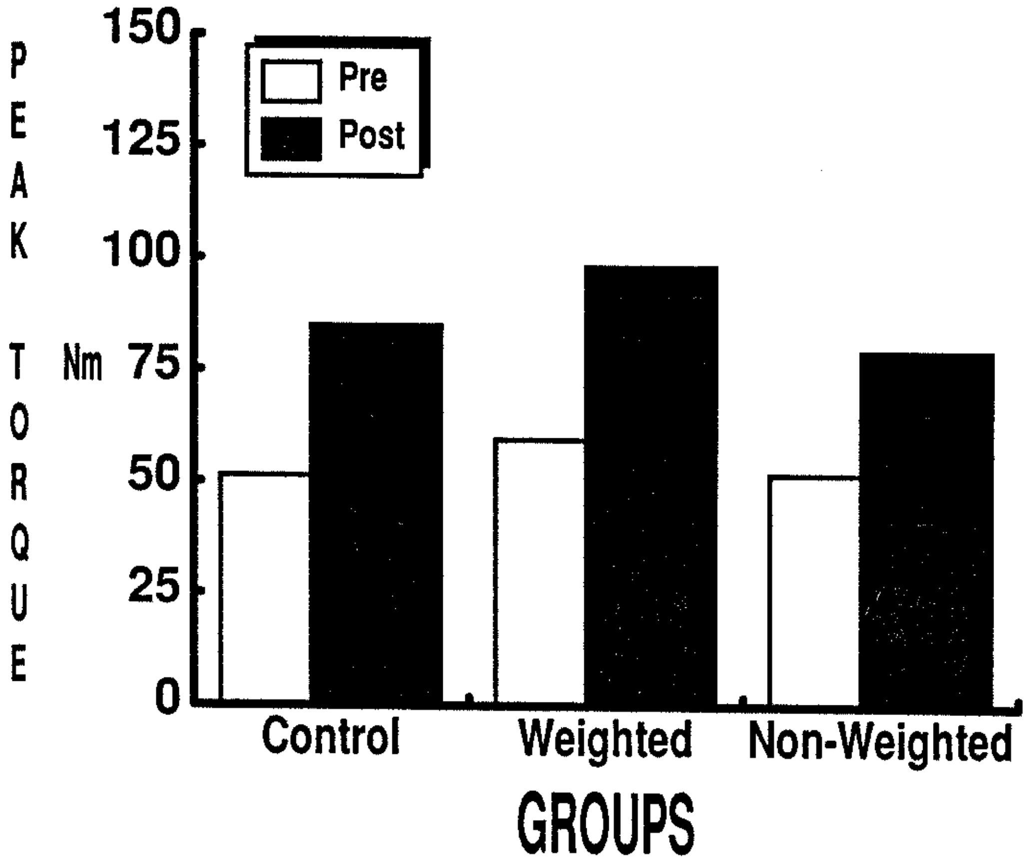

Figure 6: Peak torque during left knee extension at slow velocity (Note: Nm is newton meters).

group improved from a mean score of 51.5 Nm to 79.1 Nm, representing a 35% gain. There were no significant main effects for conditions, or interactions.

Summary of Results

There were significant improvements of 11.4% and 11.0% in vertical jumping height for both the weighted and non-weighted plyometric groups, respectively. All three groups improved their anaerobic power assessed during the Margaria-Kalamen test, from the pretest to the posttest. Increases of 11%, 10% and 8% were demonstrated by the non-weighted, weighted, and control groups respectively. Overall isokinetic strength gains were virtually nonexistent. There were significant increases demonstrated in only two variables, peak torque during right knee extension at fast velocity and during left knee extension at slow velocity.

CHAPTER V

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

The purpose of the present study was to investigate two different plyometric training programs for increasing vertical jumping ability, as well as some concommittant indices of leg strength and power. Twenty four female high school volleyball players between 14-16 yrs, were matched on the basis of body mass (as a result there were no statistical differences in height) and divided randomly into three groups. One group performed depth jumping from 0.45 m with hand-held weights proportional to their body mass (2.2 $kg \cdot kg^{-1}$ body mass). A second group performed traditional depth jumping, from 0.45 m, without weights. The third (control) group practiced volleyball or basketball skills, but did not perform depth jump training. Previous studies (Bosco and Komi, 1980; Clutch et al, 1983, and Costello, 1984) have examined peak power and concentric force development in response to plyometric training programs or to changes of jumping technique. Several other investigators have noted the benefits of plyometric training with respect to improvements in vertical jumping ability (Scoles, 1978; Grigas, 1982; Miller, 1982; and Brown et al., 1986).

Weight training has also been comprehensively investigated by several noted researchers (Berger, 1962; Berger, 1963; and Delorme and Watkins, 1948) but few studies have investigated plyometric training versus "weighted" plyometric conditioning programs. Significant effects were found for five variables.

Vertical Jumping Ability

Results from the present study suggest that a six-week program of plyometric training, performed with or without hand-held weights will improve vertical jump performance. Both the weighted and non-weighted plyometric training groups significantly increased their vertical jumping height (Figure 2). The weighted plyometric group improved by 11.4% or 0.04 m (p<.05), no different from the non-weighted group which improved by 11% (also 0.04 m). Factors which may account for the similarity of gains in these two plyometric training groups include a relatively short training period (six weeks) and/or hand-held weights that were of insufficient mass to produce increased muscular strength development in the weighted plyometric group (a viewpoint corroborated by minimal alterations of isokinetic leg strength; Tables 4-9). A study extending over a longer period of time may be required to determine the time-course of training-induced strength and power alterations, as well as when a training "plateau" may be realized. In a similar fashion to the present study, Keochane (1977) and Parcells (1976) demonstrated training-induced increases of vertical jumping ability after six weeks. Gemar (1986) found that plyometric exercises produced training adaptations of leg power after only four weeks (as demonstrated by vertical jump performance). He further noted that improvements of leg power were continuous throughout the entire training period, suggesting no plateau was reached after eight weeks.

The observations of the present investigation are in general agreement with earlier studies demonstrating significant increases in vertical jumping height through weighted plyometric training. Whether weighted plyometric training improves vertical jump performance more than weight training or plyometric training without added weights remains debatable on a theoretical basis, as well as unresolved in the present investigation.

In a rather relevant study on plyometric training by Polhemus (1981), subjects were assigned to either a conventional weight training program (Group I), to a weight program plus plyometric drills (Group II), or to a weight-training program plus plyometric drills performed with the addition of ankle and vest weights (Group III). Vertical jump test scores showed that Group I and Group II improved 4% - 5%, and were not statistically different in their training responses. Group III also improved significantly in vertical jumping ability by 11% and the addition of ankle and vest weights proved to enhance performance dramatically. A previous study by Polhemus et al. (1980) on college aged females showed similar results. The conventional weight training group improved their vertical jumping ability significantly (8%), and the combination plyometric/conventional weight group improved an astounding 23%!

Ford et al. (1983) compared three combinations of plyometric and weight conditioning programs on the vertical jumping ability of high school boys training for 10 weeks. Their groups included a combination sport-activities/ plyometric group (Group I), a sport-activities/ weight training group (Group II) and a weight training/ plyometric group (Group III). Depth jumps were performed with a 9 kg weighted vest attached to each subject in Groups I and III. The investigators found no significant differences between the groups in terms of jumping performance. All three groups demonstrated significant improvement.

In agreement with the previous study, two additional investigations found no significant differences between weight training and plyometric training programs on vertical jump performance (Blattner and Noble, 1979; and Gemar, 1986). Blattner and Noble (1979) observed no significant differences between their training groups in vertical jumping ability. One group trained with isokinetic exercises, while a second group trained with plyometrics. A control group did not train. During the eight week study, the plyometric group added resistances of 4.5 kg, 6.8 kg and 9 kg beginning with weeks 3,5 and 7, respectively. Both training groups improved significantly.

Gemar (1986) sought to determine if a plyometric program was better than a weight training program for increasing leg power, as measured by the vertical jump. During an eight week study, one group performed conventional leg weight exercises and the other group performed depth jumping from a height of 0.3 m. The gains achieved by both treatment groups were significantly greater than those experienced by non-training controls, but no difference existed between the gains attained by the two strength training groups. He concluded there was no difference between plyometric training and weight training in terms of improving vertical jumping performance. These findings were inaccordant with the findings of Parcells (1976) who demonstrated that depth jumping increased vertical jumping ability, while weight training did not. Forty-five college males were assigned to one of three groups: a depth jumping, weight training, and a control group. The depth jumping program included exercises performed twice per week for six weeks. The weight training group performed half-squat knee bends into heel raises. The control group was not allowed to participate in either a weight training or depth jumping program. There are a number of possible explanations for the differences in these findings. The length of Parcells' study was six weeks, whereas Gemar's research was conducted over an eight week period. To date, no research has been performed comparing the rate of gain in leg power for subjects undergoing weight training versus plyometric training. According to Gemar (1986) the results achieved by weight training are manifest slowly over time, whereas the performance gains for plyometric training may occur comparatively early in the training period. His findings demonstrated gains in vertical jumping ability after as little as four weeks. Different training protocols may also explain contrary results achieved between the two studies. Parcells' (1976) weight training program included only leg squats, whereas Gemar's program included three different weight conditioning exercises (leg press, leg curl, and leg extension).

In light of the reported studies, it appears that both weight training and plyometric training, improve vertical jumping performance. Yet, in view of the research of Polhemus et al.(1981) the addition of ankle and vest weights seems to increase vertical jumping ability over and above combination weight training/plyometric training or weight training alone.

The physiological mechanisms responsible for the increase of vertical jumping performance need further investigation. Theoretically, explosive power during vertical jumping should be enhanced due to the combination of stored elastic energy and/or the recruitment of facilitated units (Fox et al., 1988). The question remains as to whether one can effectively train the muscles to increase their stored elastic energy and/or alter inherent neural recruitment and synchronization of motor units.

If stored elastic energy could be enhanced through plyometric training then this might occur as a result of augmented muscular strength. Increased muscular strength has been demonstrated following weighted plyometric training (Blakey, 1984; Clutch et al., 1983). With greater strength, the muscles could produce more force and through augmented stretching of series elastic elements, increase stored elastic energy (Cavagna, 1977). According to Fox et al. (1988), through plyometric training athletes could better time their voluntary muscle contractions when jumping, to match up with any release of stored elastic energy.

A puzzling question still remains as to what provides the stimulus behind an increase of muscular strength. According to Komi (1986), there is no doubt that training per se is the primary contributing factor, but its influence is primarily reflected in increased neural activation. The neural activation is a determinant of the type and growth of myofibrils, which contributes to muscle hypertrophy. Komi has expressed the viewpoint that increases of muscle strength and power are not necessarily synonymous with the growth of individual myofibrils. In fact, the degree of hypertrophy is not only dependent upon the type of strength/power training used, but its occurrence may follow the effects of the motor input. The preceding motor unit activation might be a necessary precondition for hypertrophic changes and an increase of neural activation is likely due to an increased number of motor units and/or increase of their firing rate. Hakkinen et al. (1981) reported that the duration between strength/power training and the resultant hypertrophy could be as little as eight weeks. Their 16 week study of strength training resulted in greater rates of hypertrophy during the latter half of training and only minor fiber hypertrophy during the first eight weeks.

In an attempt to advance a plausible physiological explanation for the results of the present study, it is possible to rule out alterations concommittant upon increased leg strength because no such increases were reported. The training groups increased their vertical jump heights without a secondary increase of leg strength. It seems possible that these increases in vertical jumping ability are likely due to augmented synchronous firing of active motor units, together with an increase in overall motor unit activity. Since the study was only six weeks in duration, hypertrophy of the muscle fibers was unlikely (although leg girths were not measured).

Anaerobic Power

All three groups (control, non-weighted training and weighted plyometric training) improved their anaerobic power significantly (Figures 3 and 4). The non-weighted group began with the lowest pretest mean score of 610.6 W and improved to a posttest mean score of 686.9 W (an 11% increase). The control group improved from a pretest mean score of 649.3 W to a posttest mean score of 709.4 (an 8% increase). The weighted group improved from a pretest mean score of 652.9 W to a posttest mean score of 725.8 W (a 10% increase). It is probable that volleyball or basketball activities in which the control group participated, contributed to their gains in leg power. That plyometric training did not seem to contribute more than a 2-3% improvement over subjects who participated in sport activities may stem from the brevity of the training program (six weeks), however other studies reported similar results with longer training periods (Ford et al., 1983 and Blakey, 1984).

In comparing the combined effects of weight training and plyometrics on dynamic leg strength and leg power, Blakey's (1984) results demonstrated no significant differences between conditions, trials or interactions for leg strength and Margaria power scores. Thirty-one volunteer university students were randomly assigned to three groups according to the height of drop (1.1m= high, 0.4m=low, and no height).

The three groups then participated in an eight week plyometric and weight training program. All three groups showed significant gains of both strength and anaerobic power.

Ford et al.(1983) demonstrated the effects of three of plyometric and weight training programs on the 36.5 m [40-yd] dash. One group participated in wrestling and softball in combination with plyometric training. Another group participated in a weight training program. A third group participated in a combined program of weight training and plyometrics.
All three groups improved significantly from pretest to posttest trials, however the main effect of conditions and the interaction were nonsignificant.

Polhemus et al. (1980) also tested their subjects in the 36.5 m [40 yd] dash, but contrary to Ford et al. (1983) they reported that both the weight training and combination plyometric/weight training groups improved significantly, the latter reported gains of .43 seconds, as compared to a .10 s improvement by the former group. They concluded that the plyometric drills greatly enhanced performance in the 36.5 m dash.

According to the present study, as well as demonstrated in previous research, plyometric training enhances anaerobic power. However, the results of the Wingate bicycle test do not substantiate this. This may be due to the principle of specificity of testing. The control group did not participate in plyometric training, but did participate in basketball or volleyball activities. This may account for their improvement in the Margaria-Kalamen test and their lack of improvement in the Wingate test. It is known that fast-twitch fibers are preferentially recruited for short term intense activities (Fox et al., 1988). Therefore, in order to maximally improve performance, training must be specific to increase the capabilities of the fast-twitch fibers. The present investigation suggested that plyometric training was specific as shown by significantly higher posttest vertical jump scores by the two training groups exclusively. The time to ascend the stairs was the contributing factor to the improvements in anaerobic power. Plyometric training, along with basketball and volleyball activities must induce neuromuscular adaptations that allow for an increase in speed. Although plyometric training has been shown to significantly improve anaerobic power, the extent to which it enhances power over and above weight training or other sport activities remains unknown.

Isokinetic Strength Changes

In the current investigation, the overall strength of the subjects did not improve, regardless of the condition. Of the 27 variables tested on the Omnitron, only two produced significant effects, peak torque during right leg extension at a fast velocity (PTREF) and peak torque during left leg extension at a slow velocity (PTLES) (Figures 5 and 6). In a comparison of the pre to posttest means of the PTREF test, the control group decreased in peak torque from 15.5 Nm to 14.8 Nm. Both the non-weighted and weighted plyometric groups increased their peak torque from a mean score of 14 Nm to 15.5 Nm (10% increase) and 16.8 Nm to 23.4 Nm (28% increase), respectively. In comparing the means of the peak torque during left knee extension at slow velocity, the control group demonstrated the greatest improvement from 51.3 Nm during the pretest, to 84.8 Nm during the posttest (an increase of 40%; Figure 6). The weighted plyometric group improved 39%, from 59.4 NM to 97.9 Nm in the pretest and posttest respectively and the non-weighted group improved 35 % (from 51.5 Nm to 79.1 Nm). It seems that the weighted group was slightly stronger to begin with than the other two groups. Although these improvements in strength are notable, there was not enough significant improvement across the variables to make any generalizations about this study and strength development, except to say that no apparent increase in strength occurred.

Why significant gains in strength were not found may be explained in terms of the resistance used. It is known that chronic stress or use of the muscles, as would be the case with weight training, is the ultimate stimulus for increased levels of strength. The principle that attempts to explain the increase is known as the overload principle; the strength and hypertrophy of a muscle will increase only when the muscle performs for a given period of time at its maximal strength capacity (Fox et al., 1988). A unique investigation of chronic overload training of 11 international caliber jumpers and throwers has been reported (Bosco et al., 1984). The subjects wore weighted vests equal to 13% of their body weight all day (except while sleeping). After just three weeks the subjects showed significant improvements in vertical jumping from a squat position, following drops from .2-1 m heights. In the present study the resistance used by the weighted plyometric group represented only 7.5 % of their body weight. This may be insufficient to overload the muscles.

Fox et al.(1988) called plyometric training another type of strength training. They suggested that while clear benefits of this training over those derived from isotonic, isokinetic, or more conventional methods need additional documentation, more forceful muscle contractions may permit a greater adaptive stimulus to promote strength gains. This viewpoint was not borne out in the present investigation. The reason for this may be the shorter duration time of the study and/or specificity of training.

Contrary to the present study, Clutch et al. (1983) found that combination weight and plyometric training groups increased their one repetition maximum squat and isometric knee extension forces. They investigated the effects of depth jumps and weight training on leg strength and vertical jump. Group I trained by executing maximal vertical jumps; Group II performed depth jumping from a height of 0.3 m ; and Group III employed a depth jumping program of 0.75 and 1.1 m. All three groups participated in a conventional weight training program. There was no significant difference in improvements by the three groups.

Few studies have investigated the effects of plyometric training upon leg strength. Smith (1970) found myotatic (prestretched) strength training superior to isometric training relative to gains in static leg strength. Asmussen and Bonde Peterson (1974) found that as heights of drop increased to 0.4 m the force output of the muscles following the resultant stretch increased. Whether this increased force output results in concomitant strength gains or whether depth jump training could bring about strength gains was not determined. Blakey (1984) sought to determine the effects of plyometric training in combination with weight training, on dynamic leg strength and power. He concluded that a combined 8 week program would increase dynamic leg strength and power. While the combination program produced gains in leg strength, this study did not enable separation of contributions due to weight training or plyometric training alone.

No studies have yet been performed investigating possible gains of strength due to plyometric training alone. More research is needed in this area. In view of the reported research, the combination of weights with plyometric training would seem to enhance leg strength. Yet with the present data in mind, the additional weight should be of sufficient mass to overload the muscles.

Summary

The purpose of the present study was to investigate two different plyometric training techniques for increasing vertical jumping ability. Twenty four female high school volleyball players ranging in ages between 14-16, were distributed equally among three groups. One group performed depth jumping with hand-held weights, proportional to their body mass. A second group performed traditional depth jumping without weights. The third (control) group practiced volleyball or basketball skills, but did not perform depth jumping.

Plyometric training significantly improved vertical jump performance, although weighted plyometric training was not shown to enhance vertical jumping ability more than non-weighted plyometric training. It was the opinion of the author that the amount of weight used by the weighted plyometric training group was probably insufficient to overload the muscles. Therefore the added weight did not bring about the necessary increases in force needed to perform a higher vertical jump than the non-weighted training group.

The anaerobic power of all three groups improved significantly. The control group probably improved anaerobic power through volleyball and basketball activities alone. The Margaria-Kalamen power scores did not reflect the Wingate test scores. The specificity of testing was cited as a plausible explanation. Both the vertical jump and the Margaria-Kalamen power tests involve lifting the body vertically against gravity, whereas the Wingate bicycle test did not.

The overall isokinetic strength did not improve significantly for any of the groups. The relatively short duration (six weeks) of the study probably did not permit any evidence of strength gains. Also the insufficient mass of the weights used by the weighted plyometric training group may not have overloaded the muscles enough to produce increased strength.

Conclusions

In relation to the primary hypotheses established in the introductory section, the conclusions from this study are:

1. The first hypothesis, that there would be no statistically significant differences in vertical jumping

ability of subjects performing plyometric training with added weights and of subjects training without weights was accepted. Two possible explanations are that the weights used were not sufficient to overload the muscles and the six week training duration may have been too short to produce strength gains.

2. The second hypothesis, that there would be no statistically significant differences of the leg power, as assessed by the Margaria-Kalamen Power Test of the weighted and non-weighted groups was accepted. This may have been the result of neuromuscular adaptations brought about through plyometric training equal to those produced by volleyball and basketball activities, that allowed the groups to decrease the time to ascend the stairs. A second possible explanation is that the insufficient weight load was not enough to increase strength or power in the weighted group.

3. The third hypothesis, that there would be no statistically significant differences of leg strength, as measured by isokinetic knee flexion and extension of the weighted and non-weighted groups was accepted. Again the lack of overload placed on the muscles of the weighted plyometric group was probably the cause. The fact that none of the groups improved in muscular strength may also be due to the short duration time (six weeks) of the study. There

may not have been enough time for hypertrophy of the muscle fibers.

4. The fourth hypothesis, that there would be no statistically significant differences of anaerobic power or capacity, as assessed during a 30 second all-out bicycle test of the weighted and non-weighted groups was accepted. The principle of specificity of testing may have accounted for these results. Although the Wingate test is a test of anaerobic power and capacity, the subjects in this study at no time trained on a bicycle. Inherent in the principle is the fact that different motor units (or fiber types) and their recruitment pattern will vary with different kinds of exercises.

Recommendations

The investigator feels that several methodological changes could have improved the present study. Among these are:

1. It was suggested that a weight representing a higher percentage of the body mass be used for weighted plyometric training. The weights used in this study represented only 7.5% of the subject's mass. This may have been insufficient to overload the muscles.

2. The Wingate bicycle test should be omitted, due to the lack of specificity of testing. It is unlike the

vertical jump test, as well as the Margaria-Kalamen power test, where the subjects lifted their body mass against gravity.

3. A study longer than six weeks is needed to determine the rates of gains in vertical jumping, strength and power, due to plyometric training. The duration of this study may have been too brief to demonstrate increases in strength by the weighted plyometric training group.

The current literature and research regarding plyometrics is limited. The investigator recommends further research in the following areas:

1. An investigation of the effects of weighted plyometrics and non-weighted plyometrics on leg strength development.

2. An investigation on the physiological changes that are elicited through plyometric training.

3. An investigation on the effects of weighted plyometrics and non-weighted plyometrics on anaerobic power.

APPENDIX A

RAW DATA

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: A.W. Group: W Test Time: POST
Age: 14 Height: 170.0 Mass: 62.0

Vertical Jump Test

Standing Reach: 215 Vertical Jump: 43

Wingate Test

Resistance: 5.0 Peak 5s RPM: 10.0 Total 30s RPM: 44.0
Peak Power: 588.24 Anaerobic Capacity: 431.37
Peak Power KG: 9.49 Anaerobic Capacity KG: 6.96

Margaria Stair Run Test

Ascension Time: 0.52 Peak Power Margaria: 701.08
Peak Power Margaria KG: 11.31

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 92.0	ResTORQUE: 88.0
LesPOWER: 137.0	ResPOWER: 136.0
LesWORK: 90.0	ResWORK: 90.0
LesVELOCITY: 92.0	ResVELOCITY: 93.0
LesTWORK: 428.0	ResTWORK: 427.0
LemTORQUE: 45.0	RemTORQUE: 47.0
LemPOWER: 157.0	RemPOWER: 134.0
LemWORK: 48.0	RemWORK: 45.0
LemVELOCITY: 233.0	RemVELOCITY: 225.0
LemTWORK: 419.0	RemTWORK: 409.0
LefTORQUE: 26.0	RefTORQUE: 22.0
LefPOWER: 98.0	RefPOWER: 86.0
LefWORK: 26.0	RefWORK: 24.0
LefVELOCITY: 310.0	RefVELOCITY: 283.0
LefTWORK: 387.0	RefTWORK: 395.0
LfsTORQUE: 59.0	RfsTORQUE: 62.0
LfsPOWER: 94.0	RfSPOWER: 91.0
LfsWORK: 68.0	RfsWORK: 68.0
LfsVELOCITY: 84.0	RfsVELOCITY: 83.0
LfsTWORK: 315.0	RfsTWORK: 319.0
LfmTORQUE: 36.0	RfmTORQUE: 36.0
LfmPOWER: 124.0	RfmPOWER: 118.0
LfmWORK: 38.0	RfmWORK: 38.0
LfmVELOCITY: 231.0	RfmVELOCITY: 225.0
LfmTWORK: 349.0	RfmTWORK: 341.0
LffTORQUE: 18.0	RffTORQUE: 18.0
LffPOWER: 90.0	RffPOWER: 77.0
LffWORK: 20.0	RffWORK: 19.0
LffVELOCITY: 335.0	RffVELOCITY: 324.0
LffTWORK: 331.0	RffTWORK: 330.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: L.N. Group: C Test Time: PRE
Age: 15 Height: 154.0 Mass: 71.0

Vertical Jump Test

Standing Reach: 197 Vertical Jump: 36

Wingate Test

Resistance: 5.0 Peak 5s RPM: 6.5 Total 30s RPM: 32.5
Peak Power: 382.35 Anaerobic Capacity: 318.63
Peak Power KG: 5.39 Anaerobic Capacity KG: 4.49

Margaria Stair Run Test

Ascension Time: 0.66 Peak Power Margaria: 632.55
Peak Power Margaria KG: 8.91

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 59.0	ResTORQUE: 82.0
LesPOWER: 49.0	ResPOWER: 54.0
LesWORK: 49.0	ResWORK: 50.0
LesVELOCITY: 61.0	ResVELOCITY: 66.0
LesTWORK: 222.0	ResTWORK: 220.0
LemTORQUE: 36.0	RemTORQUE: 39.0
LemPOWER: 86.0	RemPOWER: 88.0
LemWORK: 33.0	RemWORK: 35.0
LemVELOCITY: 174.0	RemVELOCITY: 172.0
LemTWORK: 274.0	RemTWORK: 277.0
LefTORQUE: 18.0	RefTORQUE: 19.0
LefPOWER: 50.0	RefPOWER: 51.0
LefWORK: 17.0	RefWORK: 19.0
LefVELOCITY: 189.0	RefVELOCITY: 200.0
LefTWORK: 254.0	RefTWORK: 309.0
LfsTORQUE: 41.0	RfsTORQUE: 42.0
LfsPOWER: 49.0	RfSPOWER: 52.0
LfsWORK: 41.0	RfsWORK: 82.0
LfsVELOCITY: 66.0	RfsVELOCITY: 69.0
LfsTWORK: 177.0	RfsTWORK: 182.0
LfmTORQUE: 27.0	RfmTORQUE: 28.0
LfmPOWER: 81.0	RfmPOWER: 95.0
LfmWORK: 24.0	RfmWORK: 29.0
LfmVELOCITY: 207.0	RfmVELOCITY: 217.0
LfmTWORK: 193.0	RfmTWORK: 219.0
LffTORQUE: 14.0	RffTORQUE: 14.0
LffPOWER: 55.0	RffPOWER: 59.0
LffWORK: 12.0	RffWORK: 14.0
LffVELOCITY: 265.0	RffVELOCITY: 286.0
LffTWORK: 167.0	RffTWORK: 230.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: L.N. Group: C Test Time: POST
Age: 15 Height: 154.0 Mass: 69.0

Vertical Jump Test

Standing Reach: 197 Vertical Jump: 28

Wingate Test

Resistance: 5.0 Peak 5s RPM: 6.0 Total 30s RPM: 28.0
Peak Power: 352.94 Anaerobic Capacity: 274.51
Peak Power KG: 5.12 Anaerobic Capacity KG: 3.98

Margaria Stair Run Test

Ascension Time: 0.65 Peak Power Margaria: 624.18
Peak Power Margaria KG: 9.05

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 71.0	ResTORQUE: 70.0
LesPOWER: 90.0	ResPOWER: 100.0
LesWORK: 58.0	ResWORK: 72.0
LesVELOCITY: 79.0	ResVELOCITY: 82.0
LesTWORK: 261.0	ResTWORK: 308.0
LemTORQUE: 35.0	RemTORQUE: 33.0
LemPOWER: 101.0	RemPOWER: 86.0
LemWORK: 35.0	RemWORK: 32.0
LemVELOCITY: 204.0	RemVELOCITY: 204.0
LemTWORK: 319.0	RemTWORK: 285.0
LefTORQUE: 17.0	RefTORQUE: 17.0
LefPOWER: 56.0	RefPOWER: 59.0
LefWORK: 17.0	RefWORK: 18.0
LefVELOCITY: 247.0	RefVELOCITY: 252.0
LefTWORK: 277.0	RefTWORK: 295.0
LfsTORQUE: 42.0	RfsTORQUE: 49.0
LfsPOWER: 51.0	RfSPOWER: 64.0
LfsWORK: 40.0	RfsWORK: 51.0
LfsVELOCITY: 67.0	RfsVELOCITY: 72.0
LfsTWORK: 181.0	RfsTWORK: 236.0
LfmTORQUE: 24.0	RfmTORQUE: 24.0
LfmPOWER: 66.0	RfmPOWER: 65.0
LfmWORK: 25.0	RfmWORK: 26.0
LfmVELOCITY: 188.0	RfmVELOCITY: 187.0
LfmTWORK: 229.0	RfmTWORK: 231.0
LffTORQUE: 13.0	RffTORQUE: 16.0
LffPOWER: 43.0	RffPOWER: 52.0
LffWORK: 13.0	RffWORK: 16.0
LffVELOCITY: 233.0	RffVELOCITY: 248.0
LffTWORK: 228.0	RffTWORK: 252.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: R.L. Group: W Test Time: PRE
Age: 14 Height: 164.0 Mass: 46.0

Vertical Jump Test

Standing Reach: 217 Vertical Jump: 26

Wingate Test

Resistance: 3.5 Peak 5s RPM: 8.0 Total 30s RPM: 31.5
Peak Power: 329.41 Anaerobic Capacity: 216.18
Peak Power KG: 7.16 Anaerobic Capacity KG: 4.70

Margaria Stair Run Test

Ascension Time: 0.62 Peak Power Margaria: 436.26
Peak Power Margaria KG: 9.48

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 57.0	ResTORQUE: 63.0
LesPOWER: 68.0	ResPOWER: 80.0
LesWORK: 58.0	ResWORK: 66.0
LesVELOCITY: 74.0	ResVELOCITY: 79.0
LesTWORK: 241.0	ResTWORK: 310.0
LemTORQUE: 32.0	RemTORQUE: 32.0
LemPOWER: 83.0	RemPOWER: 89.0
LemWORK: 34.0	RemWORK: 39.0
LemVELOCITY: 183.0	RemVELOCITY: 183.0
LemTWORK: 321.0	RemTWORK: 302.0
LefTORQUE: 16.0	RefTORQUE: 16.0
LefPOWER: 54.0	RefPOWER: 58.0
LefWORK: 20.0	RefWORK: 20.0
LefVELOCITY: 222.0	RefVELOCITY: 227.0
LefTWORK: 314.0	RefTWORK: 320.0
LfsTORQUE: 37.0	RfsTORQUE: 45.0
LfsPOWER: 45.0	RfSPOWER: 61.0
LfsWORK: 42.0	RfsWORK: 52.0
LfsVELOCITY: 70.0	RfsVELOCITY: 74.0
LfsTWORK: 181.0	RfsTWORK: 251.0
LfmTORQUE: 24.0	RfmTORQUE: 28.0
LfmPOWER: 75.0	RfmPOWER: 99.0
LfmWORK: 26.0	RfmWORK: 30.0
LfmVELOCITY: 208.0	RfmVELOCITY: 239.0
LfmTWORK: 245.0	RfmTWORK: 283.0
LffTORQUE: 14.0	RffTORQUE: 15.0
LffPOWER: 64.0	RffPOWER: 72.0
LffWORK: 16.0	RffWORK: 17.0
LffVELOCITY: 304.0	RffVELOCITY: 306.0
LffTWORK: 232.0	RffTWORK: 258.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: R.L. Group: W Test Time: POST
Age: 14 Height: 164.0 Mass: 46.0

Vertical Jump Test

Standing Reach: 217 Vertical Jump: 29

Wingate Test

Resistance: 3.5 Peak 5s RPM: 7.0 Total 30s RPM: 24.5
Peak Power: 288.24 Anaerobic Capacity: 168.14
Peak Power KG: 6.27 Anaerobic Capacity KG: 3.66

Margaria Stair Run Test

Ascension Time: 0.55 Peak Power Margaria: 491.78
Peak Power Margaria KG: 10.69

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 59.0	ResTORQUE: 62.0
LesPOWER: 72.0	ResPOWER: 82.0
LesWORK: 58.0	ResWORK: 68.0
LesVELOCITY: 76.0	ResVELOCITY: 80.0
LesTWORK: 280.0	ResTWORK: 283.0
LemTORQUE: 31.0	RemTORQUE: 31.0
LemPOWER: 94.0	RemPOWER: 90.0
LemWORK: 36.0	RemWORK: 35.0
LemVELOCITY: 202.0	RemVELOCITY: 200.0
LemTWORK: 314.0	RemTWORK: 303.0
LefTORQUE: 15.0	RefTORQUE: 17.0
LefPOWER: 49.0	RefPOWER: 54.0
LefWORK: 18.0	RefWORK: 19.0
LefVELOCITY: 218.0	RefVELOCITY: 230.0
LefTWORK: 273.0	RefTWORK: 279.0
LfsTORQUE: 40.0	RfsTORQUE: 45.0
LfsPOWER: 46.0	RfSPOWER: 56.0
LfsWORK: 43.0	RfsWORK: 47.0
LfsVELOCITY: 66.0	RfsVELOCITY: 69.0
LfsTWORK: 189.0	RfsTWORK: 212.0
LfmTORQUE: 26.0	RfmTORQUE: 27.0
LfmPOWER: 92.0	RfmPOWER: 101.0
LfmWORK: 30.0	RfmWORK: 31.0
LfmVELOCITY: 234.0	RfmVELOCITY: 246.0
LfmTWORK: 250.0	RfmTWORK: 251.0
LffTORQUE: 15.0	RffTORQUE: 15.0
LffPOWER: 70.0	RffPOWER: 70.0
LffWORK: 16.0	RffWORK: 17.0
LffVELOCITY: 308.0	RffVELOCITY: 316.0
LffTWORK: 251.0	RffTWORK: 252.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

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Subject Name: D.O. Group: N Test Time: PRE
Age: 14 Height: 163.0 Mass: 56.0

Vertical Jump Test
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Standing Reach: 224 Vertical Jump: 20

Wingate Test
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Resistance: 4.0 Peak 5s RPM: 9.0 Total 30s RPM: 39.0
Peak Power: 423.53 Anaerobic Capacity: 305.88
Peak Power KG: 7.56 Anaerobic Capacity KG: 5.46

Margaria Stair Run Test
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Ascension Time: 0.49 Peak Power Margaria: 672.00
Peak Power Margaria KG: 12.00

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)
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Left Side	Right Side
LesTORQUE: 71.0	ResTORQUE: 77.0
LesPOWER: 87.0	ResPOWER: 111.0
LesWORK: 72.0	ResWORK: 84.0
LesVELOCITY: 83.0	ResVELOCITY: 89.0
LesTWORK: 338.0	ResTWORK: 378.0
LemTORQUE: 42.0	RemTORQUE: 45.0
LemPOWER: 119.0	RemPOWER: 115.0
LemWORK: 43.0	RemWORK: 44.0
LemVELOCITY: 218.0	RemVELOCITY: 210.0
LemTWORK: 346.0	RemTWORK: 404.0
LefTORQUE: 22.0	RefTORQUE: 22.0
LefPOWER: 74.0	RefPOWER: 63.0
LefWORK: 23.0	RefWORK: 24.0
LefVELOCITY: 245.0	RefVELOCITY: 226.0
LefTWORK: 352.0	RefTWORK: 368.0
LfsTORQUE: 56.0	RfsTORQUE: 61.0
LfsPOWER: 93.0	RfSPOWER: 102.0
LfsWORK: 69.0	RfsWORK: 71.0
LfsVELOCITY: 86.0	RfsVELOCITY: 87.0
LfsTWORK: 312.0	RfsTWORK: 344.0
LfmTORQUE: 35.0	RfmTORQUE: 34.0
LfmPOWER: 145.0	RfmPOWER: 147.0
LfmWORK: 41.0	RfmWORK: 40.0
LfmVELOCITY: 260.0	RfmVELOCITY: 265.0
LfmTWORK: 335.0	RfmTWORK: 353.0
LffTORQUE: 18.0	RffTORQUE: 17.0
LffPOWER: 105.0	RffPOWER: 95.0
LffWORK: 22.0	RffWORK: 21.0
LffVELOCITY: 366.0	RffVELOCITY: 354.0
LffTWORK: 313.0	RffTWORK: 296.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: D.O. Group: N Test Time: POST
Age: 14 Height: 163.0 Mass: 57.0

Vertical Jump Test

Standing Reach: 224 Vertical Jump: 21

Wingate Test

Resistance: 4.0 Peak 5s RPM: 10.0 Total 30s RPM: 35.0
Peak Power: 470.59 Anaerobic Capacity: 274.51
Peak Power KG: 8.26 Anaerobic Capacity KG: 4.82

Margaria Stair Run Test

Ascension Time: 0.45 Peak Power Margaria: 744.80
Peak Power Margaria KG: 13.07

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 75.0	ResTORQUE: 82.0
LesPOWER: 95.0	ResPOWER: 136.0
LesWORK: 71.0	ResWORK: 86.0
LesVELOCITY: 83.0	ResVELOCITY: 91.0
LesTWORK: 325.0	ResTWORK: 385.0
LemTORQUE: 41.0	RemTORQUE: 42.0
LemPOWER: 111.0	RemPOWER: 116.0
LemWORK: 42.0	RemWORK: 44.0
LemVELOCITY: 202.0	RemVELOCITY: 206.0
LemTWORK: 349.0	RemTWORK: 392.0
LefTORQUE: 24.0	RefTORQUE: 23.0
LefPOWER: 83.0	RefPOWER: 74.0
LefWORK: 26.0	RefWORK: 26.0
LefVELOCITY: 267.0	RefVELOCITY: 244.0
LefTWORK: 387.0	RefTWORK: 365.0
LfsTORQUE: 53.0	RfsTORQUE: 57.0
LfsPOWER: 86.0	RfSPOWER: 93.0
LfsWORK: 59.0	RfsWORK: 63.0
LfsVELOCITY: 82.0	RfsVELOCITY: 88.0
LfsTWORK: 258.0	RfsTWORK: 275.0
LfmTORQUE: 34.0	RfmTORQUE: 35.0
LfmPOWER: 149.0	RfmPOWER: 163.0
LfmWORK: 38.0	RfmWORK: 42.0
LfmVELOCITY: 278.0	RfmVELOCITY: 287.0
LfmTWORK: 318.0	RfmTWORK: 329.0
LffTORQUE: 18.0	RffTORQUE: 17.0
LffPOWER: 106.0	RffPOWER: 101.0
LffWORK: 21.0	RffWORK: 19.0
LffVELOCITY: 385.0	RffVELOCITY: 377.0
LffTWORK: 276.0	RffTWORK: 282.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: E.M. Group: N Test Time: PRE
Age: 14 Height: 165.5 Mass: 48.0

Vertical Jump Test

Standing Reach: 206 Vertical Jump: 30

Wingate Test

Resistance: 3.5 Peak 5s RPM: 6.5 Total 30s RPM: 35.5
Peak Power: 267.65 Anaerobic Capacity: 243.63
Peak Power KG: 5.58 Anaerobic Capacity KG: 5.08

Margaria Stair Run Test

Ascension Time: 0.70 Peak Power Margaria: 403.20
Peak Power Margaria KG: 8.40

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 43.0	ResTORQUE: 55.0
LesPOWER: 45.0	ResPOWER: 62.0
LesWORK: 42.0	ResWORK: 57.0
LesVELOCITY: 61.0	ResVELOCITY: 72.0
LesTWORK: 190.0	ResTWORK: 263.0
LemTORQUE: 25.0	RemTORQUE: 29.0
LemPOWER: 62.0	RemPOWER: 71.0
LemWORK: 26.0	RemWORK: 28.0
LemVELOCITY: 161.0	RemVELOCITY: 164.0
LemTWORK: 225.0	RemTWORK: 257.0
LefTORQUE: 13.0	RefTORQUE: 15.0
LefPOWER: 39.0	RefPOWER: 43.0
LefWORK: 14.0	RefWORK: 16.0
LefVELOCITY: 185.0	RefVELOCITY: 194.0
LefTWORK: 234.0	RefTWORK: 250.0
LfsTORQUE: 40.0	RfsTORQUE: 39.0
LfsPOWER: 47.0	RfSPOWER: 49.0
LfsWORK: 40.0	RfsWORK: 46.0
LfsVELOCITY: 74.0	RfsVELOCITY: 92.0
LfsTWORK: 160.0	RfsTWORK: 207.0
LfmTORQUE: 23.0	RfmTORQUE: 22.0
LfmPOWER: 66.0	RfmPOWER: 61.0
LfmWORK: 21.0	RfmWORK: 21.0
LfmVELOCITY: 193.0	RfmVELOCITY: 189.0
LfmTWORK: 196.0	RfmTWORK: 192.0
LffTORQUE: 12.0	RffTORQUE: 13.0
LffPOWER: 49.0	RffPOWER: 47.0
LffWORK: 11.0	RffWORK: 12.0
LffVELOCITY: 261.0	RffVELOCITY: 253.0
LffTWORK: 182.0	RffTWORK: 196.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: E.M. Group: N Test Time: POST
Age: 14 Height: 165.5 Mass: 48.0

Vertical Jump Test

Standing Reach: 206 Vertical Jump: 34

Wingate Test

Resistance: 3.5 Peak 5s RPM: 7.0 Total 30s RPM: 33.0
Peak Power: 288.24 Anaerobic Capacity: 226.47
Peak Power KG: 6.00 Anaerobic Capacity KG: 4.72

Margaria Stair Run Test

Ascension Time: 0.74 Peak Power Margaria: 381.41
Peak Power Margaria KG: 7.95

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 48.0	ResTORQUE: 60.0
LesPOWER: 48.0	ResPOWER: 64.0
LesWORK: 45.0	ResWORK: 53.0
LesVELOCITY: 66.0	ResVELOCITY: 71.0
LesTWORK: 208.0	ResTWORK: 248.0
LemTORQUE: 22.0	RemTORQUE: 21.0
LemPOWER: 52.0	RemPOWER: 47.0
LemWORK: 21.0	RemWORK: 21.0
LemVELOCITY: 159.0	RemVELOCITY: 159.0
LemTWORK: 185.0	RemTWORK: 179.0
LefTORQUE: 10.0	RefTORQUE: 11.0
LefPOWER: 30.0	RefPOWER: 33.0
LefWORK: 12.0	RefWORK: 12.0
LefVELOCITY: 195.0	RefVELOCITY: 192.0
LefTWORK: 183.0	RefTWORK: 204.0
LfsTORQUE: 32.0	RfsTORQUE: 39.0
LfsPOWER: 32.0	RfSPOWER: 45.0
LfsWORK: 34.0	RfsWORK: 44.0
LfsVELOCITY: 57.0	RfsVELOCITY: 66.0
LfsTWORK: 140.0	RfsTWORK: 172.0
LfmTORQUE: 19.0	RfmTORQUE: 21.0
LfmPOWER: 43.0	RfmPOWER: 41.0
LfmWORK: 17.0	RfmWORK: 19.0
LfmVELOCITY: 159.0	RfmVELOCITY: 155.0
LfmTWORK: 153.0	RfmTWORK: 148.0
LffTORQUE: 11.0	RffTORQUE: 12.0
LffPOWER: 31.0	RffPOWER: 30.0
LffWORK: 11.0	RffWORK: 11.0
LffVELOCITY: 209.0	RffVELOCITY: 200.0
LffTWORK: 172.0	RffTWORK: 172.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: N.N. Group: N Test Time: PRE
Age: 14 Height: 155.4 Mass: 91.0

Vertical Jump Test

Standing Reach: 199 Vertical Jump: 33

Wingate Test

Resistance: 7.0 Peak 5s RPM: 5.0 Total 30s RPM: 22.0
Peak Power: 411.76 Anaerobic Capacity: 301.96
Peak Power KG: 4.52 Anaerobic Capacity KG: 3.32

Margaria Stair Run Test

Ascension Time: 0.66 Peak Power Margaria: 810.73
Peak Power Margaria KG: 8.91

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 78.0	ResTORQUE: 93.0
LesPOWER: 98.0	ResPOWER: 122.0
LesWORK: 64.0	ResWORK: 90.0
LesVELOCITY: 82.0	ResVELOCITY: 88.0
LesTWORK: 277.0	ResTWORK: 377.0
LemTORQUE: 40.0	RemTORQUE: 42.0
LemPOWER: 112.0	RemPOWER: 99.0
LemWORK: 38.0	RemWORK: 39.0
LemVELOCITY: 191.0	RemVELOCITY: 183.0
LemTWORK: 359.0	RemTWORK: 307.0
LefTORQUE: 23.0	RefTORQUE: 22.0
LefPOWER: 77.0	RefPOWER: 73.0
LefWORK: 24.0	RefWORK: 23.0
LefVELOCITY: 245.0	RefVELOCITY: 241.0
LefTWORK: 389.0	RefTWORK: 362.0
LfsTORQUE: 50.0	RfsTORQUE: 59.0
LfsPOWER: 63.0	RfSPOWER: 90.0
LfsWORK: 46.0	RfsWORK: 69.0
LfsVELOCITY: 73.0	RfsVELOCITY: 84.0
LfsTWORK: 12.0	RfsTWORK: 271.0
LfmTORQUE: 32.0	RfmTORQUE: 29.0
LfmPOWER: 106.0	RfmPOWER: 89.0
LfmWORK: 31.0	RfmWORK: 29.0
LfmVELOCITY: 222.0	RfmVELOCITY: 214.0
LfmTWORK: 272.0	RfmTWORK: 249.0
LffTORQUE: 17.0	RffTORQUE: 18.0
LffPOWER: 78.0	RffPOWER: 80.0
LffWORK: 18.0	RffWORK: 18.0
LffVELOCITY: 303.0	RffVELOCITY: 310.0
LffTWORK: 307.0	RffTWORK: 300.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: N.N. Group: N Test Time: POST
Age: 14 Height: 155.4 Mass: 90.0

Vertical Jump Test

Standing Reach: 199 Vertical Jump: 37

Wingate Test

Resistance: 7.0 Peak 5s RPM: 7.0 Total 30s RPM: 31.5
Peak Power: 576.47 Anaerobic Capacity: 432.35
Peak Power KG: 6.41 Anaerobic Capacity KG: 4.80

Margaria Stair Run Test

Ascension Time: 0.65 Peak Power Margaria: 814.15
Peak Power Margaria KG: 9.05

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 82.0	ResTORQUE: 95.0
LesPOWER: 110.0	ResPOWER: 140.0
LesWORK: 75.0	ResWORK: 102.0
LesVELOCITY: 86.0	ResVELOCITY: 97.0
LesTWORK: 318.0	ResTWORK: 430.0
LemTORQUE: 45.0	RemTORQUE: 42.0
LemPOWER: 117.0	RemPOWER: 123.0
LemWORK: 42.0	RemWORK: 44.0
LemVELOCITY: 206.0	RemVELOCITY: 214.0
LemTWORK: 378.0	RemTWORK: 382.0
LefTORQUE: 21.0	RefTORQUE: 24.0
LefPOWER: 67.0	RefPOWER: 76.0
LefWORK: 21.0	RefWORK: 25.0
LefVELOCITY: 244.0	RefVELOCITY: 255.0
LefTWORK: 318.0	RefTWORK: 380.0
LfsTORQUE: 56.0	RfsTORQUE: 60.0
LfsPOWER: 82.0	RfSPOWER: 100.0
LfsWORK: 60.0	RfsWORK: 74.0
LfsVELOCITY: 82.0	RfsVELOCITY: 90.0
LfsTWORK: 253.0	RfsTWORK: 309.0
LfmTORQUE: 37.0	RfmTORQUE: 34.0
LfmPOWER: 112.0	RfmPOWER: 116.0
LfmWORK: 36.0	RfmWORK: 36.0
LfmVELOCITY: 223.0	RfmVELOCITY: 228.0
LfmTWORK: 305.0	RfmTWORK: 298.0
LffTORQUE: 17.0	RffTORQUE: 17.0
LffPOWER: 80.0	RffPOWER: 72.0
LffWORK: 17.0	RffWORK: 19.0
LffVELOCITY: 320.0	RffVELOCITY: 306.0
LffTWORK: 244.0	RffTWORK: 287.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: N.A. Group: N Test Time: PRE
Age: 14 Height: 170.0 Mass: 81.0

Vertical Jump Test

Standing Reach: 219 Vertical Jump: 15

Wingate Test

Resistance: 6.0 Peak 5s RPM: 5.0 Total 30s RPM: 25.0
Peak Power: 352.94 Anaerobic Capacity: 294.12
Peak Power KG: 4.36 Anaerobic Capacity KG: 3.63

Margaria Stair Run Test

Ascension Time: 0.74 Peak Power Margaria: 643.62
Peak Power Margaria KG: 7.95

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 67.0	ResTORQUE: 73.0
LesPOWER: 82.0	ResPOWER: 86.0
LesWORK: 82.0	ResWORK: 93.0
LesVELOCITY: 80.0	ResVELOCITY: 80.0
LesTWORK: 378.0	ResTWORK: 426.0
LemTORQUE: 31.0	RemTORQUE: 33.0
LemPOWER: 78.0	RemPOWER: 88.0
LemWORK: 40.0	RemWORK: 40.0
LemVELOCITY: 176.0	RemVELOCITY: 194.0
LemTWORK: 349.0	RemTWORK: 358.0
LefTORQUE: 15.0	RefTORQUE: 16.0
LefPOWER: 45.0	RefPOWER: 49.0
LefWORK: 19.0	RefWORK: 20.0
LefVELOCITY: 215.0	RefVELOCITY: 218.0
LefTWORK: 309.0	RefTWORK: 324.0
LfsTORQUE: 65.0	RfsTORQUE: 66.0
LfsPOWER: 91.0	RfSPOWER: 111.0
LfsWORK: 81.0	RfsWORK: 92.0
LfsVELOCITY: 87.0	RfsVELOCITY: 98.0
LfsTWORK: 391.0	RfsTWORK: 402.0
LfmTORQUE: 34.0	RfmTORQUE: 32.0
LfmPOWER: 129.0	RfmPOWER: 104.0
LfmWORK: 41.0	RfmWORK: 36.0
LfmVELOCITY: 267.0	RfmVELOCITY: 241.0
LfmTWORK: 294.0	RfmTWORK: 304.0
LffTORQUE: 16.0	RffTORQUE: 17.0
LffPOWER: 68.0	RffPOWER: 72.0
LffWORK: 18.0	RffWORK: 18.0
LffVELOCITY: 310.0	RffVELOCITY: 315.0
LffTWORK: 290.0	RffTWORK: 315.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: N.A. Group: N Test Time: POST
Age: 14 Height: 170.0 Mass: 71.0

Vertical Jump Test

Standing Reach: 219 Vertical Jump: 20

Wingate Test

Resistance: 6.0 Peak 5s RPM: 5.0 Total 30s RPM: 24.0
Peak Power: 352.94 Anaerobic Capacity: 282.35
Peak Power KG: 4.97 Anaerobic Capacity KG: 3.98

Margaria Stair Run Test

Ascension Time: 0.63 Peak Power Margaria: 662.67
Peak Power Margaria KG: 9.33

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 75.0	ResTORQUE: 71.0
LesPOWER: 107.0	ResPOWER: 93.0
LesWORK: 86.0	ResWORK: 79.0
LesVELOCITY: 87.0	ResVELOCITY: 80.0
LesTWORK: 409.0	ResTWORK: 349.0
LemTORQUE: 38.0	RemTORQUE: 40.0
LemPOWER: 105.0	RemPOWER: 115.0
LemWORK: 42.0	RemWORK: 46.0
LemVELOCITY: 189.0	RemVELOCITY: 200.0
LemTWORK: 371.0	RemTWORK: 411.0
LefTORQUE: 19.0	RefTORQUE: 21.0
LefPOWER: 64.0	RefPOWER: 77.0
LefWORK: 22.0	RefWORK: 24.0
LefVELOCITY: 217.0	RefVELOCITY: 264.0
LefTWORK: 342.0	RefTWORK: 383.0
LfsTORQUE: 69.0	RfsTORQUE: 55.0
LfsPOWER: 101.0	RfSPOWER: 75.0
LfsWORK: 78.0	RfsWORK: 60.0
LfsVELOCITY: 89.0	RfsVELOCITY: 80.0
LfsTWORK: 371.0	RfsTWORK: 268.0
LfmTORQUE: 43.0	RfmTORQUE: 42.0
LfmPOWER: 161.0	RfmPOWER: 172.0
LfmWORK: 43.0	RfmWORK: 44.0
LfmVELOCITY: 276.0	RfmVELOCITY: 288.0
LfmTWORK: 357.0	RfmTWORK: 387.0
LffTORQUE: 17.0	RffTORQUE: 19.0
LffPOWER: 94.0	RffPOWER: 20.0
LffWORK: 104.0	RffWORK: 372.0
LffVELOCITY: 364.0	RffVELOCITY: 372.0
LffTWORK: 251.0	RffTWORK: 317.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: S.H. Group: C Test Time: PRE
Age: 14 Height: 173.0 Mass: 98.0

Vertical Jump Test

Standing Reach: 221 Vertical Jump: 31

Wingate Test

Resistance: 7.0 Peak 5s RPM: 10.5 Total 30s RPM: 39.5
Peak Power: 864.71 Anaerobic Capacity: 542.16
Peak Power KG: 8.82 Anaerobic Capacity KG: 5.53

Margaria Stair Run Test

Ascension Time: 0.59 Peak Power Margaria: 976.68
Peak Power Margaria KG: 9.97

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 101.0	ResTORQUE: 105.0
LesPOWER: 158.0	ResPOWER: 207.0
LesWORK: 110.0	ResWORK: 95.0
LesVELOCITY: 104.0	ResVELOCITY: 117.0
LesTWORK: 503.0	ResTWORK: 450.0
LemTORQUE: 50.0	RemTORQUE: 61.0
LemPOWER: 166.0	RemPOWER: 189.0
LemWORK: 52.0	RemWORK: 57.0
LemVELOCITY: 247.0	RemVELOCITY: 257.0
LemTWORK: 454.0	RemTWORK: 503.0
LefTORQUE: 22.0	RefTORQUE: 29.0
LefPOWER: 85.0	RefPOWER: 90.0
LefWORK: 24.0	RefWORK: 27.0
LefVELOCITY: 295.0	RefVELOCITY: 311.0
LefTWORK: 404.0	RefTWORK: 435.0
LfsTORQUE: 73.0	RfsTORQUE: 80.0
LfsPOWER: 116.0	RfSPOWER: 122.0
LfsWORK: 86.0	RfsWORK: 89.0
LfsVELOCITY: 90.0	RfsVELOCITY: 90.0
LfsTWORK: 375.0	RfsTWORK: 392.0
LfmTORQUE: 41.0	RfmTORQUE: 49.0
LfmPOWER: 140.0	RfmPOWER: 190.0
LfmWORK: 45.0	RfmWORK: 44.0
LfmVELOCITY: 239.0	RfmVELOCITY: 270.0
LfmTWORK: 389.0	RfmTWORK: 508.0
LffTORQUE: 22.0	RffTORQUE: 25.0
LffPOWER: 123.0	RffPOWER: 143.0
LffWORK: 25.0	RffWORK: 29.0
LffVELOCITY: 386.0	RffVELOCITY: 421.0
LffTWORK: 413.0	RffTWORK: 478.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: S.H. Group: C Test Time: POST
Age: 14 Height: 173.0 Mass: 98.0

Vertical Jump Test

Standing Reach: 221 Vertical Jump: 32

Wingate Test

Resistance: 7.0 Peak 5s RPM: 6.5 Total 30s RPM: 28.5
Peak Power: 535.29 Anaerobic Capacity: 391.18
Peak Power KG: 5.46 Anaerobic Capacity KG: 3.99

Margaria Stair Run Test

Ascension Time: 0.55 Peak Power Margaria: 1047.71
Peak Power Margaria KG: 10.69

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 108.0	ResTORQUE: 105.0
LesPOWER: 136.0	ResPOWER: 172.0
LesWORK: 107.0	ResWORK: 112.0
LesVELOCITY: 96.0	ResVELOCITY: 103.0
LesTWORK: 498.0	ResTWORK: 541.0
LemTORQUE: 50.0	RemTORQUE: 57.0
LemPOWER: 183.0	RemPOWER: 204.0
LemWORK: 57.0	RemWORK: 56.0
LemVELOCITY: 249.0	RemVELOCITY: 263.0
LemTWORK: 488.0	RemTWORK: 501.0
LefTORQUE: 25.0	RefTORQUE: 28.0
LefPOWER: 95.0	RefPOWER: 105.0
LefWORK: 29.0	RefWORK: 28.0
LefVELOCITY: 265.0	RefVELOCITY: 276.0
LefTWORK: 456.0	RefTWORK: 464.0
LfsTORQUE: 63.0	RfsTORQUE: 73.0
LfsPOWER: 107.0	RfSPOWER: 132.0
LfsWORK: 87.0	RfsWORK: 91.0
LfsVELOCITY: 91.0	RfsVELOCITY: 97.0
LfsTWORK: 369.0	RfsTWORK: 423.0
LfmTORQUE: 50.0	RfmTORQUE: 51.0
LfmPOWER: 165.0	RfmPOWER: 179.0
LfmWORK: 49.0	RfmWORK: 50.0
LfmVELOCITY: 253.0	RfmVELOCITY: 263.0
LfmTWORK: 440.0	RfmTWORK: 460.0
LffTORQUE: 47.0	RffTORQUE: 51.0
LffPOWER: 162.0	RffPOWER: 190.0
LffWORK: 47.0	RffWORK: 54.0
LffVELOCITY: 255.0	RffVELOCITY: 272.0
LffTWORK: 749.0	RffTWORK: 828.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: D.R. Group: N Test Time: PRE
Age: 14 Height: 160.5 Mass: 68.0

Vertical Jump Test

Standing Reach: 203 Vertical Jump: 35

Wingate Test

Resistance: 5.0 Peak 5s RPM: 8.0 Total 30s RPM: 37.5
Peak Power: 470.59 Anaerobic Capacity: 367.65
Peak Power KG: 6.92 Anaerobic Capacity KG: 5.41

Margaria Stair Run Test

Ascension Time: 0.68 Peak Power Margaria: 588.00
Peak Power Margaria KG: 8.65

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 78.0	ResTORQUE: 85.0
LesPOWER: 114.0	ResPOWER: 137.0
LesWORK: 90.0	ResWORK: 88.0
LesVELOCITY: 91.0	ResVELOCITY: 97.0
LesTWORK: 393.0	ResTWORK: 391.0
LemTORQUE: 38.0	RemTORQUE: 34.0
LemPOWER: 104.0	RemPOWER: 105.0
LemWORK: 39.0	RemWORK: 39.0
LemVELOCITY: 219.0	RemVELOCITY: 235.0
LemTWORK: 327.0	RemTWORK: 336.0
LefTORQUE: 18.0	RefTORQUE: 16.0
LefPOWER: 61.0	RefPOWER: 62.0
LefWORK: 18.0	RefWORK: 28.0
LefVELOCITY: 267.0	RefVELOCITY: 276.0
LefTWORK: 289.0	RefTWORK: 276.0
LfsTORQUE: 57.0	RfsTORQUE: 61.0
LfsPOWER: 77.0	RfSPOWER: 88.0
LfsWORK: 65.0	RfsWORK: 62.0
LfsVELOCITY: 80.0	RfsVELOCITY: 79.0
LfsTWORK: 304.0	RfsTWORK: 280.0
LfmTORQUE: 28.0	RfmTORQUE: 29.0
LfmPOWER: 79.0	RfmPOWER: 76.0
LfmWORK: 30.0	RfmWORK: 32.0
LfmVELOCITY: 198.0	RfmVELOCITY: 196.0
LfmTWORK: 281.0	RfmTWORK: 289.0
LffTORQUE: 16.0	RffTORQUE: 17.0
LffPOWER: 57.0	RffPOWER: 55.0
LffWORK: 17.0	RffWORK: 17.0
LffVELOCITY: 254.0	RffVELOCITY: 239.0
LffTWORK: 267.0	RffTWORK: 277.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: D.R. Group: N Test Time: POST
Age: 14 Height: 160.5 Mass: 66.0

Vertical Jump Test

Standing Reach: 203 Vertical Jump: 36

Wingate Test

Resistance: 5.0 Peak 5s RPM: 10.0 Total 30s RPM: 38.0
Peak Power: 588.24 Anaerobic Capacity: 372.55
Peak Power KG: 8.91 Anaerobic Capacity KG: 5.64

Margaria Stair Run Test

Ascension Time: 0.56 Peak Power Margaria: 693.00
Peak Power Margaria KG: 10.50

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 81.0	ResTORQUE: 81.0
LesPOWER: 117.0	ResPOWER: 132.0
LesWORK: 92.0	ResWORK: 95.0
LesVELOCITY: 90.0	ResVELOCITY: 97.0
LesTWORK: 407.0	ResTWORK: 408.0
LemTORQUE: 41.0	RemTORQUE: 38.0
LemPOWER: 123.0	RemPOWER: 124.0
LemWORK: 46.0	RemWORK: 46.0
LemVELOCITY: 223.0	RemVELOCITY: 225.0
LemTWORK: 410.0	RemTWORK: 416.0
LefTORQUE: 24.0	RefTORQUE: 25.0
LefPOWER: 82.0	RefPOWER: 86.0
LefWORK: 27.0	RefWORK: 28.0
LefVELOCITY: 273.0	RefVELOCITY: 264.0
LefTWORK: 442.0	RefTWORK: 431.0
LfsTORQUE: 47.0	RfsTORQUE: 57.0
LfsPOWER: 65.0	RfSPOWER: 85.0
LfsWORK: 58.0	RfsWORK: 71.0
LfsVELOCITY: 77.0	RfsVELOCITY: 83.0
LfsTWORK: 274.0	RfsTWORK: 317.0
LfmTORQUE: 32.0	RfmTORQUE: 30.0
LfmPOWER: 110.0	RfmPOWER: 94.0
LfmWORK: 37.0	RfmWORK: 34.0
LfmVELOCITY: 242.0	RfmVELOCITY: 238.0
LfmTWORK: 296.0	RfmTWORK: 312.0
LffTORQUE: 17.0	RffTORQUE: 17.0
LffPOWER: 83.0	RffPOWER: 73.0
LffWORK: 20.0	RffWORK: 18.0
LffVELOCITY: 335.0	RffVELOCITY: 319.0
LffTWORK: 317.0	RffTWORK: 297.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: J.W. Group: W Test Time: PRE
Age: 14 Height: 168.0 Mass: 93.0

Vertical Jump Test

Standing Reach: 218 Vertical Jump: 20

Wingate Test

Resistance: 7.0 Peak 5s RPM: 4.0 Total 30s RPM: 21.0
Peak Power: 329.41 Anaerobic Capacity: 288.24
Peak Power KG: 3.54 Anaerobic Capacity KG: 3.10

Margaria Stair Run Test

Ascension Time: 0.70 Peak Power Margaria: 781.20
Peak Power Margaria KG: 8.40

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 102.0	ResTORQUE: 106.0
LesPOWER: 142.0	ResPOWER: 159.0
LesWORK: 114.0	ResWORK: 113.0
LesVELOCITY: 95.0	ResVELOCITY: 105.0
LesTWORK: 513.0	ResTWORK: 521.0
LemTORQUE: 54.0	RemTORQUE: 43.0
LemPOWER: 159.0	RemPOWER: 131.0
LemWORK: 55.0	RemWORK: 47.0
LemVELOCITY: 226.0	RemVELOCITY: 217.0
LemTWORK: 388.0	RemTWORK: 424.0
LefTORQUE: 25.0	RefTORQUE: 25.0
LefPOWER: 88.0	RefPOWER: 82.0
LefWORK: 29.0	RefWORK: 28.0
LefVELOCITY: 275.0	RefVELOCITY: 265.0
LefTWORK: 463.0	RefTWORK: 463.0
LfsTORQUE: 68.0	RfsTORQUE: 68.0
LfsPOWER: 115.0	RfSPOWER: 96.0
LfsWORK: 85.0	RfsWORK: 89.0
LfsVELOCITY: 90.0	RfsVELOCITY: 88.0
LfsTWORK: 370.0	RfsTWORK: 41.0
LfmTORQUE: 41.0	RfmTORQUE: 37.0
LfmPOWER: 157.0	RfmPOWER: 141.0
LfmWORK: 45.0	RfmWORK: 42.0
LfmVELOCITY: 262.0	RfmVELOCITY: 254.0
LfmTWORK: 388.0	RfmTWORK: 365.0
LffTORQUE: 19.0	RffTORQUE: 19.0
LffPOWER: 96.0	RffPOWER: 96.0
LffWORK: 22.0	RffWORK: 22.0
LffVELOCITY: 351.0	RffVELOCITY: 351.0
LffTWORK: 357.0	RffTWORK: 381.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: J.W. Group: W Test Time: POST
Age: 14 Height: 168.0 Mass: 91.0

Vertical Jump Test

Standing Reach: 218 Vertical Jump: 21

Wingate Test

Resistance: 7.0 Peak 5s RPM: 4.0 Total 30s RPM: 21.0
Peak Power: 329.41 Anaerobic Capacity: 288.24
Peak Power KG: 3.62 Anaerobic Capacity KG: 3.17

Margaria Stair Run Test

Ascension Time: 0.55 Peak Power Margaria: 972.87
Peak Power Margaria KG: 10.69

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 104.0	ResTORQUE: 102.0
LesPOWER: 140.0	ResPOWER: 176.0
LesWORK: 106.0	ResWORK: 123.0
LesVELOCITY: 96.0	ResVELOCITY: 109.0
LesTWORK: 494.0	ResTWORK: 584.0
LemTORQUE: 49.0	RemTORQUE: 52.0
LemPOWER: 173.0	RemPOWER: 159.0
LemWORK: 53.0	RemWORK: 52.0
LemVELOCITY: 248.0	RemVELOCITY: 247.0
LemTWORK: 442.0	RemTWORK: 442.0
LefTORQUE: 22.0	RefTORQUE: 23.0
LefPOWER: 81.0	RefPOWER: 87.0
LefWORK: 24.0	RefWORK: 25.0
LefVELOCITY: 276.0	RefVELOCITY: 303.0
LefTWORK: 398.0	RefTWORK: 396.0
LfsTORQUE: 71.0	RfsTORQUE: 43.0
LfsPOWER: 108.0	RfSPOWER: 160.0
LfsWORK: 80.0	RfsWORK: 51.0
LfsVELOCITY: 88.0	RfsVELOCITY: 88.0
LfsTWORK: 384.0	RfsTWORK: 227.0
LfmTORQUE: 43.0	RfmTORQUE: 41.0
LfmPOWER: 148.0	RfmPOWER: 149.0
LfmWORK: 44.0	RfmWORK: 47.0
LfmVELOCITY: 247.0	RfmVELOCITY: 257.0
LfmTWORK: 395.0	RfmTWORK: 419.0
LffTORQUE: 21.0	RffTORQUE: 23.0
LffPOWER: 119.0	RffPOWER: 128.0
LffWORK: 24.0	RffWORK: 27.0
LffVELOCITY: 385.0	RffVELOCITY: 393.0
LffTWORK: 394.0	RffTWORK: 383.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

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Subject Name: - A.S. Group: W Test Time: PRE
Age: 14 Height: 168.0 Mass: 68.0

Vertical Jump Test

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Standing Reach: 218 Vertical Jump: 35

Wingate Test

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Resistance: 5.0 Peak 5s RPM: 8.0 Total 30s RPM: 36.5
Peak Power: 470.59 Anaerobic Capacity: 357.84
Peak Power KG: 6.92 Anaerobic Capacity KG: 5.26

Margaria Stair Run Test

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Ascension Time: 0.51 Peak Power Margaria: 780.94
Peak Power Margaria KG: 11.48

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

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Left Side	Right Side
LesTORQUE: 93.0	ResTORQUE: 103.0
LesPOWER: 149.0	ResPOWER: 161.0
LesWORK: 89.0	ResWORK: 101.0
LesVELOCITY: 96.0	ResVELOCITY: 98.0
LesTWORK: 404.0	ResTWORK: 447.0
LemTORQUE: 66.0	RemTORQUE: 74.0
LemPOWER: 171.0	RemPOWER: 140.0
LemWORK: 52.0	RemWORK: 52.0
LemVELOCITY: 253.0	RemVELOCITY: 255.0
LemTWORK: 451.0	RemTWORK: 439.0
LefTORQUE: 28.0	RefTORQUE: 37.0
LefPOWER: 84.0	RefPOWER: 96.0
LefWORK: 27.0	RefWORK: 28.0
LefVELOCITY: 302.0	RefVELOCITY: 309.0
LefTWORK: 393.0	RefTWORK: 415.0
LfsTORQUE: 63.0	RfsTORQUE: 65.0
LfsPOWER: 95.0	RfSPOWER: 101.0
LfsWORK: 67.0	RfsWORK: 79.0
LfsVELOCITY: 82.0	RfsVELOCITY: 82.0
LfsTWORK: 313.0	RfsTWORK: 303.0
LfmTORQUE: 48.0	RfmTORQUE: 46.0
LfmPOWER: 198.0	RfmPOWER: 195.0
LfmWORK: 53.0	RfmWORK: 54.0
LfmVELOCITY: 306.0	RfmVELOCITY: 307.0
LfmTWORK: 480.0	RfmTWORK: 483.0
LffTORQUE: 22.0	RffTORQUE: 22.0
LffPOWER: 127.0	RffPOWER: 134.0
LffWORK: 27.0	RffWORK: 27.0
LffVELOCITY: 407.0	RffVELOCITY: 414.0
LffTWORK: 428.0	RffTWORK: 460.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: A.S. Group: W Test Time: POST
Age: 14 Height: 168.0 Mass: 69.0

Vertical Jump Test

Standing Reach: 218 Vertical Jump: 41

Wingate Test

Resistance: 5.0 Peak 5s RPM: 9.0 Total 30s RPM: 38.0
Peak Power: 529.41 Anaerobic Capacity: 372.55
Peak Power KG: 7.67 Anaerobic Capacity KG: 5.40

Margaria Stair Run Test

Ascension Time: 0.49 Peak Power Margaria: 828.00
Peak Power Margaria KG: 12.00

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 95.0	ResTORQUE: 100.0
LesPOWER: 119.0	ResPOWER: 165.0
LesWORK: 84.0	ResWORK: 102.0
LesVELOCITY: 87.0	ResVELOCITY: 99.0
LesTWORK: 366.0	ResTWORK: 476.0
LemTORQUE: 50.0	RemTORQUE: 66.0
LemPOWER: 152.0	RemPOWER: 160.0
LemWORK: 53.0	RemWORK: 55.0
LemVELOCITY: 233.0	RemVELOCITY: 252.0
LemTWORK: 481.0	RemTWORK: 465.0
LefTORQUE: 24.0	RefTORQUE: 28.0
LefPOWER: 84.0	RefPOWER: 93.0
LefWORK: 28.0	RefWORK: 30.0
LefVELOCITY: 259.0	RefVELOCITY: 292.0
LefTWORK: 431.0	RefTWORK: 474.0
LfsTORQUE: 66.0	RfsTORQUE: 73.0
LfsPOWER: 98.0	RfSPOWER: 125.0
LfsWORK: 68.0	RfsWORK: 89.0
LfsVELOCITY: 83.0	RfsVELOCITY: 94.0
LfsTWORK: 290.0	RfsTWORK: 386.0
LfmTORQUE: 46.0	RfmTORQUE: 50.0
LfmPOWER: 176.0	RfmPOWER: 208.0
LfmWORK: 48.0	RfmWORK: 54.0
LfmVELOCITY: 291.0	RfmVELOCITY: 310.0
LfmTWORK: 413.0	RfmTWORK: 500.0
LffTORQUE: 20.0	RffTORQUE: 22.0
LffPOWER: 107.0	RffPOWER: 126.0
LffWORK: 23.0	RffWORK: 26.0
LffVELOCITY: 373.0	RffVELOCITY: 400.0
LffTWORK: 354.0	RffTWORK: 425.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: H.W. Group: C Test Time: PRE
Age: 14 Height: 169.0 Mass: 70.0

Vertical Jump Test

Standing Reach: 213 Vertical Jump: 30

Wingate Test

Resistance: 5.0 Peak 5s RPM: 6.5 Total 30s RPM: 33.5
Peak Power: 382.35 Anaerobic Capacity: 328.43
Peak Power KG: 5.46 Anaerobic Capacity KG: 4.69

Margaria Stair Run Test

Ascension Time: 0.68 Peak Power Margaria: 605.29
Peak Power Margaria KG: 8.65

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 66.0	ResTORQUE: 72.0
LesPOWER: 75.0	ResPOWER: 97.0
LesWORK: 62.0	ResWORK: 78.0
LesVELOCITY: 79.0	ResVELOCITY: 83.0
LesTWORK: 295.0	ResTWORK: 365.0
LemTORQUE: 37.0	RemTORQUE: 40.0
LemPOWER: 101.0	RemPOWER: 100.0
LemWORK: 39.0	RemWORK: 41.0
LemVELOCITY: 204.0	RemVELOCITY: 204.0
LemTWORK: 331.0	RemTWORK: 367.0
LefTORQUE: 18.0	RefTORQUE: 20.0
LefPOWER: 62.0	RefPOWER: 61.0
LefWORK: 20.0	RefWORK: 21.0
LefVELOCITY: 251.0	RefVELOCITY: 239.0
LefTWORK: 311.0	RefTWORK: 330.0
LfsTORQUE: 53.0	RfsTORQUE: 54.0
LfsPOWER: 73.0	RfSPOWER: 79.0
LfsWORK: 58.0	RfsWORK: 65.0
LfsVELOCITY: 74.0	RfsVELOCITY: 80.0
LfsTWORK: 267.0	RfsTWORK: 316.0
LfmTORQUE: 30.0	RfmTORQUE: 31.0
LfmPOWER: 93.0	RfmPOWER: 109.0
LfmWORK: 36.0	RfmWORK: 37.0
LfmVELOCITY: 206.0	RfmVELOCITY: 239.0
LfmTWORK: 337.0	RfmTWORK: 351.0
LffTORQUE: 17.0	RffTORQUE: 18.0
LffPOWER: 72.0	RffPOWER: 81.0
LffWORK: 19.0	RffWORK: 21.0
LffVELOCITY: 304.0	RffVELOCITY: 314.0
LffTWORK: 331.0	RffTWORK: 346.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: H.W.   Group: C   Test Time: POST
Age: 14   Height: 169.0   Mass: 71.0

Vertical Jump Test

Standing Reach: 213   Vertical Jump: 31

Wingate Test

Resistance: 5.0   Peak 5s RPM: 6.0   Total 30s RPM: 31.0
Peak Power: 352.94   Anaerobic Capacity: 303.92
Peak Power KG: 4.97   Anaerobic Capacity KG: 4.28

Margaria Stair Run Test

Ascension Time: 0.59   Peak Power Margaria: 707.59
Peak Power Margaria KG: 9.97

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 64.0	ResTORQUE: 79.0
LesPOWER: 87.0	ResPOWER: 154.0
LesWORK: 70.0	ResWORK: 89.0
LesVELOCITY: 81.0	ResVELOCITY: 107.0
LesTWORK: 323.0	ResTWORK: 416.0
LemTORQUE: 35.0	RemTORQUE: 38.0
LemPOWER: 81.0	RemPOWER: 85.0
LemWORK: 37.0	RemWORK: 40.0
LemVELOCITY: 172.0	RemVELOCITY: 177.0
LemTWORK: 329.0	RemTWORK: 323.0
LefTORQUE: 21.0	RefTORQUE: 23.0
LefPOWER: 61.0	RefPOWER: 77.0
LefWORK: 23.0	RefWORK: 26.0
LefVELOCITY: 190.0	RefVELOCITY: 230.0
LefTWORK: 363.0	RefTWORK: 430.0
LfsTORQUE: 61.0	RfsTORQUE: 62.0
LfsPOWER: 79.0	RfSPOWER: 104.0
LfsWORK: 59.0	RfsWORK: 78.0
LfsVELOCITY: 80.0	RfsVELOCITY: 91.0
LfsTWORK: 287.0	RfsTWORK: 357.0
LfmTORQUE: 31.0	RfmTORQUE: 30.0
LfmPOWER: 129.0	RfmPOWER: 104.0
LfmWORK: 39.0	RfmWORK: 36.0
LfmVELOCITY: 255.0	RfmVELOCITY: 236.0
LfmTWORK: 347.0	RfmTWORK: 303.0
LffTORQUE: 41.0	RffTORQUE: 42.0
LffPOWER: 128.0	RffPOWER: 140.0
LffWORK: 48.0	RffWORK: 52.0
LffVELOCITY: 190.0	RffVELOCITY: 206.0
LffTWORK: 769.0	RffTWORK: 861.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: M.N. Group: W Test Time: PRE
Age: 14 Height: 171.5 Mass: 60.0

Vertical Jump Test

Standing Reach: 220 Vertical Jump: 34

Wingate Test

Resistance: 4.5 Peak 5s RPM: 7.0 Total 30s RPM: 35.5
Peak Power: 370.59 Anaerobic Capacity: 313.24
Peak Power KG: 6.18 Anaerobic Capacity KG: 5.22

Margaria Stair Run Test

Ascension Time: 0.63 Peak Power Margaria: 560.00
Peak Power Margaria KG: 9.33

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 78.0	ResTORQUE: 86.0
LesPOWER: 116.0	ResPOWER: 113.0
LesWORK: 99.0	ResWORK: 97.0
LesVELOCITY: 95.0	ResVELOCITY: 96.0
LesTWORK: 471.0	ResTWORK: 451.0
LemTORQUE: 38.0	RemTORQUE: 43.0
LemPOWER: 96.0	RemPOWER: 101.0
LemWORK: 43.0	RemWORK: 47.0
LemVELOCITY: 212.0	RemVELOCITY: 213.0
LemTWORK: 401.0	RemTWORK: 434.0
LefTORQUE: 22.0	RefTORQUE: 22.0
LefPOWER: 68.0	RefPOWER: 64.0
LefWORK: 24.0	RefWORK: 24.0
LefVELOCITY: 263.0	RefVELOCITY: 252.0
LefTWORK: 402.0	RefTWORK: 414.0
LfsTORQUE: 56.0	RfsTORQUE: 58.0
LfsPOWER: 96.0	RfSPOWER: 103.0
LfsWORK: 80.0	RfsWORK: 86.0
LfsVELOCITY: 91.0	RfsVELOCITY: 98.0
LfsTWORK: 388.0	RfsTWORK: 376.0
LfmTORQUE: 33.0	RfmTORQUE: 37.0
LfmPOWER: 105.0	RfmPOWER: 127.0
LfmWORK: 41.0	RfmWORK: 45.0
LfmVELOCITY: 243.0	RfmVELOCITY: 267.0
LfmTWORK: 346.0	RfmTWORK: 399.0
LffTORQUE: 18.0	RffTORQUE: 18.0
LffPOWER: 85.0	RffPOWER: 89.0
LffWORK: 23.0	RffWORK: 23.0
LffVELOCITY: 345.0	RffVELOCITY: 344.0
LffTWORK: 381.0	RffTWORK: 382.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: M.N. Group: W Test Time: POST
Age: 14 Height: 171.5 Mass: 61.0

Vertical Jump Test

Standing Reach: 220 Vertical Jump: 39

Wingate Test

Resistance: 4.5 Peak 5s RPM: 7.0 Total 30s RPM: 35.0
Peak Power: 370.59 Anaerobic Capacity: 308.82
Peak Power KG: 6.08 Anaerobic Capacity KG: 5.06

Margaria Stair Run Test

Ascension Time: 0.57 Peak Power Margaria: 629.26
Peak Power Margaria KG: 10.32

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 72.0	ResTORQUE: 76.0
LesPOWER: 93.0	ResPOWER: 94.0
LesWORK: 83.0	ResWORK: 81.0
LesVELOCITY: 87.0	ResVELOCITY: 86.0
LesTWORK: 402.0	ResTWORK: 356.0
LemTORQUE: 38.0	RemTORQUE: 39.0
LemPOWER: 102.0	RemPOWER: 108.0
LemWORK: 40.0	RemWORK: 41.0
LemVELOCITY: 215.0	RemVELOCITY: 223.0
LemTWORK: 338.0	RemTWORK: 364.0
LefTORQUE: 19.0	RefTORQUE: 20.0
LefPOWER: 64.0	RefPOWER: 68.0
LefWORK: 22.0	RefWORK: 22.0
LefVELOCITY: 271.0	RefVELOCITY: 271.0
LefTWORK: 344.0	RefTWORK: 360.0
LfsTORQUE: 51.0	RfsTORQUE: 46.0
LfsPOWER: 77.0	RfSPOWER: 59.0
LfsWORK: 70.0	RfsWORK: 54.0
LfsVELOCITY: 83.0	RfsVELOCITY: 74.0
LfsTWORK: 330.0	RfsTWORK: 266.0
LfmTORQUE: 31.0	RfmTORQUE: 31.0
LfmPOWER: 102.0	RfmPOWER: 99.0
LfmWORK: 36.0	RfmWORK: 36.0
LfmVELOCITY: 245.0	RfmVELOCITY: 224.0
LfmTWORK: 346.0	RfmTWORK: 331.0
LffTORQUE: 19.0	RffTORQUE: 18.0
LffPOWER: 78.0	RffPOWER: 70.0
LffWORK: 23.0	RffWORK: 21.0
LffVELOCITY: 330.0	RffVELOCITY: 290.0
LffTWORK: 396.0	RffTWORK: 350.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

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Subject Name: I.S. Group: N Test Time: PRE
Age: 14 Height: 157.0 Mass: 48.0

Vertical Jump Test
=================
Standing Reach: 201 Vertical Jump: 48

Wingate Test
============
Resistance: 3.5 Peak 5s RPM: 9.0 Total 30s RPM: 45.0
Peak Power: 370.59 Anaerobic Capacity: 308.82
Peak Power KG: 7.72 Anaerobic Capacity KG: 6.43

Margaria Stair Run Test
=====================
Ascension Time: 0.52 Peak Power Margaria: 542.77
Peak Power Margaria KG: 11.31

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)
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Left Side	Right Side
LesTORQUE: 69.0	ResTORQUE: 76.0
LesPOWER: 97.0	ResPOWER: 108.0
LesWORK: 77.0	ResWORK: 84.0
LesVELOCITY: 87.0	ResVELOCITY: 91.0
LesTWORK: 352.0	ResTWORK: 371.0
LemTORQUE: 34.0	RemTORQUE: 36.0
LemPOWER: 205.0	RemPOWER: 116.0
LemWORK: 37.0	RemWORK: 36.0
LemVELOCITY: 206.0	RemVELOCITY: 205.0
LemTWORK: 351.0	RemTWORK: 297.0
LefTORQUE: 18.0	RefTORQUE: 19.0
LefPOWER: 64.0	RefPOWER: 79.0
LefWORK: 21.0	RefWORK: 22.0
LefVELOCITY: 243.0	RefVELOCITY: 274.0
LefTWORK: 326.0	RefTWORK: 346.0
LfsTORQUE: 48.0	RfsTORQUE: 49.0
LfsPOWER: 66.0	RfSPOWER: 74.0
LfsWORK: 56.0	RfsWORK: 59.0
LfsVELOCITY: 75.0	RfsVELOCITY: 79.0
LfsTWORK: 271.0	RfsTWORK: 269.0
LfmTORQUE: 28.0	RfmTORQUE: 28.0
LfmPOWER: 84.0	RfmPOWER: 109.0
LfmWORK: 30.0	RfmWORK: 30.0
LfmVELOCITY: 218.0	RfmVELOCITY: 245.0
LfmTWORK: 277.0	RfmTWORK: 254.0
LffTORQUE: 14.0	RffTORQUE: 16.0
LffPOWER: 67.0	RffPOWER: 79.0
LffWORK: 16.0	RffWORK: 29.0
LffVELOCITY: 293.0	RffVELOCITY: 326.0
LffTWORK: 279.0	RffTWORK: 313.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: I.S. Group: N Test Time: POST
Age: 14 Height: 157.0 Mass: 48.6

Vertical Jump Test

Standing Reach: 201 Vertical Jump: 52

Wingate Test

Resistance: 3.5 Peak 5s RPM: 9.0 Total 30s RPM: 46.0
Peak Power: 370.59 Anaerobic Capacity: 315.69
Peak Power KG: 7.63 Anaerobic Capacity KG: 6.50

Margaria Stair Run Test

Ascension Time: 0.50 Peak Power Margaria: 571.54
Peak Power Margaria KG: 11.76

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 71.0	ResTORQUE: 79.0
LesPOWER: 108.0	ResPOWER: 124.0
LesWORK: 70.0	ResWORK: 81.0
LesVELOCITY: 86.0	ResVELOCITY: 101.0
LesTWORK: 331.0	ResTWORK: 378.0
LemTORQUE: 39.0	RemTORQUE: 42.0
LemPOWER: 129.0	RemPOWER: 128.0
LemWORK: 43.0	RemWORK: 43.0
LemVELOCITY: 214.0	RemVELOCITY: 213.0
LemTWORK: 372.0	RemTWORK: 384.0
LefTORQUE: 24.0	RefTORQUE: 28.0
LefPOWER: 86.0	RefPOWER: 98.0
LefWORK: 25.0	RefWORK: 29.0
LefVELOCITY: 233.0	RefVELOCITY: 238.0
LefTWORK: 394.0	RefTWORK: 461.0
LfsTORQUE: 46.0	RfsTORQUE: 48.0
LfsPOWER: 71.0	RfSPOWER: 71.0
LfsWORK: 53.0	RfsWORK: 57.0
LfsVELOCITY: 79.0	RfsVELOCITY: 80.0
LfsTWORK: 237.0	RfsTWORK: 274.0
LfmTORQUE: 28.0	RfmTORQUE: 30.0
LfmPOWER: 108.0	RfmPOWER: 112.0
LfmWORK: 30.0	RfmWORK: 31.0
LfmVELOCITY: 235.0	RfmVELOCITY: 240.0
LfmTWORK: 281.0	RfmTWORK: 286.0
LffTORQUE: 14.0	RffTORQUE: 16.0
LffPOWER: 71.0	RffPOWER: 78.0
LffWORK: 15.0	RffWORK: 17.0
LffVELOCITY: 309.0	RffVELOCITY: 321.0
LffTWORK: 246.0	RffTWORK: 278.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

==

Subject Name: C.D. Group: W Test Time: PRE
Age: 14 Height: 159.4 Mass: 48.0

Vertical Jump Test
=================
Standing Reach: 201 Vertical Jump: 38

Wingate Test
============
Resistance: 3.5 Peak 5s RPM: 10.0 Total 30s RPM: 48.5
Peak Power: 411.76 Anaerobic Capacity: 332.84
Peak Power KG: 8.58 Anaerobic Capacity KG: 6.93

Margaria Stair Run Test
======================
Ascension Time: 0.49 Peak Power Margaria: 576.00
Peak Power Margaria KG: 12.00

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)
==========================

Left Side	Right Side
LesTORQUE: 60.0	ResTORQUE: 63.0
LesPOWER: 71.0	ResPOWER: 84.0
LesWORK: 59.0	ResWORK: 69.0
LesVELOCITY: 75.0	ResVELOCITY: 86.0
LesTWORK: 287.0	ResTWORK: 341.0
LemTORQUE: 31.0	RemTORQUE: 30.0
LemPOWER: 95.0	RemPOWER: 94.0
LemWORK: 33.0	RemWORK: 34.0
LemVELOCITY: 196.0	RemVELOCITY: 206.0
LemTWORK: 302.0	RemTWORK: 305.0
LefTORQUE: 18.0	RefTORQUE: 16.0
LefPOWER: 60.0	RefPOWER: 58.0
LefWORK: 19.0	RefWORK: 19.0
LefVELOCITY: 244.0	RefVELOCITY: 239.0
LefTWORK: 297.0	RefTWORK: 293.0
LfsTORQUE: 44.0	RfsTORQUE: 46.0
LfsPOWER: 57.0	RfSPOWER: 72.0
LfsWORK: 52.0	RfsWORK: 66.0
LfsVELOCITY: 72.0	RfsVELOCITY: 84.0
LfsTWORK: 233.0	RfsTWORK: 246.0
LfmTORQUE: 23.0	RfmTORQUE: 24.0
LfmPOWER: 79.0	RfmPOWER: 84.0
LfmWORK: 26.0	RfmWORK: 29.0
LfmVELOCITY: 221.0	RfmVELOCITY: 224.0
LfmTWORK: 238.0	RfmTWORK: 259.0
LffTORQUE: 15.0	RffTORQUE: 14.0
LffPOWER: 70.0	RffPOWER: 68.0
LffWORK: 16.0	RffWORK: 16.0
LffVELOCITY: 308.0	RffVELOCITY: 303.0
LffTWORK: 277.0	RffTWORK: 252.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: . C.D. Group: W Test Time: POST
Age: 14 Height: 159.4 Mass: 48.5

Vertical Jump Test

Standing Reach: 201 Vertical Jump: 43

Wingate Test

Resistance: 3.5 Peak 5s RPM: 10.0 Total 30s RPM: 48.0
Peak Power: 411.76 Anaerobic Capacity: 329.41
Peak Power KG: 8.49 Anaerobic Capacity KG: 6.79

Margaria Stair Run Test

Ascension Time: 0.46 Peak Power Margaria: 619.96
Peak Power Margaria KG: 12.78

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 64.0	ResTORQUE: 66.0
LesPOWER: 93.0	ResPOWER: 97.0
LesWORK: 73.0	ResWORK: 74.0
LesVELOCITY: 82.0	ResVELOCITY: 84.0
LesTWORK: 339.0	ResTWORK: 361.0
LemTORQUE: 34.0	RemTORQUE: 32.0
LemPOWER: 108.0	RemPOWER: 96.0
LemWORK: 40.0	RemWORK: 38.0
LemVELOCITY: 206.0	RemVELOCITY: 194.0
LemTWORK: 352.0	RemTWORK: 337.0
LefTORQUE: 53.0	RefTORQUE: 52.0
LefPOWER: 139.0	RefPOWER: 120.0
LefWORK: 61.0	RefWORK: 61.0
LefVELOCITY: 153.0	RefVELOCITY: 136.0
LefTWORK: 928.0	RefTWORK: 896.0
LfsTORQUE: 59.0	RfsTORQUE: 55.0
LfsPOWER: 88.0	RfSPOWER: 85.0
LfsWORK: 62.0	RfsWORK: 65.0
LfsVELOCITY: 89.0	RfsVELOCITY: 90.0
LfsTWORK: 279.0	RfsTWORK: 302.0
LfmTORQUE: 30.0	RfmTORQUE: 25.0
LfmPOWER: 122.0	RfmPOWER: 104.0
LfmWORK: 35.0	RfmWORK: 30.0
LfmVELOCITY: 258.0	RfmVELOCITY: 249.0
LfmTWORK: 319.0	RfmTWORK: 246.0
LffTORQUE: 31.0	RffTORQUE: 31.0
LffPOWER: 105.0	RffPOWER: 127.0
LffWORK: 32.0	RffWORK: 34.0
LffVELOCITY: 202.0	RffVELOCITY: 231.0
LffTWORK: 576.0	RffTWORK: 524.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: J.J. Group: C Test Time: PRE
Age: 14 Height: 160.5 Mass: 52.0

Vertical Jump Test

Standing Reach: 209 Vertical Jump: 34

Wingate Test

Resistance: 4.0 Peak 5s RPM: 10.0 Total 30s RPM: 44.5
Peak Power: 470.59 Anaerobic Capacity: 349.02
Peak Power KG: 9.05 Anaerobic Capacity KG: 6.71

Margaria Stair Run Test

Ascension Time: 0.65 Peak Power Margaria: 470.40
Peak Power Margaria KG: 9.05

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 61.0	ResTORQUE: 66.0
LesPOWER: 66.0	ResPOWER: 109.0
LesWORK: 65.0	ResWORK: 72.0
LesVELOCITY: 74.0	ResVELOCITY: 93.0
LesTWORK: 269.0	ResTWORK: 334.0
LemTORQUE: 34.0	RemTORQUE: 47.0
LemPOWER: 105.0	RemPOWER: 124.0
LemWORK: 38.0	RemWORK: 40.0
LemVELOCITY: 210.0	RemVELOCITY: 224.0
LemTWORK: 330.0	RemTWORK: 365.0
LefTORQUE: 19.0	RefTORQUE: 19.0
LefPOWER: 73.0	RefPOWER: 68.0
LefWORK: 19.0	RefWORK: 20.0
LefVELOCITY: 269.0	RefVELOCITY: 256.0
LefTWORK: 286.0	RefTWORK: 306.0
LfsTORQUE: 43.0	RfsTORQUE: 55.0
LfsPOWER: 60.0	RfSPOWER: 70.0
LfsWORK: 57.0	RfsWORK: 97.0
LfsVELOCITY: 72.0	RfsVELOCITY: 76.0
LfsTWORK: 259.0	RfsTWORK: 275.0
LfmTORQUE: 28.0	RfmTORQUE: 30.0
LfmPOWER: 102.0	RfmPOWER: 134.0
LfmWORK: 34.0	RfmWORK: 38.0
LfmVELOCITY: 224.0	RfmVELOCITY: 272.0
LfmTWORK: 306.0	RfmTWORK: 336.0
LffTORQUE: 17.0	RffTORQUE: 19.0
LffPOWER: 73.0	RffPOWER: 68.0
LffWORK: 19.0	RffWORK: 20.0
LffVELOCITY: 269.0	RffVELOCITY: 256.0
LffTWORK: 286.0	RffTWORK: 306.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: J.J. Group: C Test Time: POST
Age: 14 Height: 160.5 Mass: 51.0

Vertical Jump Test

Standing Reach: 209 Vertical Jump: 35

Wingate Test

Resistance: 4.0 Peak 5s RPM: 8.0 Total 30s RPM: 39.0
Peak Power: 376.47 Anaerobic Capacity: 305.88
Peak Power KG: 7.38 Anaerobic Capacity KG: 6.00

Margaria Stair Run Test

Ascension Time: 0.54 Peak Power Margaria: 555.33
Peak Power Margaria KG: 10.89

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 67.0	ResTORQUE: 68.0
LesPOWER: 98.0	ResPOWER: 118.0
LesWORK: 77.0	ResWORK: 88.0
LesVELOCITY: 84.0	ResVELOCITY: 95.0
LesTWORK: 344.0	ResTWORK: 370.0
LemTORQUE: 36.0	RemTORQUE: 35.0
LemPOWER: 109.0	RemPOWER: 102.0
LemWORK: 34.0	RemWORK: 37.0
LemVELOCITY: 196.0	RemVELOCITY: 204.0
LemTWORK: 305.0	RemTWORK: 329.0
LefTORQUE: 17.0	RefTORQUE: 17.0
LefPOWER: 59.0	RefPOWER: 49.0
LefWORK: 17.0	RefWORK: 17.0
LefVELOCITY: 230.0	RefVELOCITY: 221.0
LefTWORK: 286.0	RefTWORK: 296.0
LfsTORQUE: 40.0	RfsTORQUE: 45.0
LfsPOWER: 56.0	RfSPOWER: 63.0
LfsWORK: 44.0	RfsWORK: 63.0
LfsVELOCITY: 71.0	RfsVELOCITY: 77.0
LfsTWORK: 203.0	RfsTWORK: 265.0
LfmTORQUE: 24.0	RfmTORQUE: 24.0
LfmPOWER: 71.0	RfmPOWER: 81.0
LfmWORK: 24.0	RfmWORK: 28.0
LfmVELOCITY: 196.0	RfmVELOCITY: 229.0
LfmTWORK: 201.0	RfmTWORK: 212.0
LffTORQUE: 13.0	RffTORQUE: 13.0
LffPOWER: 46.0	RffPOWER: 52.0
LffWORK: 13.0	RffWORK: 14.0
LffVELOCITY: 246.0	RffVELOCITY: 265.0
LffTWORK: 209.0	RffTWORK: 237.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

==

Subject Name: CW Group: W Test Time: POST
Age: 14 Height: 165.0 Mass: 54.0

Vertical Jump Test
=================
Standing Reach: 212 Vertical Jump: 40

Wingate Test
============
Resistance: 4.0 Peak 5s RPM: 10.0 Total 30s RPM: 42.0
Peak Power: 470.59 Anaerobic Capacity: 329.41
Peak Power KG: 8.71 Anaerobic Capacity KG: 6.10

Margaria Stair Run Test
=====================
Ascension Time: 0.43 Peak Power Margaria: 738.42
Peak Power Margaria KG: 13.67

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)
==========================

Left Side	Right Side
LesTORQUE: 71.0	ResTORQUE: 93.0
LesPOWER: 96.0	ResPOWER: 82.0
LesWORK: 87.0	ResWORK: 92.0
LesVELOCITY: 89.0	ResVELOCITY: 77.0
LesTWORK: 378.0	ResTWORK: 419.0
LemTORQUE: 34.0	RemTORQUE: 40.0
LemPOWER: 98.0	RemPOWER: 114.0
LemWORK: 44.0	RemWORK: 48.0
LemVELOCITY: 198.0	RemVELOCITY: 218.0
LemTWORK: 370.0	RemTWORK: 427.0
LefTORQUE: 28.0	RefTORQUE: 62.0
LefPOWER: 90.0	RefPOWER: 113.0
LefWORK: 38.0	RefWORK: 77.0
LefVELOCITY: 237.0	RefVELOCITY: 229.0
LefTWORK: 589.0	RefTWORK: 705.0
LfsTORQUE: 50.0	RfsTORQUE: 59.0
LfsPOWER: 68.0	RfSPOWER: 86.0
LfsWORK: 65.0	RfsWORK: 77.0
LfsVELOCITY: 81.0	RfsVELOCITY: 88.0
LfsTWORK: 289.0	RfsTWORK: 242.0
LfmTORQUE: 33.0	RfmTORQUE: 34.0
LfmPOWER: 121.0	RfmPOWER: 123.0
LfmWORK: 39.0	RfmWORK: 40.0
LfmVELOCITY: 264.0	RfmVELOCITY: 264.0
LfmTWORK: 338.0	RfmTWORK: 365.0
LffTORQUE: 18.0	RffTORQUE: 25.0
LffPOWER: 78.0	RffPOWER: 73.0
LffWORK: 21.0	RffWORK: 26.0
LffVELOCITY: 341.0	RffVELOCITY: 326.0
LffTWORK: 334.0	RffTWORK: 316.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: CW Group: W Test Time: PRE
Age: 14 Height: 165.0 Mass: 54.0

Vertical Jump Test

Standing Reach: 212 Vertical Jump: 39

Wingate Test

Resistance: 4.0 Peak 5s RPM: 8.5 Total 30s RPM: 44.0
Peak Power: 400.00 Anaerobic Capacity: 345.10
Peak Power KG: 7.41 Anaerobic Capacity KG: 6.39

Margaria Stair Run Test

Ascension Time: 0.49 Peak Power Margaria: 648.00
Peak Power Margaria KG: 12.00

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 73.0	ResTORQUE: 85.0
LesPOWER: 97.0	ResPOWER: 130.0
LesWORK: 72.0	ResWORK: 97.0
LesVELOCITY: 86.0	ResVELOCITY: 99.0
LesTWORK: 349.0	ResTWORK: 443.0
LemTORQUE: 39.0	RemTORQUE: 47.0
LemPOWER: 99.0	RemPOWER: 98.0
LemWORK: 34.0	RemWORK: 35.0
LemVELOCITY: 218.0	RemVELOCITY: 243.0
LemTWORK: 289.0	RemTWORK: 280.0
LefTORQUE: 22.0	RefTORQUE: 19.0
LefPOWER: 79.0	RefPOWER: 68.0
LefWORK: 27.0	RefWORK: 24.0
LefVELOCITY: 280.0	RefVELOCITY: 262.0
LefTWORK: 407.0	RefTWORK: 372.0
LfsTORQUE: 59.0	RfsTORQUE: 61.0
LfsPOWER: 87.0	RfSPOWER: 92.0
LfsWORK: 69.0	RfsWORK: 83.0
LfsVELOCITY: 81.0	RfsVELOCITY: 88.0
LfsTWORK: 327.0	RfsTWORK: 356.0
LfmTORQUE: 31.0	RfmTORQUE: 32.0
LfmPOWER: 115.0	RfmPOWER: 105.0
LfmWORK: 37.0	RfmWORK: 37.0
LfmVELOCITY: 236.0	RfmVELOCITY: 234.0
LfmTWORK: 342.0	RfmTWORK: 330.0
LffTORQUE: 17.0	RffTORQUE: 18.0
LffPOWER: 74.0	RffPOWER: 83.0
LffWORK: 20.0	RffWORK: 22.0
LffVELOCITY: 323.0	RffVELOCITY: 344.0
LffTWORK: 348.0	RffTWORK: 343.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: S.M. Group: C Test Time: PRE
Age: 15 Height: 158.0 Mass: 46.0

Vertical Jump Test

Standing Reach: 209 Vertical Jump: 27

Wingate Test

Resistance: 3.5 Peak 5s RPM: 7.5 Total 30s RPM: 36.5
Peak Power: 308.82 Anaerobic Capacity: 250.49
Peak Power KG: 6.71 Anaerobic Capacity KG: 5.45

Margaria Stair Run Test

Ascension Time: 0.54 Peak Power Margaria: 500.89
Peak Power Margaria KG: 10.89

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 44.0	ResTORQUE: 54.0
LesPOWER: 44.0	ResPOWER: 43.0
LesWORK: 59.0	ResWORK: 66.0
LesVELOCITY: 68.0	ResVELOCITY: 69.0
LesTWORK: 223.0	ResTWORK: 273.0
LemTORQUE: 26.0	RemTORQUE: 29.0
LemPOWER: 66.0	RemPOWER: 63.0
LemWORK: 33.0	RemWORK: 33.0
LemVELOCITY: 195.0	RemVELOCITY: 185.0
LemTWORK: 260.0	RemTWORK: 261.0
LefTORQUE: 14.0	RefTORQUE: 17.0
LefPOWER: 42.0	RefPOWER: 48.0
LefWORK: 18.0	RefWORK: 21.0
LefVELOCITY: 210.0	RefVELOCITY: 213.0
LefTWORK: 255.0	RefTWORK: 275.0
LfsTORQUE: 35.0	RfsTORQUE: 41.0
LfsPOWER: 51.0	RfSPOWER: 58.0
LfsWORK: 52.0	RfsWORK: 61.0
LfsVELOCITY: 76.0	RfsVELOCITY: 77.0
LfsTWORK: 217.0	RfsTWORK: 255.0
LfmTORQUE: 24.0	RfmTORQUE: 25.0
LfmPOWER: 81.0	RfmPOWER: 83.0
LfmWORK: 31.0	RfmWORK: 33.0
LfmVELOCITY: 232.0	RfmVELOCITY: 242.0
LfmTWORK: 288.0	RfmTWORK: 298.0
LffTORQUE: 14.0	RffTORQUE: 25.0
LffPOWER: 58.0	RffPOWER: 60.0
LffWORK: 17.0	RffWORK: 19.0
LffVELOCITY: 296.0	RffVELOCITY: 308.0
LffTWORK: 257.0	RffTWORK: 243.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: S.M. Group: C Test Time: POST
Age: 15 Height: 158.0 Mass: 45.5

Vertical Jump Test

Standing Reach: 209 Vertical Jump: 33

Wingate Test

Resistance: 3.5 Peak 5s RPM: 9.5 Total 30s RPM: 43.5
Peak Power: 391.18 Anaerobic Capacity: 298.53
Peak Power KG: 8.60 Anaerobic Capacity KG: 6.56

Margaria Stair Run Test

Ascension Time: 0.45 Peak Power Margaria: 594.53
Peak Power Margaria KG: 13.07

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 42.0	ResTORQUE: 49.0
LesPOWER: 37.0	ResPOWER: 53.0
LesWORK: 51.0	ResWORK: 57.0
LesVELOCITY: 64.0	ResVELOCITY: 72.0
LesTWORK: 218.0	ResTWORK: 243.0
LemTORQUE: 24.0	RemTORQUE: 30.0
LemPOWER: 66.0	RemPOWER: 79.0
LemWORK: 31.0	RemWORK: 37.0
LemVELOCITY: 190.0	RemVELOCITY: 205.0
LemTWORK: 272.0	RemTWORK: 312.0
LefTORQUE: 14.0	RefTORQUE: 15.0
LefPOWER: 41.0	RefPOWER: 47.0
LefWORK: 16.0	RefWORK: 19.0
LefVELOCITY: 212.0	RefVELOCITY: 235.0
LefTWORK: 244.0	RefTWORK: 280.0
LfsTORQUE: 34.0	RfsTORQUE: 32.0
LfsPOWER: 44.0	RfSPOWER: 40.0
LfsWORK: 48.0	RfsWORK: 43.0
LfsVELOCITY: 71.0	RfsVELOCITY: 69.0
LfsTWORK: 218.0	RfsTWORK: 180.0
LfmTORQUE: 24.0	RfmTORQUE: 25.0
LfmPOWER: 86.0	RfmPOWER: 96.0
LfmWORK: 31.0	RfmWORK: 34.0
LfmVELOCITY: 241.0	RfmVELOCITY: 254.0
LfmTWORK: 254.0	RfmTWORK: 320.0
LffTORQUE: 13.0	RffTORQUE: 15.0
LffPOWER: 60.0	RffPOWER: 65.0
LffWORK: 15.0	RffWORK: 18.0
LffVELOCITY: 311.0	RffVELOCITY: 325.0
LffTWORK: 224.0	RffTWORK: 261.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

===

Subject Name: T.S. Group: W Test Time: PRE
Age: 14 Height: 173.0 Mass: 74.0

Vertical Jump Test
==================
Standing Reach: 226 Vertical Jump: 38

Wingate Test
============
Resistance: 5.5 Peak 5s RPM: 9.5 Total 30s RPM: 47.0
Peak Power: 614.71 Anaerobic Capacity: 506.86
Peak Power KG: 8.31 Anaerobic Capacity KG: 6.85

Margaria Stair Run Test
=======================
Ascension Time: 0.55 Peak Power Margaria: 791.13
Peak Power Margaria KG: 10.69

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)
===========================

Left Side	Right Side
LesTORQUE: 99.0	ResTORQUE: 97.0
LesPOWER: 153.0	ResPOWER: 153.0
LesWORK: 110.0	ResWORK: 115.0
LesVELOCITY: 102.0	ResVELOCITY: 103.0
LesTWORK: 529.0	ResTWORK: 523.0
LemTORQUE: 54.0	RemTORQUE: 74.0
LemPOWER: 189.0	RemPOWER: 177.0
LemWORK: 56.0	RemWORK: 52.0
LemVELOCITY: 247.0	RemVELOCITY: 268.0
LemTWORK: 4652.0	RemTWORK: 466.0
LefTORQUE: 28.0	RefTORQUE: 27.0
LefPOWER: 118.0	RefPOWER: 99.0
LefWORK: 27.0	RefWORK: 25.0
LefVELOCITY: 331.0	RefVELOCITY: 324.0
LefTWORK: 238.0	RefTWORK: 237.0
LfsTORQUE: 76.0	RfsTORQUE: 72.0
LfsPOWER: 139.0	RfSPOWER: 123.0
LfsWORK: 103.0	RfsWORK: 99.0
LfsVELOCITY: 98.0	RfsVELOCITY: 97.0
LfsTWORK: 482.0	RfsTWORK: 464.0
LfmTORQUE: 43.0	RfmTORQUE: 44.0
LfmPOWER: 168.0	RfmPOWER: 169.0
LfmWORK: 47.0	RfmWORK: 50.0
LfmVELOCITY: 279.0	RfmVELOCITY: 275.0
LfmTWORK: 442.0	RfmTWORK: 482.0
LffTORQUE: 23.0	RffTORQUE: 22.0
LffPOWER: 118.0	RffPOWER: 113.0
LffWORK: 26.0	RffWORK: 27.0
LffVELOCITY: 348.0	RffVELOCITY: 366.0
LffTWORK: 247.0	RffTWORK: 245.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

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Subject Name: T.S. Group: W Test Time: POST
Age: 14 Height: 173.0 Mass: 76.0

Vertical Jump Test

=================

Standing Reach: 226 Vertical Jump: 49

Wingate Test

============

Resistance: 5.5 Peak 5s RPM: 7.5 Total 30s RPM: 35.0
Peak Power: 485.29 Anaerobic Capacity: 377.45
Peak Power KG: 6.39 Anaerobic Capacity KG: 4.97

Margaria Stair Run Test

======================

Ascension Time: 0.53 Peak Power Margaria: 843.17
Peak Power Margaria KG: 11.09

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

==========================

Left Side	Right Side
LesTORQUE: 102.0	ResTORQUE: 103.0
LesPOWER: 127.0	ResPOWER: 171.0
LesWORK: 95.0	ResWORK: 111.0
LesVELOCITY: 92.0	ResVELOCITY: 104.0
LesTWORK: 417.0	ResTWORK: 500.0
LemTORQUE: 51.0	RemTORQUE: 47.0
LemPOWER: 178.0	RemPOWER: 116.0
LemWORK: 52.0	RemWORK: 542.0
LemVELOCITY: 251.0	RemVELOCITY: 217.0
LemTWORK: 458.0	RemTWORK: 414.0
LefTORQUE: 24.0	RefTORQUE: 30.0
LefPOWER: 93.0	RefPOWER: 90.0
LefWORK: 26.0	RefWORK: 26.0
LefVELOCITY: 289.0	RefVELOCITY: 301.0
LefTWORK: 425.0	RefTWORK: 406.0
LfsTORQUE: 73.0	RfsTORQUE: 75.0
LfsPOWER: 124.0	RfSPOWER: 130.0
LfsWORK: 84.0	RfsWORK: 84.0
LfsVELOCITY: 94.0	RfsVELOCITY: 93.0
LfsTWORK: 382.0	RfsTWORK: 406.0
LfmTORQUE: 45.0	RfmTORQUE: 45.0
LfmPOWER: 175.0	RfmPOWER: 158.0
LfmWORK: 47.0	RfmWORK: 48.0
LfmVELOCITY: 267.0	RfmVELOCITY: 273.0
LfmTWORK: 431.0	RfmTWORK: 390.0
LffTORQUE: 22.0	RffTORQUE: 24.0
LffPOWER: 117.0	RffPOWER: 134.0
LffWORK: 24.0	RffWORK: 26.0
LffVELOCITY: 379.0	RffVELOCITY: 393.0
LffTWORK: 402.0	RffTWORK: 443.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: R.W. Group: C Test Time: PRE
Age: 15 Height: 162.5 Mass: 52.0

Vertical Jump Test

Standing Reach: 206 Vertical Jump: 40

Wingate Test

Resistance: 4.0 Peak 5s RPM: 7.0 Total 30s RPM: 35.0
Peak Power: 329.41 Anaerobic Capacity: 274.51
Peak Power KG: 6.33 Anaerobic Capacity KG: 5.28

Margaria Stair Run Test

Ascension Time: 0.48 Peak Power Margaria: 637.00
Peak Power Margaria KG: 12.25

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 55.0	ResTORQUE: 66.0
LesPOWER: 63.0	ResPOWER: 82.0
LesWORK: 57.0	ResWORK: 71.0
LesVELOCITY: 73.0	ResVELOCITY: 79.0
LesTWORK: 266.0	ResTWORK: 293.0
LemTORQUE: 25.0	RemTORQUE: 23.0
LemPOWER: 62.0	RemPOWER: 53.0
LemWORK: 27.0	RemWORK: 26.0
LemVELOCITY: 175.0	RemVELOCITY: 172.0
LemTWORK: 120.0	RemTWORK: 106.0
LefTORQUE: 15.0	RefTORQUE: 13.0
LefPOWER: 48.0	RefPOWER: 42.0
LefWORK: 16.0	RefWORK: 15.0
LefVELOCITY: 217.0	RefVELOCITY: 214.0
LefTWORK: 233.0	RefTWORK: 245.0
LfsTORQUE: 41.0	RfsTORQUE: 42.0
LfsPOWER: 54.0	RfSPOWER: 49.0
LfsWORK: 54.0	RfsWORK: 51.0
LfsVELOCITY: 71.0	RfsVELOCITY: 70.0
LfsTWORK: 229.0	RfsTWORK: 238.0
LfmTORQUE: 23.0	RfmTORQUE: 25.0
LfmPOWER: 62.0	RfmPOWER: 73.0
LfmWORK: 23.0	RfmWORK: 28.0
LfmVELOCITY: 180.0	RfmVELOCITY: 210.0
LfmTWORK: 106.0	RfmTWORK: 135.0
LffTORQUE: 15.0	RffTORQUE: 15.0
LffPOWER: 37.0	RffPOWER: 64.0
LffWORK: 14.0	RffWORK: 17.0
LffVELOCITY: 216.0	RffVELOCITY: 288.0
LffTWORK: 229.0	RffTWORK: 276.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: R.W. Group: C Test Time: POST
Age: 15 Height: 162.5 Mass: 51.0

Vertical Jump Test

Standing Reach: 206 Vertical Jump: 40

Wingate Test

Resistance: 4.0 Peak 5s RPM: 10.0 Total 30s RPM: 43.5
Peak Power: 470.59 Anaerobic Capacity: 341.18
Peak Power KG: 9.23 Anaerobic Capacity KG: 6.69

Margaria Stair Run Test

Ascension Time: 0.46 Peak Power Margaria: 651.91
Peak Power Margaria KG: 12.78

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 59.0	ResTORQUE: 73.0
LesPOWER: 71.0	ResPOWER: 105.0
LesWORK: 609.0	ResWORK: 74.0
LesVELOCITY: 76.0	ResVELOCITY: 85.0
LesTWORK: 257.0	ResTWORK: 311.0
LemTORQUE: 32.0	RemTORQUE: 35.0
LemPOWER: 96.0	RemPOWER: 105.0
LemWORK: 35.0	RemWORK: 37.0
LemVELOCITY: 190.0	RemVELOCITY: 202.0
LemTWORK: 293.0	RemTWORK: 298.0
LefTORQUE: 16.0	RefTORQUE: 16.0
LefPOWER: 60.0	RefPOWER: 59.0
LefWORK: 16.0	RefWORK: 18.0
LefVELOCITY: 232.0	RefVELOCITY: 240.0
LefTWORK: 264.0	RefTWORK: 281.0
LfsTORQUE: 41.0	RfsTORQUE: 48.0
LfsPOWER: 55.0	RfSPOWER: 73.0
LfsWORK: 47.0	RfsWORK: 52.0
LfsVELOCITY: 70.0	RfsVELOCITY: 76.0
LfsTWORK: 221.0	RfsTWORK: 224.0
LfmTORQUE: 28.0	RfmTORQUE: 30.0
LfmPOWER: 94.0	RfmPOWER: 106.0
LfmWORK: 28.0	RfmWORK: 30.0
LfmVELOCITY: 220.0	RfmVELOCITY: 229.0
LfmTWORK: 252.0	RfmTWORK: 276.0
LffTORQUE: 14.0	RffTORQUE: 15.0
LffPOWER: 75.0	RffPOWER: 78.0
LffWORK: 14.0	RffWORK: 15.0
LffVELOCITY: 315.0	RffVELOCITY: 325.0
LffTWORK: 238.0	RffTWORK: 255.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: M.C. Group: C Test Time: PRE
Age: 14 Height: 165.0 Mass: 64.0

Vertical Jump Test

Standing Reach: 208 Vertical Jump: 47

Wingate Test

Resistance: 4.5 Peak 5s RPM: 12.5 Total 30s RPM: 50.0
Peak Power: 661.76 Anaerobic Capacity: 441.18
Peak Power KG: 10.34 Anaerobic Capacity KG: 6.89

Margaria Stair Run Test

Ascension Time: 0.48 Peak Power Margaria: 784.00
Peak Power Margaria KG: 12.25

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 81.0	ResTORQUE: 80.0
LesPOWER: 123.0	ResPOWER: 130.0
LesWORK: 82.0	ResWORK: 92.0
LesVELOCITY: 91.0	ResVELOCITY: 95.0
LesTWORK: 374.0	ResTWORK: 390.0
LemTORQUE: 48.0	RemTORQUE: 59.0
LemPOWER: 137.0	RemPOWER: 141.0
LemWORK: 48.0	RemWORK: 42.0
LemVELOCITY: 236.0	RemVELOCITY: 237.0
LemTWORK: 417.0	RemTWORK: 369.0
LefTORQUE: 35.0	RefTORQUE: 29.0
LefPOWER: 83.0	RefPOWER: 88.0
LefWORK: 27.0	RefWORK: 24.0
LefVELOCITY: 306.0	RefVELOCITY: 280.0
LefTWORK: 392.0	RefTWORK: 367.0
LfsTORQUE: 70.0	RfsTORQUE: 63.0
LfsPOWER: 119.0	RfSPOWER: 116.0
LfsWORK: 84.0	RfsWORK: 78.0
LfsVELOCITY: 92.0	RfsVELOCITY: 92.0
LfsTWORK: 375.0	RfsTWORK: 332.0
LfmTORQUE: 41.0	RfmTORQUE: 41.0
LfmPOWER: 201.0	RfmPOWER: 169.0
LfmWORK: 51.0	RfmWORK: 46.0
LfmVELOCITY: 301.0	RfmVELOCITY: 284.0
LfmTWORK: 464.0	RfmTWORK: 413.0
LffTORQUE: 22.0	RffTORQUE: 23.0
LffPOWER: 136.0	RffPOWER: 127.0
LffWORK: 27.0	RffWORK: 29.0
LffVELOCITY: 415.0	RffVELOCITY: 384.0
LffTWORK: 446.0	RffTWORK: 353.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: M.C. Group: C Test Time: POST
Age: 14 Height: 165.0 Mass: 64.0

Vertical Jump Test

Standing Reach: 208 Vertical Jump: 49

Wingate Test

Resistance: 4.5 Peak 5s RPM: 10.0 Total 30s RPM: 44.0
Peak Power: 529.41 Anaerobic Capacity: 388.24
Peak Power KG: 8.27 Anaerobic Capacity KG: 6.07

Margaria Stair Run Test

Ascension Time: 0.52 Peak Power Margaria: 723.69
Peak Power Margaria KG: 11.31

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 90.0	ResTORQUE: 84.0
LesPOWER: 158.0	ResPOWER: 160.0
LesWORK: 93.0	ResWORK: 100.0
LesVELOCITY: 99.0	ResVELOCITY: 108.0
LesTWORK: 417.0	ResTWORK: 409.0
LemTORQUE: 45.0	RemTORQUE: 45.0
LemPOWER: 149.0	RemPOWER: 148.0
LemWORK: 47.0	RemWORK: 43.0
LemVELOCITY: 235.0	RemVELOCITY: 232.0
LemTWORK: 413.0	RemTWORK: 380.0
LefTORQUE: 31.0	RefTORQUE: 24.0
LefPOWER: 91.0	RefPOWER: 86.0
LefWORK: 25.0	RefWORK: 22.0
LefVELOCITY: 314.0	RefVELOCITY: 288.0
LefTWORK: 365.0	RefTWORK: 341.0
LfsTORQUE: 78.0	RfsTORQUE: 73.0
LfsPOWER: 142.0	RfSPOWER: 137.0
LfsWORK: 85.0	RfsWORK: 88.0
LfsVELOCITY: 98.0	RfsVELOCITY: 98.0
LfsTWORK: 384.0	RfsTWORK: 357.0
LfmTORQUE: 46.0	RfmTORQUE: 46.0
LfmPOWER: 215.0	RfmPOWER: 201.0
LfmWORK: 51.0	RfmWORK: 52.0
LfmVELOCITY: 311.0	RfmVELOCITY: 298.0
LfmTWORK: 448.0	RfmTWORK: 391.0
LffTORQUE: 23.0	RffTORQUE: 22.0
LffPOWER: 143.0	RffPOWER: 130.0
LffWORK: 25.0	RffWORK: 23.0
LffVELOCITY: 433.0	RffVELOCITY: 400.0
LffTWORK: 410.0	RffTWORK: 337.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: .V.F. Group: N Test Time: PRE
Age: 16 Height: 164.0 Mass: 59.0

Vertical Jump Test

Standing Reach: 210 Vertical Jump: 36

Wingate Test

Resistance: 4.5 Peak 5s RPM: 8.0 Total 30s RPM: 39.5
Peak Power: 423.53 Anaerobic Capacity: 348.53
Peak Power KG: 7.18 Anaerobic Capacity KG: 5.91

Margaria Stair Run Test

Ascension Time: 0.78 Peak Power Margaria: 444.77
Peak Power Margaria KG: 7.54

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 75.0	ResTORQUE: 84.0
LesPOWER: 115.0	ResPOWER: 122.0
LesWORK: 90.0	ResWORK: 97.0
LesVELOCITY: 92.0	ResVELOCITY: 94.0
LesTWORK: 406.0	ResTWORK: 470.0
LemTORQUE: 46.0	RemTORQUE: 43.0
LemPOWER: 137.0	RemPOWER: 138.0
LemWORK: 53.0	RemWORK: 52.0
LemVELOCITY: 232.0	RemVELOCITY: 239.0
LemTWORK: 437.0	RemTWORK: 447.0
LefTORQUE: 21.0	RefTORQUE: 22.0
LefPOWER: 71.0	RefPOWER: 72.0
LefWORK: 27.0	RefWORK: 27.0
LefVELOCITY: 257.0	RefVELOCITY: 260.0
LefTWORK: 420.0	RefTWORK: 421.0
LfsTORQUE: 75.0	RfsTORQUE: 84.0
LfsPOWER: 115.0	RfSPOWER: 122.0
LfsWORK: 90.0	RfsWORK: 97.0
LfsVELOCITY: 92.0	RfsVELOCITY: 94.0
LfsTWORK: 406.0	RfsTWORK: 470.0
LfmTORQUE: 38.0	RfmTORQUE: 38.0
LfmPOWER: 140.0	RfmPOWER: 139.0
LfmWORK: 45.0	RfmWORK: 44.0
LfmVELOCITY: 265.0	RfmVELOCITY: 267.0
LfmTWORK: 405.0	RfmTWORK: 393.0
LffTORQUE: 18.0	RffTORQUE: 17.0
LffPOWER: 93.0	RffPOWER: 87.0
LffWORK: 23.0	RffWORK: 21.0
LffVELOCITY: 370.0	RffVELOCITY: 358.0
LffTWORK: 377.0	RffTWORK: 361.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: V.F. Group: N Test Time: POST
Age: 16 Height: 164.0 Mass: 60.0

Vertical Jump Test

Standing Reach: 210 Vertical Jump: 43

Wingate Test

Resistance: 4.5 Peak 5s RPM: 8.5 Total 30s RPM: 36.5
Peak Power: 450.00 Anaerobic Capacity: 322.06
Peak Power KG: 7.50 Anaerobic Capacity KG: 5.37

Margaria Stair Run Test

Ascension Time: 0.50 Peak Power Margaria: 705.60
Peak Power Margaria KG: 11.76

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 73.0	ResTORQUE: 85.0
LesPOWER: 108.0	ResPOWER: 124.0
LesWORK: 79.0	ResWORK: 95.0
LesVELOCITY: 89.0	ResVELOCITY: 97.0
LesTWORK: 341.0	ResTWORK: 422.0
LemTORQUE: 38.0	RemTORQUE: 44.0
LemPOWER: 108.0	RemPOWER: 114.0
LemWORK: 39.0	RemWORK: 41.0
LemVELOCITY: 226.0	RemVELOCITY: 229.0
LemTWORK: 327.0	RemTWORK: 331.0
LefTORQUE: 18.0	RefTORQUE: 17.0
LefPOWER: 62.0	RefPOWER: 53.0
LefWORK: 21.0	RefWORK: 18.0
LefVELOCITY: 270.0	RefVELOCITY: 254.0
LefTWORK: 289.0	RefTWORK: 314.0
LfsTORQUE: 56.0	RfsTORQUE: 59.0
LfsPOWER: 89.0	RfSPOWER: 98.0
LfsWORK: 70.0	RfsWORK: 80.0
LfsVELOCITY: 83.0	RfsVELOCITY: 90.0
LfsTWORK: 337.0	RfsTWORK: 367.0
LfmTORQUE: 33.0	RfmTORQUE: 37.0
LfmPOWER: 104.0	RfmPOWER: 121.0
LfmWORK: 38.0	RfmWORK: 42.0
LfmVELOCITY: 217.0	RfmVELOCITY: 231.0
LfmTWORK: 346.0	RfmTWORK: 367.0
LffTORQUE: 23.0	RffTORQUE: 20.0
LffPOWER: 86.0	RffPOWER: 71.0
LffWORK: 27.0	RffWORK: 23.0
LffVELOCITY: 287.0	RffVELOCITY: 265.0
LffTWORK: 457.0	RffTWORK: 407.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: - J. P. Group: N Test Time: PRE
Age: 16 Height: 162.0 Mass: 65.0

Vertical Jump Test

Standing Reach: 204 Vertical Jump: 40

Wingate Test

Resistance: 5.0 Peak 5s RPM: 8.0 Total 30s RPM: 36.5
Peak Power: 470.59 Anaerobic Capacity: 357.84
Peak Power KG: 7.24 Anaerobic Capacity KG: 5.51

Margaria Stair Run Test

Ascension Time: 0.49 Peak Power Margaria: 780.00
Peak Power Margaria KG: 12.00

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 78.0	ResTORQUE: 81.0
LesPOWER: 113.0	ResPOWER: 121.0
LesWORK: 95.0	ResWORK: 91.0
LesVELOCITY: 93.0	ResVELOCITY: 94.0
LesTWORK: 417.0	ResTWORK: 413.0
LemTORQUE: 36.0	RemTORQUE: 40.0
LemPOWER: 112.0	RemPOWER: 115.0
LemWORK: 45.0	RemWORK: 45.0
LemVELOCITY: 209.0	RemVELOCITY: 208.0
LemTWORK: 406.0	RemTWORK: 421.0
LefTORQUE: 19.0	RefTORQUE: 20.0
LefPOWER: 67.0	RefPOWER: 69.0
LefWORK: 24.0	RefWORK: 25.0
LefVELOCITY: 246.0	RefVELOCITY: 247.0
LefTWORK: 405.0	RefTWORK: 420.0
LfsTORQUE: 56.0	RfsTORQUE: 55.0
LfsPOWER: 93.0	RfSPOWER: 101.0
LfsWORK: 71.0	RfsWORK: 74.0
LfsVELOCITY: 89.0	RfsVELOCITY: 92.0
LfsTWORK: 325.0	RfsTWORK: 337.0
LfmTORQUE: 31.0	RfmTORQUE: 33.0
LfmPOWER: 119.0	RfmPOWER: 121.0
LfmWORK: 37.0	RfmWORK: 37.0
LfmVELOCITY: 256.0	RfmVELOCITY: 251.0
LfmTWORK: 346.0	RfmTWORK: 348.0
LffTORQUE: 15.0	RffTORQUE: 17.0
LffPOWER: 79.0	RffPOWER: 84.0
LffWORK: 19.0	RffWORK: 20.0
LffVELOCITY: 345.0	RffVELOCITY: 345.0
LffTWORK: 327.0	RffTWORK: 352.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: ~''J.P. Group: N Test Time: POST
Age: 16 Height: 162.0 Mass: 65.0

Vertical Jump Test

Standing Reach: 204 Vertical Jump: 46

Wingate Test

Resistance: 5.0 Peak 5s RPM: 8.0 Total 30s RPM: 37.5
Peak Power: 470.59 Anaerobic Capacity: 367.65
Peak Power KG: 7.24 Anaerobic Capacity KG: 5.66

Margaria Stair Run Test

Ascension Time: 0.46 Peak Power Margaria: 830.87
Peak Power Margaria KG: 12.78

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 79.0	ResTORQUE: 85.0
LesPOWER: 113.0	ResPOWER: 115.0
LesWORK: 87.0	ResWORK: 95.0
LesVELOCITY: 91.0	ResVELOCITY: 89.0
LesTWORK: 408.0	ResTWORK: 429.0
LemTORQUE: 35.0	RemTORQUE: 36.0
LemPOWER: 113.0	RemPOWER: 121.0
LemWORK: 42.0	RemWORK: 43.0
LemVELOCITY: 220.0	RemVELOCITY: 232.0
LemTWORK: 358.0	RemTWORK: 377.0
LefTORQUE: 21.0	RefTORQUE: 19.0
LefPOWER: 71.0	RefPOWER: 69.0
LefWORK: 23.0	RefWORK: 22.0
LefVELOCITY: 262.0	RefVELOCITY: 262.0
LefTWORK: 354.0	RefTWORK: 361.0
LfsTORQUE: 56.0	RfsTORQUE: 60.0
LfsPOWER: 83.0	RfSPOWER: 93.0
LfsWORK: 69.0	RfsWORK: 74.0
LfsVELOCITY: 82.0	RfsVELOCITY: 85.0
LfsTWORK: 333.0	RfsTWORK: 345.0
LfmTORQUE: 31.0	RfmTORQUE: 36.0
LfmPOWER: 113.0	RfmPOWER: 121.0
LfmWORK: 42.0	RfmWORK: 43.0
LfmVELOCITY: 220.0	RfmVELOCITY: 232.0
LfmTWORK: 358.0	RfmTWORK: 377.0
LffTORQUE: 42.0	RffTORQUE: 41.0
LffPOWER: 131.0	RffPOWER: 117.0
LffWORK: 57.0	RffWORK: 54.0
LffVELOCITY: 197.0	RffVELOCITY: 190.0
LffTWORK: 851.0	RffTWORK: 898.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: T.H. Group: C Test Time: PRE
Age: 14 Height: 167.0 Mass: 61.0

Vertical Jump Test

Standing Reach: 214 Vertical Jump: 41

Wingate Test

Resistance: 4.5 Peak 5s RPM: 11.0 Total 30s RPM: 46.0
Peak Power: 582.35 Anaerobic Capacity: 405.88
Peak Power KG: 9.55 Anaerobic Capacity KG: 6.65

Margaria Stair Run Test

Ascension Time: 0.61 Peak Power Margaria: 588.00
Peak Power Margaria KG: 9.64

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 89.0	ResTORQUE: 91.0
LesPOWER: 137.0	ResPOWER: 147.0
LesWORK: 97.0	ResWORK: 98.0
LesVELOCITY: 98.0	ResVELOCITY: 100.0
LesTWORK: 474.0	ResTWORK: 481.0
LemTORQUE: 43.0	RemTORQUE: 47.0
LemPOWER: 144.0	RemPOWER: 144.0
LemWORK: 54.0	RemWORK: 53.0
LemVELOCITY: 227.0	RemVELOCITY: 223.0
LemTWORK: 458.0	RemTWORK: 473.0
LefTORQUE: 22.0	RefTORQUE: 22.0
LefPOWER: 83.0	RefPOWER: 89.0
LefWORK: 27.0	RefWORK: 28.0
LefVELOCITY: 268.0	RefVELOCITY: 279.0
LefTWORK: 419.0	RefTWORK: 455.0
LfsTORQUE: 64.0	RfsTORQUE: 61.0
LfsPOWER: 112.0	RfSPOWER: 108.0
LfsWORK: 82.0	RfsWORK: 80.0
LfsVELOCITY: 93.0	RfsVELOCITY: 94.0
LfsTWORK: 391.0	RfsTWORK: 366.0
LfmTORQUE: 37.0	RfmTORQUE: 36.0
LfmPOWER: 154.0	RfmPOWER: 152.0
LfmWORK: 46.0	RfmWORK: 42.0
LfmVELOCITY: 278.0	RfmVELOCITY: 262.0
LfmTWORK: 411.0	RfmTWORK: 400.0
LffTORQUE: 19.0	RffTORQUE: 19.0
LffPOWER: 106.0	RffPOWER: 103.0
LffWORK: 23.0	RffWORK: 23.0
LffVELOCITY: 387.0	RffVELOCITY: 374.0
LffTWORK: 380.0	RffTWORK: 395.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: T.H. Group: C Test Time: POST
Age: 14 Height: 167.0 Mass: 61.0

Vertical Jump Test

Standing Reach: 214 Vertical Jump: 36

Wingate Test

Resistance: 4.5 Peak 5s RPM: 9.0 Total 30s RPM: 39.0
Peak Power: 476.47 Anaerobic Capacity: 344.12
Peak Power KG: 7.81 Anaerobic Capacity KG: 5.64

Margaria Stair Run Test

Ascension Time: 0.49 Peak Power Margaria: 732.00
Peak Power Margaria KG: 12.00

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 86.0	ResTORQUE: 96.0
LesPOWER: 141.0	ResPOWER: 170.0
LesWORK: 104.0	ResWORK: 116.0
LesVELOCITY: 101.0	ResVELOCITY: 110.0
LesTWORK: 491.0	ResTWORK: 546.0
LemTORQUE: 41.0	RemTORQUE: 44.0
LemPOWER: 135.0	RemPOWER: 140.0
LemWORK: 51.0	RemWORK: 53.0
LemVELOCITY: 231.0	RemVELOCITY: 233.0
LemTWORK: 440.0	RemTWORK: 434.0
LefTORQUE: 21.0	RefTORQUE: 21.0
LefPOWER: 75.0	RefPOWER: 74.0
LefWORK: 26.0	RefWORK: 26.0
LefVELOCITY: 265.0	RefVELOCITY: 275.0
LefTWORK: 383.0	RefTWORK: 398.0
LfsTORQUE: 68.0	RfsTORQUE: 68.0
LfsPOWER: 124.0	RfSPOWER: 133.0
LfsWORK: 91.0	RfsWORK: 94.0
LfsVELOCITY: 103.0	RfsVELOCITY: 106.0
LfsTWORK: 430.0	RfsTWORK: 450.0
LfmTORQUE: 36.0	RfmTORQUE: 37.0
LfmPOWER: 143.0	RfmPOWER: 160.0
LfmWORK: 44.0	RfmWORK: 47.0
LfmVELOCITY: 276.0	RfmVELOCITY: 290.0
LfmTWORK: 392.0	RfmTWORK: 418.0
LffTORQUE: 17.0	RffTORQUE: 21.0
LffPOWER: 75.0	RffPOWER: 74.0
LffWORK: 26.0	RffWORK: 26.0
LffVELOCITY: 265.0	RffVELOCITY: 275.0
LffTWORK: 383.0	RffTWORK: 398.0

Traci Benesh's Thesis Training Data of High School Women Volleyball Players
Undergoing Plyometric Training for 6 Weeks @ 3x/week

Subject Name: A.W. Group: W Test Time: PRE
Age: 14 Height: 170.0 Mass: 63.0

Vertical Jump Test

Standing Reach: 215 Vertical Jump: 40

Wingate Test

Resistance: 5.0 Peak 5s RPM: 11.5 Total 30s RPM: 48.0
Peak Power: 676.47 Anaerobic Capacity: 470.59
Peak Power KG: 10.74 Anaerobic Capacity KG: 7.47

Margaria Stair Run Test

Ascension Time: 0.57 Peak Power Margaria: 649.89
Peak Power Margaria KG: 10.32

Leg Omni-tron Strength Test (Note: Data in Ft.LB!!!)

Left Side	Right Side
LesTORQUE: 82.0	ResTORQUE: 78.0
LesPOWER: 124.0	ResPOWER: 127.0
LesWORK: 90.0	ResWORK: 75.0
LesVELOCITY: 91.0	ResVELOCITY: 89.0
LesTWORK: 415.0	ResTWORK: 358.0
LemTORQUE: 44.0	RemTORQUE: 46.0
LemPOWER: 129.0	RemPOWER: 135.0
LemWORK: 42.0	RemWORK: 44.0
LemVELOCITY: 225.0	RemVELOCITY: 227.0
LemTWORK: 379.0	RemTWORK: 381.0
LefTORQUE: 21.0	RefTORQUE: 20.0
LefPOWER: 77.0	RefPOWER: 67.0
LefWORK: 21.0	RefWORK: 20.0
LefVELOCITY: 290.0	RefVELOCITY: 272.0
LefTWORK: 328.0	RefTWORK: 304.0
LfsTORQUE: 56.0	RfsTORQUE: 69.0
LfsPOWER: 87.0	RfSPOWER: 95.0
LfsWORK: 69.0	RfsWORK: 63.0
LfsVELOCITY: 86.0	RfsVELOCITY: 83.0
LfsTWORK: 310.0	RfsTWORK: 297.0
LfmTORQUE: 33.0	RfmTORQUE: 36.0
LfmPOWER: 120.0	RfmPOWER: 129.0
LfmWORK: 35.0	RfmWORK: 37.0
LfmVELOCITY: 251.0	RfmVELOCITY: 247.0
LfmTWORK: 301.0	RfmTWORK: 348.0
LffTORQUE: 18.0	RffTORQUE: 19.0
LffPOWER: 78.0	RffPOWER: 73.0
LffWORK: 19.0	RffWORK: 20.0
LffVELOCITY: 310.0	RffVELOCITY: 289.0
LffTWORK: 328.0	RffTWORK: 339.0

APPENDIX B

INFORMED CONSENT

Dear Parent/Guardian:

I will be conducting a research project for my thesis. The study is is designed to examine the benefits of plyometric training in improving the vertical jump. Plyometric training involves dropping down from a height of 40 centimeters (1 1/2 feet) then immediately rebounding upward.

I request permission for your daughter to participate in this study. We will be performing the drop jumps every other day, three times a week. The girls will be tested before and after the study begins. The tests include measurements of their height, weight, vertical jump and strength, power and endurance tests. The strength test will be performed at the Texas Institute for Sports Rehabilition in Bedford. It involves a leg strength test done by a computerized apparatus called the Omnitron. The power test requires the girls to run up a flight of stairs, three at a time and their power is calculated as they land on switch mats. The endurance test includes a 30 second bicycle test. All of these tests will preceed any training. The training seesions involve four sets of ten repetitions of drop jumping.

To preserve confidentiality, only first names will be used to identify the girls. This study will benefit your daughter in that what we learn from this will be applied to our volleyball strategy.

Your decision whether or not to allow your daughter to participate will in no way affect your daughter's standing on the team. At the conclusion of this study a summary of all the results will be made to all interested parents. Should you have any questions or desire further information, please call me at 255-2171(work), or 817-430-0528 (home). Thank you in advance for your support and cooperation

Sincerely,

Lisa Benek

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Please indicate whether or not you wish to have your daughter participate in this study, by checking a statement below and returning this to me as quickly as possible.

I do grant permission for my child,__________________to participate in this study.

I do not grant permission for my child,_______________to participate.

____

Parent/Guardian signature

If anyone can help drive to the Institute after school, please let me know.

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