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PLYOMETRIC EXERCISES WITH HIGH AND LOW INTENSITIES HAVE AN IMPACT ON ATHLETES' MAXIMUM VOLUNTARY ISOMETRIC CONTRACTION AND VERTICAL JUMP HEIGHT.

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ABSTRACT
The study involved 24 athletes with ages ranging from 20 to 30. The individuals were randomized into two groups, high and low intensity plyometric groups, at random. Exercises including double and single leg vertical leaps, single leg tuck jumps, and other high-intensity plyometric exercises were provided to the high-intensity plyometric group. Split and cycled squat jumps were given to the low-intensity plyometric group. During four weeks, both groups received plyometric training. The maximal voluntary isometric contraction and vertical leap were measured in both groups at the beginning, the second, and the fourth weeks of training. After 4 weeks, high-intensity and low-intensity plyometric workouts in the current research improved vertical jump height and maximum voluntary isometric contraction to varying degrees.

KEY WORDS : Plyometric Training, Athletes, Vertical Jump, Maximum Voluntary Isometric Contraction

INTRODUCTION
Athletes always strive to enhance their performances due to the numerous advantages that come with being successful in sports, generally with the help of knowledgeable trainers, coaches, and sports physiotherapists (Williams, 1997). Combining different training techniques is said to improve sports performance, which is constrained by many reasons such insufficient energy generation, ineffective energy regulation, and ineffective energy efficiency (Siegler et al., 2003). (Williams, 1997). As compared to unsupervised and traditional training, supervised and periodized training offers a greater potential to improve performance and lower the risk of injury in a variety of sports.

Athletics is one of the most popular sports, practiced to varied degrees of skill in every country. For improved success in this multi-factorial event, consideration must be given to body size, body composition, strength, power, quickness, response time, speed, agility, and endurance. Strength training programmes have dramatically enhanced athletes' strength and performance characteristics at all levels of competition (Willifor & Kirpatrik, 1994). According to research by Boisseau et al. (2007), male athletes who are 14 years old have protein needs that are higher than the RDA for male adolescents who are not active. There have been studies that demonstrate how different training procedures may improve performance. A number of muscle training regimens, including traditional training and plyometric training, are used in training for improved performance and injury prevention.

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A useful metric of power performance in athletes is said to be the eccentric usage ratio (EUR), which is the ratio of counter-movement jump performance to static jump performance. Athletes in sports like soccer and rugby have displayed higher EUR values, which are indicative of these games' increased dependence on stretch-shortening exercises (Mcguigan et al, 2006). In plyometric training, the same muscle and connective tissue are rapidly stretched (using an eccentric movement), then quickly contracted (using a concentric action) (Baechle & Earle, 2000).Plyometric exercises often entail abrupt stopping, starting, and direction changes. Muscle is known to produce more force and energy under these circumstances than it would without one. The primary goal of plyometric training is to raise neural system excitability in order to improve the neuromuscular system's capacity to react quickly, which is beneficial in sports. Moore et al. (2005) tested a soccer player's ability to leap and recorded knee extensor torques (Kramer & Balsor, 1990). To evaluate the performance, many training methods have been developed. According to Kramer & Balsor (1990), it indicates that athletes should not undertake jumps right after resistance training in order to maximize jump performance.

Exercises that use plyometrics can vary in complexity and intensity. It has to be taught and developed appropriately. Low intensity, medium intensity, high intensity, and shock workouts are the four categories into which plyometric activities fall. In contrast to low intensity plyometric, which is moderate and has a longer amortization period, high intensity plyometric is a robust, time-consuming, exhausting training regimen. Low-intensity exercises can provide the same result while being less taxing on the players and necessitating less downtime. While plyometric training has been demonstrated to improve athletic performance by increasing knee extensor strength and vertical leap, no scientific data is currently available to compare the effects of high intensity versus low intensity plyometric training on athletic performance.

Consequently, the goal of the study was to compare the effectiveness of four weeks of high intensity plyometric activities with low intensity treatments on athletes' vertical jump and knee extensor strength.

METHODOLOGY

With a total of 24 players, the average age was 20.05 years, the average height was 1.70 meters, the average weight was 63.95 kilogrammes, and the average body mass index was 21.97. After a homogeneous random sample, the 50 players were chosen from UG, PG, and Ph.D. Scholars at Bangalore University. Exercises were given to the individuals at the UCPE sports field, and measurements were made at the institute's Research Laboratory of Physiotherapy Department.Only individuals with a one-year history of athletic participation, no prior involvement in plyometric activities, normal range of motion at the lumbar spine, hip, knee, and ankle, and a normal degree of cardio-respiratory fitness were included. If a subject had a history of fracture, had any discomfort during the regimen, or was otherwise irregular, they were disqualified from the study.

The consent form was filled out by the subjects. At the start of training, or "zero week," the vertical jump height (VJH) and maximal voluntary isometric contraction were measured. The individuals were verbally instructed before being randomly divided into two groups based on the type of training they received: Group A received high-intensity plyometric training, whereas Group B received low-intensity plyometric training (Low Intensity Plyometric Group). Prior to the training schedule, each group completed warm-up activities and a cool-down session. During a period of four weeks, exercises were performed three times each week. At the conclusion of the

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second and fourth training weeks, measurements were once more collected.

Test of Vertical Jump Height (VJH): The participants were instructed to stand straight, with their dominant side against the wall and one flat foot. The participant was given chalk. He was told to climb as far up the wall as he could, with the highest point attained being measured and noted. The difference between the standing reach height and the peak height attained when jumping was used to assess VJH. Averaging the results of the two readings was done.

The quadriceps muscle underwent a Maximum Voluntary Isometric Contraction (MVIC) test. The individual was made to squat on the quadriceps table with the knees flexed to 90 degrees, and a chain-attached strain gauge was fastened to the subject's foot. The participant was instructed to tighten their quadriceps muscle in opposition to the strain gauge's pull from behind. The average of the three measurements was computed.

Exercises including plyometrics were provided to both groups A and B. Group A received high-intensity plyometric training, whereas Group B received low-intensity plyometric training.

Group A- High Intensity Plyometric

1. Double Leg Vertical Power Jump
2. Single Leg vertical Power Jump
3. Single Leg Tuck Jump

Group B- Low Intensity Plyometric

1. Split Squat Jump
2. Cycled Split Squat Jump
3. Squat Jump

Each exercise was performed ten times. Each subject received an explanation of the tasks based on their group. Two participants in Group A were discovered to have arrived to the field in an unusual manner. These people were not included in the research because it met one of the exclusion criteria. One of the subjects in Group B withdrew after the first week, while the other had an injury during the practise match. An anterior cruciate ligament damage was the determined kind of injury. As a result, neither of the Group B players could participate in the research.

ANALYTICAL CONSIDERATION OF THE EXAMINATION'S DATA AND FINDINGS

Data analysis was done. The maximal voluntary isometric contraction and vertical leap height were compared between the high intensity and low intensity plyometric groups using an unpaired t test. The maximal voluntary isometric contraction and the vertical leap height were each subjected to a paired t test among groups A and B.

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The state of the study is described in the table that is provided below.

	High Intensity Plyometric Group (N=10)		Low Intensity Plyometric Group (N=10)	
	Mean	**SD**	**Mean**	**SD**
Age (Yrs)	21.40	1.26	20.73	1.33
VJH at 0 Wk	34.65	5.01	31.92	6.30
VJH at 2 Wk	36.11	5.33	32.96	6.32
VJH at 4 Wk	38.21	5.23	33.90	3.36
MVIC at 0 Wk	20.53	6.06	22.50	5.03
MVIC at 2 Wk	23.83	6.94	23.86	5.11
MVIC at 4 Wk	26.50	6.74	24.56	5.09

Significant differences in the means were found between the two groups for each variable using an unpaired t test (P> 0.05). Vertical Jump Height (VJH) mean differences between the two groups at zero week and four weeks were determined to be significant with a value of P 0.007, with Group-A having a value of 3.56+1.066 and Group-B having a value of 2.27+0.814. As a result, Group A's High Intensity Plyometric Exercises helped VJH.

When examined between 0 and 4 weeks, Maximum Voluntary Isometric Contraction (MVIC) indicated a significant change. As a result, when Groups A and B were compared, the data demonstrate that the MVIC had a substantial value during the 0–4 week period of time.

When the test was run independently within each group A and B, the paired t test result indicated that all values were significant (P 0.05). The t value (probability) for VJH 0-2 week; 0-4 week and 2-4 week of Group A were - 8.184 (P< 0.000); -8.113 (P < 0.000) and -10.557 (P < 0.000) and for Group B were -5.016 (P < 0.001); -7.224 (P < 0.000) and -7.595 7.487 (P < 0.000); -0.270 (P < 0.049) and -6.760 (P < 0.000) correspondingly. Due to plyometric exercise, all results of the paired t test demonstrate a significant change in the variables.

DISCUSSION

The improvement in vertical jump height and maximum voluntary isometric contraction following high intensity and moderate intensity plyometric training in athletes is compared in this experimental investigation. The vertical jump height and maximum voluntary isometric

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contraction for the two groups showed no significant difference at the start of training, making the study homogeneous in character. The results reveal a substantial difference between the two groups of athletes' maximum voluntary isometric contraction and vertical jump height after doing high-intensity and low-intensity plyometric workouts during a 4-week period.The effectiveness of plyometric exercise was demonstrated at the same time by increases in maximum voluntary isometric contraction and vertical leap height in both groups. These findings confirmed what earlier studies on the elastic loading of muscles had discovered.

The outcomes of this study, which showed improvements in maximum voluntary isometric contraction and vertical jump height in the two groups, are consistent with findings from Matavulj et al. (2001), Toumi et al. (2004), Wisloff et al. (2004), Hoffman et al. (2005), and McMillan et al (2005). In the current study, four weeks of high-intensity plyometric training and low-intensity plyometric exercise resulted in varying degrees of improvement in maximal voluntary isometric contraction and vertical jump height. Power, which is the capacity to generate muscle forces extremely quickly, is crucial in an activity like athletics. Plyometric workouts are specific movements that allow a muscle to quickly attain its maximum strength.This method involves extending a muscle, then using its elastic qualities to generate stronger forces during the reflex contraction (when the muscle contracts to return to its resting length). The muscle must contract as soon as feasible after lengthening in order to provide this higher muscular force (www.playtheball.com). When compared to Low Intensity Plyometric Training, High Intensity Plyometric Training improved maximum voluntary isometric contraction and vertical jump height greater in Group A.

Improvements could have been brought about by improved motor unit recruitment patterns, as proposed by Potteiger et al (1999). According to Craig, another factor might be neural adaptation, which happens when athletes respond or react due to better coordination between the CNS signal and proprioceptive input (2004). Shock absorption, or the spring-like movement, is a crucial function that must not be overlooked. Stretch shortening cycle is another name for this eccentric-concentric coupling. It has been demonstrated by several writers that an eccentric contraction that comes right before a concentric contraction would greatly increase the force produced by the concentric contraction as a result of the storing of elastic energy.

According to Donald Chu, plyometric exercises are among the finest for enhancing a person's speed, strength, acceleration, and explosive power so they may continue to be at the top of their game (www.physioroom.com). This illustration of a "dig" shortly before a vertical jump can help to clarify the study's findings on an increase in vertical jump height. When the centre of gravity is abruptly lowered, the muscles used for the leap are briefly stretched, resulting in stronger motions.Two hypotheses may be used to explain this phenomena. The mechanical model, proposed by Bosco et al. (1982a), states that when a stretch is immediately followed by a concentric muscular action, the energy held during the eccentric contraction is released. Hill claims that the result is similar to stretching a spring that seeks to return to its original length. The spring in this instance is a muscle and tendon component known as the series elastic component (Hill, 1970).

The second hypothesis describes the stretch reflex using a neurophysiological model. The stretch reflex makes the muscle undergoing the stretch or eccentric muscular action more active and enables it to function with considerably more force. As a result, the potential for a strong concentric muscular movement is severely slowed down. Time, stretch magnitude, and stretch

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velocity are three factors that influence how well the elastic energy may be used. By employing the elastic component of the muscle, fast direction shift is crucial

It is commonly known that anaerobic energy system testing techniques include vertical leap height and maximal voluntary isometric contraction. One sport where anaerobic energy is used in addition to aerobic and ATP-CP is athletics. Indicating an increase in the athlete's anaerobic system is the improvement in vertical jump height and maximum voluntary isometric contraction with low- and high-intensity plyometric activities. Any improvement to the anaerobic energy system boosts athletes' performance.Consequently, for a sport-specific activity, coaches, athletes, or physiotherapists can choose between high intensity and moderate intensity plyometric training. The findings point in the direction of a greater acceptability of high-intensity training to increase vertical jump height and maximum voluntary isometric contraction. Exercises of low intensity can also be utilized to improve an athlete's anaerobic capacity.

CONCLUSION

According to study findings, High Intensity Plyometric has a substantial impact on Maximum Voluntary Isometric Contraction and Vertical Jump Height compared to Low Intensity Plyometric. So, if one wishes to increase their performance for competition, they must engage in High Intensity Plyometrics.

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