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Effect of Active Isolated Stretching and Static Stretching on Vertical Jump Performance and Flexibility

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Effect of Active Isolated Stretching and Static Stretching on Vertical Jump Performance and Flexibility

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CHAPTER I

INTRODUCTION

It is essential for all active personnel to be well prepared before the start of any athletic activity or event. Many athletes incorporate a light warm up and stretch into their pre workout regime. This is not only seen in professional athletes, but also youth sports, junior varsity athletes and recreational exercisers. Pre-activity warm up and stretches are practices that are omnipresent in the exercise regime of many active people because of the widespread notion that it can provide many exercise related benefits. For example, research indicates that stretching can reduce the incidence of injuries, accelerate recovery and enhance an athlete's performance (Oliveira et al., 2017). In addition, it is promoted that warm-up stretches prevent muscle strain and tears that occur from sudden over-lengthening of the musculotendinous unit (Mattes, 1996). Stretching can also reduce emotional distress that can manifest as increased hypertonicity, reduce cramp spasms, enhance circulation and relieve stiffness (Mattes, 1996). Therefore, there are many reasons for athletes to take advantage of warmups and stretches before athletic events. However, determining the appropriate type of stretch for the occasion is an important factor of consideration.

There are many different stretching methods utilized by athletes. Of those, static stretching is the most commonly used stretching method used before training sessions by many athletes (Pinto et al., 2014). During a static stretch, the individual slowly shifts the body into a stationary position. This position is held without bouncing (Waqqash et al., 2017). For a brief amount of time, groups of muscles and ligaments are put into mild tension. The static stretch is a self-induced stretch that can be completed in small areas of space.

Ballistic stretching also receives much attention from athletes and coaches. Ballistic stretching consists of dynamic, kinetic or body momentum that involves bouncing, bobbing or rhythmic motion designed to increase range of motion. This type of stretching is commonly used in sports like gymnastics, karate and dance. Some researchers have considered ballistic stretching unsafe because of the difficulty in judging the stretch tolerance. Rapid contractions that occur in ballistic stretching could cause spasms, micro trauma and result in scar tissue (Mattes, 1996). Research shows that muscle stretching performed at slower velocities appear to be more effective than rapid and repetitive movements such as ballistic stretching because the former avoids a reflex response (Stafilidis & Tilp, 2015). This means that ballistic stretching can cause muscles to contract more often than relax (Waqqash et al., 2017). Therefore, ballistic stretching is not often promoted by researchers for athletes to use.

Passive stretching is another commonly used stretching method among athletes. The difference between this stretch compared to the previous ones is that this stretch requires assistance from a partner or trainer. The second individual aids in gradually extending the range of mobility for the athlete (Mattes, 1996). All the while, the person being stretched makes no contribution or active contraction during the stretching process. The stretch is held for about 10 to 15 seconds at the end of the joints range of motion and then returned to a neutral position. Therefore, this stretch is heavily dependent on the assistance of a partner for completion. For those who work out alone, this stretch can be difficult to achieve. This stretch also fails to activate or strengthen weak, overstretched agonists, which oppose the tight structures being treated.

Proprioceptive Neuromuscular Facilitation or PNF is a method of stretching that has gained more popularity recently. The objective of PNF is to purposely stimulate the neural mechanisms of the muscles during contraction and relaxation. PNF increases ROM by increasing the length of the muscle and increasing neuromuscular efficiency. PNF stretching has been found to increase ROM in trained, as well as untrained, individuals (Hindle et al., 2012). An assistant or partner employs motion that extends the range of motion of the athlete as far as possible through active muscle work and holds the stretch for 6 seconds. Then resistance is applied by the assistant in order to cause isometric muscle tightening in the opposing muscle (Mattes, 1996). The isometric contractions at the end of each hold improves the range of motion by creating autogenic inhibition (Kirmizigil et al., 2014). PNF combines active and passive movements with isometric, concentric and eccentric muscle actions by moving the muscle to complete range of motion and then allowing the muscle to relax before resuming the procedure. However, when completed prior to exercise, proprioceptive neuromuscular facilitation decreases performance in maximal effort exercises (Hindle et al., 2012). Also, since this stretch involves an assistant, it is difficult to achieve for those who work out on their own.

Dynamic stretching is a highly praised method of stretching in the literature because of its proven benefits in pre exercise warmups. The purpose of dynamic stretching is to simulate the movement patterns necessary for success in a particular sport (Kirmizigil et al., 2014). It accomplishes this by imitating sport specific movements through fast, controlled actions that are within the normal range of motion of the athlete (Waqqash et al., 2017). Completing a dynamic stretch before an athletic event gives the athletes the opportunity to rehearse their movements in a way that also increases body temperature and blood flow (Perrier et al., 2011). This is a highly recommended type of stretch for athletes before exercise. There is already sufficient data on its effectiveness in the literature.

Active isolated stretching or AIS is a type of stretching that is practiced less often among athletes due to the lack of attention it receives in the literature. Aaron Mattes is the developer of AIS and has made a forty-year effort into studying and refining the procedure. He has written a book that is filled with about one hundred and twenty different stretches to reference (Kukkonen, 2019). AIS has made a breakthrough to some athletes, but there is still a large population who have yet to see it. In AIS, the muscle group is first isolated and then stretched by activating the opposing muscle (Waqqash et al., 2017). The stretch is held for no longer than 2 seconds before returning to a neutral position. This stretch integrates active movement and reciprocal inhibition to improve flexibility. It incorporates a method of myofascial release that provides dynamic juxtaposing of isolated muscles promoting functional and physiological restoration of facial planes (Kochno, 2002). These are all premium qualities to receive in a stretch before an athletic event. AIS can be completed with a partner or on their own. Active isolated stretching has a solid foundation of knowledge and reasoning behind it but has the least amount of research and analysis in the literature.

Stretching is a well-known concept among all active exercisers. It is not something only professional athletes do. Recreational exercisers, youth sports athletes and even the elderly population want to achieve all the benefits from stretching. However, stretching is a daily requirement. The muscles shorten, stiffen and become tense from daily work, training or stress (Kukkonen, 2019). It is important for all levels of exercisers to utilize the appropriate stretching protocols to properly warm up the body and increase range of motion. For experienced athletes, it is important to reevaluate their normative warm-up and stretching routines. These populations could come to learn that they are causing more harm than good with the protocol they are currently using. For most athletes, enhancing power output and speed is necessary to excel. It is important for the active community to make the best use of their time while they are exercising. They need to start off on the right foot by choosing the correct stretching protocol that will be able to enhance their athletic abilities throughout their workout.

In the literature, there is still little consensus on the most effective stretching technique or combination of techniques for peak performance. This makes it even more difficult for athletes to choose from the various options available. More research on the acute effects of stretching in the performance of sports is needed. Successful performance in sports often requires explosive power and quick reaction time (Perrier et al., 2011). Therefore, power output is a key component of sports performance. A stretch that could increase power output would be a great stretch option before an athletic event. One way to indirectly evaluate multi-joint lower limb power is by utilizing the countermovement jump (CMJ) (Pinto et al., 2014). CMJ's are considered a valid anaerobic power test (Waqqash et al., 2017). Research shows correlations between CMJ heights and activities such as sprints and squat force (Pinto et al., 2014). Therefore, a comparison between the most popular stretching method, static stretching, and the least researched stretch, AIS, can be tested. Therefore, the stretching protocol will be the independent variable while the countermovement jump height will be the measured dependent variable.

STATIC STRETCHING AND ACTIVATED ISOLATED STRETCHING ON POWER

Static stretching is incorporated into many pre-workout routines as the main method of stretching. However, past research indicates that static stretching may result in a detrimental effects on power output for athletes . Several researchers have attempted to explain this phenomenon. For example, Holt and Lamboune state that static stretching may reduce musculotendinous stiffness that inhibits the production of force in the muscles (Holt &

Lamboune, 2008). Others claim that static stretching may place a portion of motor units into a fatigue state resulting in an increased number of motor units recruited to perform the same mechanical work (Bogdanis et al., 2017). Another explanation states that a decrease in muscle stiffness after long duration static stretching could increase the electromechanical delay thus reducing CMJ performance (Bogdanis et al., 2017). Therefore, most of the literature is against static stretching before an athletic event due to the detrimental effects it can cause in power and force production in athletes. This shows that many coaches or athletes have read the new data that has been collected on static stretching and continue to incorporate into their workout routine. It is important to bring awareness to the general population of the new data that have disproven older beliefs and theories. This is commonly seen as new coaches will simply take the same training routine as the previous coach without making any adjustments because of tradition.

Evidence-based research on the effect of AIS on CMJ's and power output is scarce. However, one study that included sixty physically active men showed that performing active isolated stretching prior to CMJ performance resulted in a drop in jumping height of about 0.3979 meters (Waqqash et al., 2017). Therefore, an acute stretch such as active isolated stretching could also negatively affect countermovement jump height. However, the participants were either assigned to the control group or the experimental group. Therefore, the height jumps were not even compared to their own initial jumps in order to show an improvement or not. More studies need to be conducted in order to reinforce or negate the conclusion made by this study. Altering one or two variables in the methodology of an experiment has the ability to show completely differing results. Active isolated stretching has a solid foundation of reasoning that needs to be researched more in order to see the effects it can have on the active community.

STATEMENT OF PROBLEM

Static stretching is a common practice among athletes at all levels. However, claims about the detrimental effect it has on power output makes this a subject of interest (Holt & Lamboune, 2008). Some research says that the time subjected to a static stretch is what causes the decrease. Prolonged static stretching including > 60 seconds reduces the ability of muscles to generate power (Bogdanis et al., 2017). Meanwhile, stretching for less than 45 seconds would go without risk of significant decrease in performance (Bogdanis et al., 2017). According to this study, 16 elite athletes applied intermittent stretching with a 30 seconds break in between each set increased CMJ heights by 8.1% compared to continuous stretching which decreases CMJ heights by 17.5% (Bogdanis et al., 2017). However, they did not measure CMJ until 4 minutes into recovery and only stretched the quad muscle group. Therefore, there are many differing results when it comes to static stretching and CMJ height research. It is important for the active population to know whether it is safe to use static stretching before exercising or not. In addition, more research needs to be completed on the relationship between AIS, countermovement jump height and flexibility.

STATEMENT OF PURPOSE

The purpose of this study is to evaluate the effect of AIS compared to static stretching on countermovement jump height production. Currently, only a few studies have conducted research on AIS and CMJ. None of which compared the differences in power production between static stretching and AIS. Most studies show 30 or 60-second holds per muscle group for static stretching. This study will utilize a static stretching and AIS protocol of 45 second hold per muscle group for a total stretch volume of 6 minutes, which meets the American College of Sports Medicine guidelines (ACSM, 2018).

HYPOTHESIS

The statement below outlines the research hypothesis that will be addressed in this study: There will be a significant decrease in CMJ’s for the warmup that includes static stretching while the warmup that includes activated isolated stretching will increase jump height among college students when compared to their control measurements. I also hypothesize that both warm-ups would be equally effective at increasing hamstrings flexibility.

Chapter II

LITERATURE REVIEW

Stretching and warming-up are subjects that are heavily researched in the exercise science literature. The structure of the human muscle tendon unit is characterized by thixotropic properties which indicates that the stiffness and viscosity of the system depends on the preceding activity of the muscle (Guissard & Duchateau, 2005). This means that the activities that the athlete decides to do before an athletic event should be picked very carefully because it has an effect on their future performance. For this reason, stretching and warm-ups have become an integral part of many athlete’s workouts. Luckily the general population knows that warm-ups get blood and oxygen to the muscles (Pinto et al., 2014) and stretching increases flexibility (Kirmizigil et al., 2014). The question is what type of stretching each athlete should be doing based off of their workout goals and expectations.

This study will focus on two types of stretching. Static stretching is one of the more popular stretching types among the stretches that will be focused on. It is commonly used among the public and researched in the literature. Static stretching involves bringing a joint to the end of its range of motion and holding it in a stationary position. The stretch is typically held for a brief amount of time or around 10 to 15 seconds while the muscle and tendons feel mild discomfort. After the stretch is complete, the joint is placed back into its neutral position. The same area can be stretched for multiple sets. Being the most popular stretch, is this the most beneficial pre-exercise stretch or is it being blindly applied because of traditions and lack of knowledge? This study will investigate these concerns for static stretching.

Active isolated stretching is the second method of stretching that will be further evaluated in this study. Although it is less researched when compared to static stretching, there is still a growing collection of research that has started to branch out. In active isolated stretching, the muscle to be stretched is relaxed by contracting the antagonist muscle while moving the body segment actively from the starting position to the stretched position (Kukkonen, 2019). AIS uses Sherrington's law of reciprocal inhibition and muscle contraction to enforce the methods of the stretch. It states that when a muscle on one side of a joint is contracted, the antagonistic muscle receives a neurological signal to relax or release which in turn allows for a greater stretch (Kochno, 2002). The stretch is gently applied with 1 pound of pressure for 2 seconds and then placed back to a neutral position. If the subject is unassisted, the pressure is provided by a stretching rope. The same isolated muscle stretch is repeated for up to 10 reps with each subsequent stretch achieving incremental gains of a few degrees of range of motion (Kochno, 2002). Because the stretch length is a mere 2 seconds, it reduces the activation of the body's stretch reflexes and avoids the reflexive contraction of muscle spindles and Golgi tendon organs (Kochno, 2002). A stretch reflex is a regulatory mechanism that helps the body to maintain muscle tone and posture. It is activated as a defensive response to any attempt to overstretch muscles and cause injury (Mattes, 1996). AIS should be directed along the stress lines of each muscle based on Wolff's law. This method minimizes the friction among fascia sheets and breaks down adhesion and scar tissue formation removing muscular pain (Kukkonen, 2019). Relaxation of the muscles and stretching along the stress lines are required in order to be correctly identified as AIS (Kukkonen, 2019). Unlike static stretching, AIS is performed with less torque, can isolate the stretch more and increase oxygenation to tissue more efficiently (Kukkonen, 2019). This may give an advantage to AIS over static stretching when it comes to being the best stretch to complete before a workout.

COUNTERMOVEMENT JUMPS

In this study, the countermovement jump is the chosen method to measure power output. According to Perrier et al. (2011), CMJ's are greatly related to performance measures such as agility, sprint acceleration, sprint velocity and leg power. Athletes should prepare for these types of measures because they are all essential components of most athletic events. This method involves a coordinated movement of all major muscle groups of the lower extremity (Perrier et al., 2011). A greater CMJ height would suggest that the individual is able to generate force with his or her legs at a rapid speed. A successful athletic performance involves coordinated movement of all major muscle groups of the lower extremity.

HOW STRETCHING EFFECTS POWER PRODUCTION OF COUNTERMOVEMENT JUMPS

Few studies have tested the effect of AIS on power production. According to (Waqqash et al., 2017) results indicated that performing active isolated stretching prior to countermovement jump performance resulted in a significant drop in jumping height among 60 physically active university students. However, the population was assigned to either a control group or the experimental group. Therefore, they used a group of people as a standard instead of using the same person for the control. They also took the mean of the three jumps instead of picking the best jump out of the three as other studies commonly do. This study argues that over flexibility could reduce the ability of the muscle unit to store elastic energy thus negatively affecting CMJ heights. Viscoelastic deformation of the muscle may not recover even after one hour has passed (Holt & Lamboune, 2008). It also notes that the muscle fibers of each individual may play a large role in their jump heights. Each individual may have a different dominant fiber type in his or her muscles. People with more fast twitch fibers (type 2) may gain more from short and fast stretch of the leg extensor muscles (Waqqash et al., 2017). Therefore, athletes or exercisers who often participate in sports that include sprinting and explosive power might benefit from AIS. Athletes with slow twitch fibers (type 1) will have a lower CMJ because they cannot explode as fast as subjects who have predominantly fast twitch muscles. Marathon runners or endurance-based athletes may not benefit from AIS as a means of enhancing power production. Research suggests that sports that require maximal power output should not be preceded with acute static stretching because it can negatively affect the power output of the muscles. Therefore, based on the elements of the sport, the individual can determine the types of muscle types that are most dominant in their muscles. This can direct the athlete into the right direction as far as determining if AIS is the best stretch for them or not.

Although there is more research conducted on static stretching and CMJ, the conclusions are conflicting. For example, some studies argue that the amount of time that the stretch is held can determine if it affects the vertical height or not. According to Pinto et al. (2014), in a group of sixteen physically active men a 30-second stretch resulted in no difference for jump height while a 60-second stretch negatively affected the jump compared to a control. They stretched four different muscle groups and did not include a warmup in their study. The study concluded that shorter durations of stretching may not affect performance while sixty second stretches reduces the ability of muscles to generate power. According to Stafilidis and Tilp in their 2015 article, eleven recreationally active university students applied a static stretch regime of 15 or 60-seconds. Neither stretching regiments altered their jumping performance. However, the subjects only stretched the vastus lateralis in their procedures. Also, there was a time delay of about two to ten minutes between the time the participants stretched and performed the CMJ. This explains the discrepancy between the results of the two studies that used similar stretching time. In addition, the effect of static stretching can also depend on the individual's training background. Therefore, using subjects of the same level of physical fitness will eliminate that confounding factor. Furthermore, the combination of a warm-up and a stretch is brought into question. 64 division I football players participated in a study that tested a warmup only condition, a warm-up plus a static stretch conditioning, and a warm-up plus dynamic stretching resulted in an improvement from all post-jump performances. However, the mean for the static stretching group was significantly lower than the means for the other groups (Holt & Lamboune, 2008). This shows that a warm-up alone increased CMJ heights higher when compared to warm-ups that included static stretching. However, participants only held the stretch for 5 seconds with 1-second interval for 3 sets (Holt & Lamboune, 2008). They concluded that static stretching inhibits production of force in the contractile component of the muscle. In a different study that included 21 recreationally active men, found that a static stretch produced higher CMJ heights when compared to a warmup with no stretching. After the subjects completed ten CMJ, an average of the jump heights were taken. The warmup with the static stretching resulted in a mean of 41.9 cm while the trail with no stretching resulted in a mean of 41.4 cm (Perrier et al., 2011).

Studies also differ in the muscle groups that are stretched. This also makes it difficult to compare results. In one study, they only stretched two lower body muscles including the hamstrings and quads 30 secs for 3 sets (Samuel et al., 2008). They found that static stretching did not affect the CMJ. Additionally, subjects were not stretched by an assistant but stretched themselves. There is a possibility that the subjects did not stretch to mild discomfort leaving room for error in results. Therefore, there are many variables that come into play when it comes to determining the overall effect static stretching has on CMJ heights.

There are also non-modifiable characteristics of the population that need to be taken into consideration. In a study conducted by Kukkonen in 2019, gender and age influenced the results of stretching because women are typically more flexible, and flexibility reduces with age. Therefore, it is possible that women are less affected by static stretching because of their already reduced stiffness of the musculotendinous units of the targeted muscles (Dalrymple et al., 2010). However, stretching does not affect genders differently when a practical stretch duration of 90 seconds is used (Samuel et al., 2008). In another study, CMJ performances of men were consistently and significantly higher than the performance of women for all three of their stretching conditions (Samuel et al., 2008). Another study showed that the use of static stretching for 8 minutes does not significantly affect CMJ performance in female collegiate volleyball players. This suggests that static stretching can be incorporated into the warm-up, but the coaches should always consider the individual athletes and their history before eliminating or prescribing exercises (Dalrymple et al., 2010). When analyzing future data, it is important to take into consideration the effect gender and age may have on those results.

EFFECTS OF STRETCHING ON RANGE OF MOTION

Aside from power production, increasing range of motion is also an important attribute for athletes. Range of motion is also dependent on the type of stretch that is utilized. Therefore, the effect that the two types of stretching has on flexibility will be analyzed in this study. When it comes to static stretching, Perrier et al. (2011) found that flexibility was greater after static stretching when compared to no stretching at all. This was concluded after twenty-one active men participated in stretching seven lower body muscle groups. Each muscle group was stretched for 2 sets of 30 seconds. After the sit-and-reach component, they found that the group that had not stretched had an average value of 30 cm while the group that participated in the static stretch had an average value of 32.8 cm. Increased flexibility during a prolonged stretch results mainly from reduced passive stiffness of the muscle tendon unit (Waqqash et al., 2017). Intermittent and continuous static stretching protocols result in similar increases in ROM (Holt & Lamboune, 2008). Kukkonen states that AIS produces more ROM in a short amount of time compared to static stretching. There was an indication that long term AIS (6 wks.) can be efficient in increasing ROM after participants stretched their hamstrings and experienced an increase in extension ROM by 15 degrees (Kukkonen, 2019). Therefore, stretching can significantly reduce the rigidity on the tendomuscular unit. However, research states that there is an indirect correlation between flexibility and CMJ heights. Subjects who are inflexible may have stronger jumping power than subjects who are flexible according to (Waqqash et al., 2017). For those reasons, there is a large consensus in the literature that acute static stretches should be performed at the end of workouts for increasing range of motion and rather than in pre-workout routines (Samuel et al., 2008).

Chapter III

METHODOLOGY

Statement of Purpose

The purpose of this study will be to determine if there is a significant difference on CMJ height measurements following static stretching compared to the effects from activated isolated stretching among well-trained college age students. These procedures will be conducted in college age subjects aged 18 to 24 that are enrolled at the University of North Georgia.

Research Question

Is there a significant difference between the countermovement jumps after static stretching and activated isolated stretching?

Subjects

The subjects in this study will be well-trained college aged men and women. Well-trained will be defined as any subject that participates in vigorous activity at least three times a week. There will be up to 40 subjects recruited to participate in the study. If any subject is 17 or younger, they will be excluded from the study. Gender will be male, female, or other if a subject identifies as something else; it will not affect the outcome of the study. Race will not be a determinant factor of the study. This inclusivity will eliminate any bias in the results. Subjects must not present any musculoskeletal injuries or health problems limiting physical exercise.

Individuals who report lower back or lower-extremity injury in the past 6 months will be excluded. This information will be collected through a physical activity and medical history form. All subjects will sign informed consent forms confirming voluntary participation. Subjects will be informed that they can withdraw at any time. Current medications taken by the subjects are allowed and should not be discontinued for the study. The subjects are advised to abstain from strenuous activity or resistance training at least 24 hours before testing. They will also be asked to refrain from caffeine consumption 4 hours prior to testing and to consume a light meal and fluids before the experiment. All of these points will be mentioned in the consent form and verified by a 24-hour history form.

Experimental Procedures

To begin the procedure, a sample size of up to 40 university subjects will be obtained. All of the subjects will undergo a familiarization session. Trial one will consist of a familiarization. Subjects will complete a 5-minute warm-up on the treadmill consisting of low intensity walking. Afterward, subjects will practice the CMJs, receive instruction and practice both stretching protocols as well as the sit and reach test. This will help avoid possible interferences in the results as a function of learning and coordination.

One day after familiarization of procedures, subjects will return for testing. The subjects will begin with a 5-minute warm-up on the treadmill up to 60 percent of their heart rate max based on 220- age (age-predicted maximal heart rate). After the warm-up, the subject will complete a pre-test of three trials of CMJ and then three trials of sit and reach. Then, subjects will complete 1 of 2 treatments in a randomized order: Static stretching (SS) or Active Isolated Stretching (AIS). They will be given a number from a random number generator app with 1, being static stretch, or a 2, being AIS. All test sessions will be conducted at the same time of day. There will be 24 hours in between each session.

The SS treatment will consist of 4 lower-extremity stretching exercises. Each stretch will be applied for 45 seconds . The subject will be instructed to hold a self-induced stretch to mild discomfort. The intensity will be adjusted based on feedback from the subject to ensure 90% of discomfort where 0 is “no stretch discomfort and 100 is “maximum imaginable stretch discomfort” (Bogdanis et al., 2017). These stretches include: (Figure 1) straight-leg calf muscle stretch with band (calf), (Figure 2) supine, straight-leg hamstrings stretch with band (hamstring), (Figure 3) supine hip flexion (glute) stretch, and (Figure 4) kneeling lunge and grasp foot (quadriceps and hip extensors) (Holt & Lamboune, 2008). For illustrations of the exercises used in this project, see Appendix.

Lastly, the AIS treatment will consist of 4 lower extremity stretching exercises. The subject will be reminded to contract their agonist muscles in order to relax the targeted muscles (Waqqash et al., 2017). Subjects will be instructed to remain relaxed while stretching is timed with a digital countdown timer. Ten reps of 2-second intervals will be conducted for AIS. Stretching techniques will target calf, hamstrings, gluteus maximus, quadriceps and hip extensors. First, subjects will be instructed to sit down with their leg straight and perform dorsiflexion by contracting their shin with a band (calf). The subject is then moved to a supine position with non-exercising leg flexed. On exhalation, the subject raises the leg by contraction of the quadriceps to maintain extension of the knee with the help of a band. After a 2-second stretch, the leg returns to the starting position on inhalation (hamstring). Afterwards, the subjects will be told to lie supine and bring his or her knee to their chest by contracting the hip flexor muscle (glutes). Lastly, the subject will start with a kneeling lunge then proceed to bend his/her knee back to grasp the foot with the same-side hand (Quadriceps and hip extensors).These are the same stretches as mentioned for the static stretch, however, the methodology for the stretch is changed to represent an AIS stretch. .

A pre-test CMJ will be completed before each of the stretching protocols. Post CMJ will be performed immediately after the completion of the stretching protocol. The post CMJs will consist of 3 attempts. To complete the CMJ, subjects will be asked to begin with their hands on their hips, spine erect and shoulders back. Next, they will lower their body towards the ground by moving into 90-degree flexion at knee. Lastly, they will be asked to jump as high as possible with no excessive side-to side or front-to-back movements. Their hip, knee and ankle will be fully extended. They will land softly in the same spot with flexed knees. There will be a 10-second break in between repetitions. The best pre and post CMJ will be chosen for evaluation.

The sit and reach posttest will be completed after the CMJ segment. The sit and reach will test the flexibility of the hamstring and the range of motion in the hips. The subjects will be sitting on the mat with knees extended and feet flat against the board. Then, the subjects will be instructed to reach and hold for 3 seconds along the board without bouncing. The best score out of the three attempts will be recorded.

Institutional Review Board Approval

Before this study is conducted, the study procedures and instruments would be approved by the IRB at the University of North Georgia.

ANALYSIS

Data collection would start with assigning each participant a randomized ID number in order to keep track of their data. This will be done so that the results cannot be linked back to individual participants to ensure anonymity and confidentiality of the study participants. A handwritten chart would document all of the measurements throughout the data collection days. The chart would include seven columns: ID #, Pre sit and reach (cm), Pre CMJ (cm), Static sit and reach (cm), Static CMJ (cm), AIS sit and reach (cm) and AIS CMJ (cm). The best measurement out of the three attempts will be written down as data. A “change” variable will be calculated by subtracting the best post-test result from the best pre-test result. This “change” variable will be statistically analyzed. Using the data results, two different paired T-tests would be conducted in order to determine if there is a statistical significance between the two stretching types. One paired t-test would evaluate the differences between the countermovement jump heights while the other paired t-test would evaluate the difference between sit and reach measurements. We can calculate the p-values from the t-statistic and reject the null hypothesis if the p-value is smaller than the chosen alpha level of 0.05. Factors such as the subject's height, weight, and age can be used to evaluate the results to establish if these variables could have affected the results. However, due to the sudden shut down and restrictions implemented due to COVID-19, human data collection could not be collected. Therefore, a completed analysis could not be achieved.

CONCLUSION

This study aimed to determine the appropriate stretching technique used in the warm-up period of power-required sport activities. After the study is finished, subjects will receive a copy of their test results to take home and analyze. A chart of average reports for sit and reach as well as countermovement jump measurements will also be given as a reference. For fun, this will show what level they are on compared to the standards. All of this information will help them understand the effect different stretching protocols have on countermovement jump heights and flexibility. This will change the way they will conceptualize stretching. This will influence participants to create new fitness goals to achieve based off of these results. Perhaps they use these results as standard measurements as they work on improving their flexibility and countermovement jump heights. They will also understand which type of stretching is beneficial for them depending on the type of exercise they do in order to benefit their future performance. This information can also be used to alter the design of their previous pre-workout regimes, group exercise classes, athletic teams and personal training. After receiving their results, subjects will be more informed and well prepared for the start of any athletic event. Furthermore, this study will increase the interest for research in active isolated stretching. Additional investigation is required to find appropriate stretching methods to improve talents of athletes having high flexibility and power-production capacities. Although a conclusive result cannot be stated at this time, I believe this is still a well-rounded study to conduct in the future.

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Appendix

Pictorial Representation of the Stretching Exercises

Figure 1. Position used during seated assisted calf stretch.

Figure 2. Position used during supine assisted hamstring stretch.

Figure 3. Position used during supine glute stretch.

Figure 4. Position used during kneeling quad and hip flexor stretch.