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The Effect of Four Different Stretching Protocols on Muscular Power

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To the Dean of the Graduate School:

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THE EFFECT OF FOUR DIFFERENT STRETCHING PROTOCOLS ON MUSCULAR POWER

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Table of Contents

List of Tables

REVIEW OF LITERATURE REGARDING STRETCHING PROTOCOLS

Abstract

This review of literature explores the varying amount of evidence available for different stretching protocols included in the warm-up period. The objective of a comprehensive warm-up is to increase core temperature and improve muscle elasticity to prepare muscles for the demands of activity. Static (held) stretching and dynamic (slow moving) stretching seem to be utilized more often, and they are most studied in the bulk of stretching research. There has been less research published on the effect of ballistic (rapid bouncing movement) stretching. The overwhelming majority of literature has found that when compared, dynamic stretching increases power activity performance significantly more than static stretching. Noticeably, most available research using dynamic stretching protocols actually have a mix of both ballistic and dynamic stretches. The few articles that focused on ballistic-only stretches found conflicting results. Ballistic stretching has a stigma of increasing the chance of injury, due to the bouncing aspect. With the repeated bounce at the end range of motion, it may cause the muscle to be overstretched. The available research shows that the extra bounce has aided in increasing flexibility, while not increasing the chance of injury. With ballistic stretching being safe to perform, there is a need for more research to determine if dynamic-only or ballistic-only stretching has the greater effect on power performance.

Introduction

In sports and activities, warm-ups should be paramount to the pregame and pre-workout time. Warm-ups are performed in order to prepare the participant for competition, decrease risk of injury and reduce muscle soreness (Bishop & Middleton, 2013; Carvalho et al., 2012; Taylor, Sheppard, Lee, Plummer, 2009). The warm-up effect on athletic performance has been a topic of previous literature. Primarily, these studies examined the effect on low-intensity anaerobic exercises prior to participation in training. The literature comparing dynamic-only stretching to ballistic-only stretching is extremely lacking. The bulk of stretching research shows that dynamic stretching is superior to static stretching, but very few studies compare the effects of ballistic stretching to dynamic stretching specifically. Many of the studies that implement a “dynamic warm-up” actually includes both ballistic and dynamic stretching activities. This confounds the findings of dynamic effects for the warm-up period. Stretching techniques utilize different actions that aids in preparing the participant for activity. Static stretching has the participants hold a stationary position for 15-30 seconds that applies a slight pull in the muscle. This technique is utilized most for increasing flexibility. Dynamic stretching is a movement-based stretch. This technique has the participant move through their full range of motion in a controlled low intensity movement. This aids to increase muscle temperature allowing an increase in flexibility. Ballistic is also a movement-based technique. The biggest difference between dynamic and ballistic is that ballistic has a high intensity movement aspect. A ballistic stretch also, has a bounce at the end range of motion of the stretch. This aids in increasing muscle temperature and elastic qualities like a dynamic stretch.

General Warm-Up

It is well documented that completing a warm-up or stretching routine before participating in moderate or vigorous activity is beneficial for a variety of reasons. It is believed that warm-ups will decrease the risk of injury and aid in the preparing muscles for activity. Bishop & Middleton (2013) found that a warm-up helps decrease muscle stiffness, increase muscle temperature, and flexibility. No matter what the physical activity entails, almost all sport and fitness organizations recommend a general warm-up strategy prior to activity engagement, most of which agree on some variation of low-intensity activity followed by some type of stretching. The American College of Sports Medicine (ACSM) believes that every activity should begin with a warm-up. They believe it helps prepare the body by increasing heart rate and blood flow to muscles in order for them to work at peak performance. They recommend the lower intensity exercise such as walking or jogging in order to increase core temperature. This creates a smooth transition to the flexibility aspect of a warm-up. Once muscles are warm, flexibility increases are more likely due to increased elasticity. The ACSM encourages stretching to include both static and dynamic stretching in order for the joint to move throughout its full range of motion. Static stretches should be held from 10-30 seconds each and dynamic stretches are moved throughout the joint's functional range of motion actively (American College of Sports Medicine, 2013).

The National Strength and Conditioning Association (NSCA) follows similar guidelines for completing the warm up. The NSCA agrees that increasing muscle temperature, blood flow, and range of motion around joints are keys to an effective and safe warm-up. While they do recommend a static stretch component of a warm-up, they stress that dynamic stretching is essential to increasing performance while also decreasing chances of injury (Haff & Triplett. 2015). Even though the NSCA stresses a dynamic stretch more than the ACSM, they still want the participants to build a light sweat with low intensity exercises before beginning any stretch routine. Both of these leading organizations conclude that before activity a warm-up increasing muscular temperature, blood flow, and joint range of motion is critical.

While the benefits of performing a warm-up are widely accepted, there is debate as to the type of stretching activity that should be included for maximum performance. Specifically, the topic of discussion is the inclusion of static stretching, dynamic stretching movements, or ballistic stretching movements that should follow the light activity that increased core temperature. Recently, many studies have attempted to compare the effects of various stretching protocols on athletic performance variables (Andrejic, 2012; Behm, et al., 2011; Carvalho, et al., 2012; Faigenbaum, et al., 2005; Ertugrul, 2011; Hough, Ross, & Howatson, 2011; McMillian, Moore, Hatler, & Taylor, 2006; Pagaduan, Pojskic, Uzicanin, & Babajic, 2012; Ryan et al., 2014; Sudhakar & Padmasheela, 2012; Taylor et al., 2009; Vanderka, 2011). Most research has examined the differences in static-only, dynamic-only, or static-dynamic combination in relation to performance (Bishop and Middleton, 2013; Faigenbaum et al., 2006; Morrin and Redding, 2013; Turki-Belkhira et al., 2014). Others have looked at just the effect that different static stretching has on vertical jump performance (Fortier et al., 2013; McNeal & Sands, 2003; Power, Behm, Cahill, Carroll, and Young, 2004). Most of the research is largely similar in finding that dynamic stretching increases vertical jump performance while static stretching decreases or has no change. Only Paradisis et al. (2014) and Turki-

Belkhira et al. (2014) found that dynamic stretching decreases or did not change vertical jump performance over static stretching. It seems to be a general acceptance that dynamic stretching seems to has an improved effect on vertical jump performance over static stretching protocols.

While it is typical for active individuals to use a multitude of different stretches, they do not always use the appropriate stretches for their activity. Carvalho et al (2012) reported static stretching aids in increasing flexibility, reducing delayed onset muscle soreness, along with decreasing strength and power. This could prove problematic for participants in activities that require power such as basketball or volleyball, but could be helpful in endurance-based sports such as cross-country. A better understanding of the effect of static, dynamic, and ballistic stretching protocols on all athletic performance variables is key in designing effective performance and injury prevention programs. A call for more consistent findings is critical.

Static Stretch

Several previous studies have shown a decreased effect of static stretching on vertical jump and long jump performance (Bishop and Middleton, 2013; Carvalho et al., 2012; Faigenbaum et al., 2005; Faigenbaum et al., 2006). Carvalho et al. (2012) studied 16 male tennis athletes that trained for at least eight hours a week. The participants got a baseline of the vertical jump performance through a no stretch protocol. The participants were compared to a passive static stretching protocol that focused on the hamstrings, quadriceps and triceps surae. The study used a force platform to measure the jump power and height of the participants. The participants utilized a counter movement jump but had their hands on their hips, so that they could not use their arms for momentum. The test was completed three times for each participant for accurate scores. The results showed that the passive static stretching protocol had a diminished effect on the power of the participants' vertical jump test when compared to the no stretching protocol. This study suggested that by completing a passive static stretch, athletes could be compromising their short-term power performance.

Fortier et al. (2013) compared an isolated static stretching protocol to a no stretching group in order to see if any improvements were observed. The study used fifteen participants: nine men and six women who were active for about seven hours a week. All treatments used a warm-up protocol that included five minutes and thirty seconds of high knees, butt kicks, ankle flips, sideway runs and accelerations to increase core temperature. The no-stretch protocol was completed by having the participants relaxed in a seated or standing position for four minutes and 30 seconds after the warm-up. The static-stretch protocol had the participants complete three stretches that were held for 20 seconds at the point of discomfort for both legs. Vertical jump height was measured via a force platform. The results of the study showed that the static-stretch protocol had no improvements compared to the no-stretch protocol. The findings suggests that there is no advantage to complete static stretching for short term vertical jump power.

McNeal and Sands (2003) compared passive static stretching to no stretching in 13 competitive gymnasts that practiced between eight and twenty-five hours a week and had one-year competitive experience. Each protocol tested completed a gymnastic specific stretch directed by the coach each day. The warm-ups were identical between testing days. The passive static stretching protocol included a stair stretch that focused on the gastrocnemius. A partner supine stretch was also performed, where the participant would lie on their back and a partner would keep their leg straight at 90 degrees and apply pressure to the ball of the foot, which focuses on the gastrocnemius (and the hamstring). Finally, a pike stretch where the participant sat straight up and bent forward at the hips while a partner applied pressure to the ball of the foot for maximal dorsiflexion. The no-stretch protocol only completed the warm-up and did not perform any stretches. Drop jumps with a timing mat were used as the measure of power performance. The results found that the airtime was significantly reduced when the participants completed the passive static stretching protocol. The results indicated that since the jump time was reduced by passive static stretching, the power of the gymnasts' jumps was also diminished.

Hough et al. (2009) used 11 healthy men who competed regularly in university sports to examine stretching protocols on vertical jump performance. The participants completed no-stretching and static-stretching conditions with at least 24 hours in between each test. Each condition included a submaximal five-minute bike warm-up. The no-stretch condition rested for two minutes after the warm-up, before being tested. The static stretch condition completed stretches that focused on the plantar flexors, hip extensors, hamstrings, hip flexors and quadriceps. They held each stretch for 30 seconds at the point of mild discomfort. The measure used a vertical jump that had no eccentric loading. The participants waited two minutes after completing the static stretching to complete the jump. Participants were instructed to move into the jumping position by flexing their knees until they were comfortable that they were in the position to jump the highest. Once there, they held that position for two seconds to reduce eccentric effects on the jump. A contact mat system was used to record jump height and flight time. The findings showed that static stretching significantly reduced vertical jump height and flight time compared to no-stretching. As shown, the overwhelming majority of research continues to find that static stretching diminishes short term power in participants (Behm et al., 2011; Faigenbaum et al., 2005; Ertugrul, 2011; Sudhakar and Padmasheela, 2012; Taylor et al., 2009; Vanderka, 2011). These findings suggest that participants will have a better jumping performance when they do not stretch, rather than static stretching before.

Some research has indicated that static warm-up decreases musculotendinous unit stiffness which can cause a decreased length-tension and force-velocity relationship and reduced force production (Morrin & Redding, 2013). While static stretching shows a negative effect on force production, dynamic stretching has shown to increase performances during anaerobic exercises. One of the theories for the increased performance is that the post-activation potential effect pushes muscle contractions to be faster and increase the potential for force production (Morrin & Redding, 2013; Bishop & Middleton, 2013). Additionally, this may have prevented participants in the studies to reach the most beneficial length-tension relationship (Faigenbaum et al., 2005).

Dynamic Stretching

Other studies have investigated different dynamic stretching protocols to evaluate the effect on short term power. Behm et al. (2011) assessed vertical jump in 18 participants that completed three different stretching protocols. Vertical jump was measured using a jump mat device. The participants completed a control group where they warmed up for five minutes on a bike, then rested 12 minutes before completing the performance test. A static stretching group completed four repetitions of static stretches on both quadriceps, hamstrings and plantar flexors. In the dynamic stretching protocol, eight repetitions of stretches were used. The protocol included walking butt kicks, walking lunges and extending leg dorsiflexion. These exercises stressed the quadriceps, hamstrings and plantar flexors. This study showed that a dynamic stretch increased the vertical jump performance in the participants over the other two protocols. The findings suggest that for the best performance in vertical jumping, a dynamic stretch is recommended.

Faigenbaum et al. (2005) completed a study that examined stretching protocols on vertical jump and long jump in children. Participants included 27 girls and 33 boys, with the majority participating in after school activities. The subjects completed two introductory sessions to reduce the learning curve while testing. Each of the three warm up protocols lasted for about 10 minutes. The static protocol consisted of a five-minute walk and five minutes of stretches that focused on the lower body. The dynamic protocol consisted of 10 minutes of dynamic stretching that increased in intensity over the 10 minutes. These exercises included: high knee walk, straight-leg march, hand walk, lunge walks, backward lunge, high-knee skip, lateral shuffle, back pedal, heel-ups, and high-knee run. The second dynamic protocol consisted of 10 minutes of stretching, followed by 3 drop jumps. The measures of vertical jump and long jump utilized a countermovement jump (arm swing) to complete the tests. Both tests were completed three times and the best score was recorded. The results showed that vertical jump and long jump performance were significantly better during the dynamic stretching protocol. The study suggests that to increase jumping performance participants would benefit from dynamic stretching before activity the most.

Research by Hough et al. (2009) utilized the 5-step jump in 30 cadets that participated in the study. The cadets completed a no-stretch, static-stretch, and dynamic-stretch protocol that lasted about 10 minutes. The no-stretch protocol had the participants rest for 10 minutes before completing the test. The static-stretch protocol included one repetition of eight stretches that were held for 20-30 seconds followed immediately by testing. The dynamic-stretch protocol included 5 repetitions slowly followed by ten repetitions quickly without bouncing. These stretches were focusing on hip flexors, hip extensors, hamstrings, plantar flexors and quadriceps femoris. The study concluded that the dynamic-stretch protocol increased the performance of the participants compared to the no-stretch and static-stretching protocols. This study coincides with other research that has found that dynamic stretch can improve short-term performance. The findings suggest, that the 5-step test jump height can be improved by a dynamic stretching, instead of static and no stretching.

Pagaduan et al. (2012) compared stretching protocols on jumping power in 29 football players using a counter movement jump on an Opto Jump system (Bolzano, Italy). The protocols included static-only stretching, dynamic stretching with a general warm-up, and static stretching with a general warm-up. The general warm-up consisted of five minutes of running at a set pace in an 86-meter circular circumference area. The preset pace consisted of a four 30-second runs around the circle, followed by four 25-second runs, and then four 20-second runs. The dynamic stretching protocol included straight leg march, butt kicks, carioca, high knees, and reverse lunge with twist, power shuffle and jogging with squats. Two sets of 20 seconds were completed, summating to a total seven-minute stretch. The static stretching protocol included standing quadriceps stretch, calf stretch, hamstring stretch, single leg straddle, inverted hurdler's stretch, lying single knee to chest and seated cross-legged gluteus stretch. These stretches were done on both legs to the point of discomfort for seven minutes. The study found that after the protocols were complete that static stretching had lower vertical jump performances than static stretching with a general warm-up. Dynamic stretching with a general warm-up showed superior improvements than any of the other protocols. These findings aid those attempting to improve their vertical jump power.

In 2009, Taylor et al. examined stretching protocols on 13 participants that competed in a Netball Program. Participants completed a 15-minute dynamic stretch that included multiple separate exercises. These exercises included: high knees, butt flicks, carioca, dynamic hamstring swings, dynamic groin swings, arm swings, faster high knees, swerving, side stepping over, Spiderman walks over, sideways low squat walks, upper body rotations, vertical jump, run through over, countermovement jump then 5 m sprints at 90%, sprint for 5 m then countermovement jump. The participants also completed a static stretching protocol that included nine stretches that were held for 30 seconds each. The study used vertical jump apparatus to measure their vertical jump height. Following a counter movement jump, participants would jump and touch the apparatus, where the vertical jump height was recorded. The study found that the vertical jump heights following the dynamic stretching protocol was significantly higher than the heights following the static stretching protocol. Based on the research, the inclusion of dynamic stretching before completing an activity that requires power is preferred. In the research collected, many different types of stretching protocols were completed.

Dynamic combined with static stretching

There is a vast amount of literature on dynamic stretching and static stretching separately for power and their effect on performance. Research on the combination of the two is less common and inconclusive. Bishop and Middleton (2013) used 25 male participants who were active on university team sports. The participants completed two separate stretching protocols. The dynamic stretching protocol used different exercises that lasted 10 minutes. These exercises include: ankle flicks, jogging skips, high knees, heel flicks, small 2 footed jumps, lateral running, squats, carioca, high knee skip, zig zags, Russian walk, two high jumps, one small, open, close gate, lunges, and sprints. The dynamic plus static stretching protocol used the same dynamic warm-up, but also included five minutes of static stretching. The static stretches were held for 20 seconds, and focused on the quadriceps, hamstrings, gastrocnemius, soleus, glutes, adductors and hip flexors. After each protocol was completed, the participants waited two minutes before completing the vertical jump test. The tests found that the dynamic stretching plus static stretching protocol had no significant differences in results from the dynamic stretching protocol. This suggests that having including static stretching with a dynamic warm-up will not have any negative effects on power performance. The findings show that completing either dynamic or a combination of dynamic and static will yield the same results.

Faigenbaum et al. (2006) examined three stretching protocols on 30 participants (26 boys and four girls) who competed in sport activity at least four times a week. The three stretching protocols included static-only stretching, dynamic-only stretching, and static-then-dynamic stretching. Each protocol was completed in 10 minutes. The static stretching warm-up included stretches that focused on the hip and low back, hamstrings, quadriceps and gastrocnemius. The dynamic-only protocol included nine exercises that were moderate to high intensity. These exercises include: speed skips, heel-ups, in and out, trunk twists, skipping toe touches, drop squat/carioca, power push-ups, sprint series, high knee skips. With the dynamic stretches having a high intensity, it is likely a ballistic stretch being done and not dynamic-only. This is found when looking at the specific exercises done. A few of these ballistic exercises are speed skips, heel-ups, in and outs, carioca, and high knee skip. The static-then-dynamic warm-up included five minutes of static stretches followed by five minutes of dynamic stretches. During the combination protocol, only one set of each type of stretch was completed, while the other protocols performed two sets. Before the vertical jump tests were completed, the participants walked for one to two minutes. The study used the Vertec system (Hilliard, OH) to record the vertical jump heights of each participant. The system has the participant jump and try to touch the highest notch. The results of the tests showed that the static-then-dynamic protocol showed significantly higher vertical jump heights when compared to the static-only stretching protocol, but no different from the dynamic-only protocol. These findings suggests that those who engage in activities that require short term power should include either a combination of static and dynamic stretches or dynamic-only stretching in their warm-up period.

Morrin et al. (2013) examined different stretching protocols in 10 females that had three or more years of contemporary dance experience. The protocols included a static-only stretch, a dynamic-only stretch, a static-plus-dynamic stretch and a no stretch. Before each protocol, a cardiovascular warm up was completed. The static stretch included four stretches that focused on the hamstrings, quadriceps, gastrocnemius and gluteus maximus. The dynamic stretch focused on quadriceps, hamstrings and gastrocnemius. These cardiovascular exercises included: slow paced walking, moderate paced walking, shoulder rotations combined with moderate paced walking, circular arm swings with moderate paced walking, body swings, marching around the room low knees and high knees, moderate paced side stepping around in a circle, mini jumps on the spot, step-hop around the room, side stepping around in a circle, heel kickbacks, slow paced walking, body swings, slow march on the spot. The combination protocol had the static stretch completed before the dynamic stretch, with each protocol halved compared to the non-combined protocols. The no-stretch protocol sat for eight minutes before completing the performance test. The performance test used was the Just Jump System that measured the flight time and power of each jump. The study results showed that the dynamic and combination protocols produced significantly higher power measurements compared to the static stretching and no stretching protocols. The findings suggest that static-only stretching will decrease power performance in participants when compared to a combination stretch.

Ballistic Stretching

While most research on stretching protocol mentions using only dynamic and/or static stretching, only a small portion has clarified including ballistic stretching protocols. One reason for this is probably due to the belief that ballistic stretching is dangerous and increases the risk for possible injury. Ballistic stretching is different from static or dynamic in that it includes a “bounce” or rapid bounce-like movement to a stretch at its end range. There is no published evidence that indicates controlled bouncing movements at end range directly caused injury. Woolstenhulme et al. (2006) reported that the extra bounce does not cause harm to muscles, but actually aids in flexibility when compared to static stretching. This study tested 27 women and 16 men over a 6-week period of warm-up followed by basketball activity. The participants were set in one of four stretching groups: control, static, ballistic and sprint. The controlled group only participated in a basketball shooting exercise with a partner for 8 minutes. Static completed four different stretches: sit and reach, lunge, standing heel cord-knee extended, and standing heel cord-Knee flexed. These were held for 30 seconds. Ballistic stretching focused on those same stretches, but added an end range of motion bouncing movement, with a 60 b-min to bounce to. The sprint group completed five 35 second sprints that had them cutting at the foul line, half court, far foul line, and end baseline and back each time. They tested vertical jump height every two weeks, both before and after the basketball activity. The ballistic exercises utilized an end range of motion, bouncing movement. Stretches performed included sit and reach, lunge, standing heel cord with knee flexed and extended. The participants completed the warm-up as stated above, tested a vertical jump, participated in basketball play for 20 minutes and were tested again. This study was continued for 7 weeks with testing every two weeks. The results showed no increase in vertical jump after six weeks for any group for both pre- and post-warm-up. The only effect they found was after basketball activity with the ballistic stretching. They found the heights had increased by 3.2 cm. They inferred from their results that ballistic stretching followed by basketball activity can be completed safely and able to increase basketball jumping heights.

Bradley et al. (2007) was also one of the few studies that investigated the ballistic stretching effects on vertical jump height. Participants included 18 college aged students that completed four different stretching protocols. The participants completed a no-stretch, static-only, ballistic-only and Proprioceptive Neuromuscular Facilitation-only stretching protocol after a 10-minute sit, then a five minute bike. Each protocol was performed after a pre-stretch jump, then again 15 minutes after completion of the protocol. The participants completed a familiarity test before each protocol to reduce the likelihood of a learning effect during the study. The study focused on stretching of the quadriceps, hamstrings, and plantarflexor muscle groups. The exercises included: supine gastrocnemius stretch, butterfly stretch, supine hamstring stretch, prone quadriceps stretch, and kneeling quadriceps stretch. The results of the study showed that on the post stretch, ballistic stretching no significant effect on vertical jump height, while static and no stretch had negative effects. An interesting finding of the study was that after 15 minutes the jump heights all returned to their pre-stretch values. These results would suggest that 15 minute and beyond of sedentary activity, athletes do not get any change in their performance.

Ballistic Movements in “Dynamic” Protocols

While there is a dearth of research that specify ballistic stretching is extremely thin, the stretches that are used in dynamic stretching contain both dynamic and ballistic movements. For example, in Bishop & Middleton (2013) exercises such as butt kicks and carioca are “ballistic” although they were used in the “dynamic” protocol. Other research using a “dynamic” protocol is similar (Faigenbaum et al, 2005; Faigenbaum et al, 2006; Fortier et al., 2012; Gelen, 2011; McMillian et al., 2006; Pagaduan et al 2012; Ryan et al., 2014; Sudhakar & Padmasheela, 2012; Taylor et al., 2009; Turki-Belkhiria et al., 2014). Herein is the question that should be clarified. If "dynamic" stretching protocols that have actually included ballistic-type movements have been shown to produce significantly greater power outputs than other stretching protocols, is the effect due more to the dynamic stretch, the ballistic stretch, or a combination of the two?

Conclusion

The research that has examined different stretching protocols and their effect on muscular power have been largely consistent. Most the studies compared either static-only stretching or dynamic-only stretching protocols to each other, or to a non-stretching protocol. The bulk of the findings show that static stretching is not beneficial for muscular power and explosiveness, which was mostly measured through a vertical jump assessment.

The research that finds dynamic stretching to be more beneficial to static stretching or no stretching suggests that one way it improves performance could be due to an elevated muscle and body temperature (Behm et al., 2011). Dynamic stretching has shown to be significantly more effective than static-only stretching or no stretching, but some research has shown that a combination stretching protocol of static and dynamic can be just as effective.

While there is an enormity of research that has found dynamic-only stretching to be more beneficial than static-only stretching (Andrejic, 2012; Behm, et al., 2011; Carvalho, et al., 2012; Faigenbaum, et al., 2005; Ertugrul, 2011; Hough, Ross, & Howatson, 2011; McMillian, Moore, Hatler, & Taylor, 2006; Pagaduan, Pojskic, Uzicanin, & Babajic, 2012; Ryan et al., 2014; Sudhakar & Padmasheela, 2012; Taylor et al., 2009; Vanderka, 2011), not enough studies have specified the roll of ballistic stretching within the protocols used for dynamic-only treatments. If both ballistic and dynamic combinations have been used and shown to be superior to other methods, there is not a clarification on which might be causing the significant differences. Research examining specific stretching protocols prior to explosive anaerobic exercise is extremely important for performance. More research is needed to clearly define the best stretching protocol for production of power and explosiveness. There is a need for more reliable evidence regarding specific ballistic stretching protocols.

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COMPARISON OF FOUR STRETCHING PROTOCOLS ON EXPLOSIVE POWER

Abstract

The purpose of the study was to compare different stretching protocols on vertical jump and long jump. Participants included 22 females and 16 males that completed four different stretching protocols in a randomized, cross-over treatment design. Protocols were performed on separate days, with at least 48 hours of rest in between. Each session began with a 5-minute self-paced jog, followed by one of the four stretching protocols: static-only stretch, dynamic-only stretch, ballistic-only stretch, and dynamic-plus-ballistic stretch. Each stretching protocol lasted for about five minutes. Participants performed either a vertical jump or long jump directly after finishing the stretching protocol, then switched testing conditions. There were no significant differences in vertical jump or long jump performance across the four conditions. Consequently, this study did not support previous research showing performance improvement after dynamic stretching.

Introduction

Stretching before activity is routine for almost all who participate. The leading sport and fitness organizations recommend a warm-up that consists of a low intensity walk or jog, which breaks a sweat before completing stretching. For stretching they recommend a static stretch and dynamic stretch, with static stretching being done for a 15-30 second count. The aim of stretching is to warm the muscles so that it is easier to increase flexibility through the elasticity from the increased tissue temperature (American College of Sports Medicine, 2013; Haff & Triplett 2015).

While benefits of performing a warm-up are accepted throughout the community, there is still debate on the type that aids in maximizing vertical jump and long jump performances. The large portion of research that compare static and dynamic stretching show dynamic stretching improves vertical jump and long jump performances more than static stretching Faigenbaum et al. (2005). While dynamic stretching is considered more beneficial than static stretching, few studies look at how dynamic stretching tends to include both dynamic and ballistic stretching. Almost all of the studies found included both types of stretches. This brings up the question of do ballistic-only stretches or dynamic-only stretches influence the performance improvement that so many studies have found. Both stretching techniques increase the fast twitch response time in muscular power. Due to ballistic and dynamic stretching utilizing this response, having mixed stretches in one dynamic protocol clouds the results that state dynamic is better than ballistic. The thin amount of literature on ballistic-only stretching research is conflicting on its findings. Woolstenhulme et al (2006) found improvements in ballistic stretching in basketball activity. The participants showed improvements after a six week stretching program, only when coupled with basketball activity and ballistic stretching. A conflicting study by Bradley et al. (2007) showed only little improvement in jumping height after ballistic stretching. The interesting finding in this study was that after 15 minutes, the jump heights went back to the baseline heights.

To test vertical jump, there were many different ways that were done. The most popular was a force platform, allowing them to time how long the participants were in the air, and calculate how high the jump was (Behm et al., 2011; Bishop and Middleton, 2013; Bradley et al., 2007; Carvalho et al., 2012; Fortier et al., 2013; Ertugrul, 2011; Hough et al., 2009; Morrin and Redding, 2013; Pagaduan et al., 2012; Paradisis et al., 2014; Power et al., 2004; Ryan et al., 2014; Turki-Belkhiria et al., 2014; Vanderka, 2011). The vertec was another reliable method, using the vertec apparatus (Hilliard, OH). The heights of jumps are measured every half inch slats (Faigenbaum et al., 2005; Faigenbaum et al., 2006; Sudhakar and Padmasheela, 2012; Taylor et al., 2009). For standing long jump, measuring tapes, tend to be used often. They allow the participants to complete a CMJ before jumping as far as possible. Before any stretching technique can be named "best" to prepare participants before activity, more research needs to be done comparing dynamic-only stretching to ballistic-only stretching. More consistent findings are needed either negative or positive.

Methods and Procedures

Participants & Recruitment

Participants included 38 healthy college students, aged 18 – 25 (females = 22; males =16). Participants were volunteers recruited from exercise science classes at a Division I university in Southeastern United States. Participants signed an informed consent and were screened prior to participation, and the study was approved by the Institutional Review Board (IRB). Screening tools included a Physical Activity Readiness Questionnaire (PAR-Q) and four items that asked about recent injuries.

Inclusionary criteria for this study consisted of the following:

1. Participants who were at least 18 years old.
2. Participants who were enrolled in exercise science activity class at the university during fall 2016.
3. Participants who were free from pregnancy, disease, or injury.
4. Participants with a Body Mass Index (BMI) lower than 30.

Exclusionary criteria for this study consisted of the following:

1. Participants who were under 18 years of age.
2. Participants who were not enrolled at the university during fall 2016.
3. Participants who were pregnant, had diagnosed cardiac or pulmonary disease or diabetes, or had a recent lower body injury.
4. Participant with a BMI greater than 30 kg/m^2.

Research Design

The research was an experimental study using a randomized cross-over treatment design. The subjects were randomly assigned to one of four protocols: static-only stretching (control), dynamic-only stretching, ballistic-only stretching, and dynamic-plus-ballistic stretching protocols. Data collection occurred on four days over a three-week period from November to December 2016. Each group was randomly assigned to a different treatment protocol for each testing day. Independent variables for this study were the type of flexibility protocol implemented during the warm-up period. The dependent variables were the scores for the vertical jump and standing long jump assessments, both of which are a measure of high-speed power.

Procedures

Once participants consented and were approved for the study, they completed a five-minute jog (self-paced) and were randomized to flexibility protocol. Each flexibility protocol was completed in about 10 minutes, and the type of activities performed in each group are listed in Tables 1 - 4. Two groups went at one time. Facilitation of the groups was performed by two members of the research team, both of which are certified and qualified to teach flexibility protocols. This helped ensure conformity and consistency across the groups, as each protocol was performed identical across all four groups. Once a group completed the assigned flexibility protocol, they were directed to either the vertical jump assessment station or the standing long jump assessment station.

Instrumentation

Vertical jump height was measured with the Vertec apparatus (Hilliard, OH). The reach height for the Vertec apparatus was found by having the participant stand erect, with both feet together and arms above their head, reaching as high as possible. Participants then performed a counter movement jump by flexing the hips and knees, to a depth of their preference. Once at the depth, they extended their knees, hips and plantar flexed their ankles explosively to generate the most power, and gain the highest jump possible. During the concentric jump, the participant would reach up to hit the colored strips (Nuzzo et al., 2011). The participants continued to jump, until they missed on two consecutive jumps. Vertical jump height was recorded to the nearest half inch.

Standing long jump was measured with a tape measure adhered to the ground. Participants began the test standing just behind the 0 on the measuring tape, and performed a counter movement jump with both legs shoulder with apart and feet parallel. Only trials where the participant landed on both feet without additional movement were used. The length of the jump was measured from the back of the rearmost heel to the nearest inch (Faigenbaum et al., 2005). The participants completed 3 trials, and the highest score was recorded.

Analysis

The vertical jump and long jump measurements were evaluated using the Statistical Package for the Social Sciences (SPSS) Program (IBM Corporation, Armonk, NY). Descriptive statistics of height of jump, length of jump, and specific stretching protocol were used to evaluate measurements completed by participants. Repeated measures analysis of variance (ANOVA) was used to evaluate the vertical and long jump heights for each subject.

Results

The study initially began with 55 participants, 17 of which did not attend enough scheduled testing sessions to be considered for the study. The sample of 38 participants included 22 females and 16 males.

Vertical Jump

Table 6 represents the repeated measures ANOVA performed while comparing the vertical jump heights of static-only stretch, dynamic-only stretch, ballistic-only stretch and combination of dynamic and ballistic stretch against each other. There were no violations of sphericity in the repeated measures test ($\chi^2 = 7.138$, $p = .211$); therefore, no corrections to the degrees of freedom were made. For vertical jump, there were no significant difference found for any of the stretching protocols either by time ($F_{(3,102)} = .310$, $p = .818$) or group by time interaction ($F_{(3,9)}$, = 1.00, $p = .438$) . The results that were found did not support the hypothesis that the dynamic-plus-ballistic stretching protocol would show higher vertical jump height over the other conditions.

Long Jump

Table 7 shows the repeated measures ANOVA, which compared long jump distance for four different conditions. The conditions compared were static-only stretch, dynamic-only stretch, ballistic-only stretch, and combination of dynamic and ballistic stretch. There were violations of sphericity in the repeated measures test ($\chi^2 = 31.19$, $p < .001$); therefore, corrections to the degrees of freedom were made using the Greenhouse-Geisser $\varepsilon = 1.300$. For long jump, there were no significant difference found for any of the stretching protocols either by time ($F_{(1.3,45)} = 1.252$, $p = .291$) or group by time interaction ($F_{(1.3,3.9)}$, = 1.002, $p = .429$). The results that were found did not support the hypothesis that the dynamic-plus-ballistic stretching protocol would show higher long jump scores over the other conditions.

Discussion

The purpose of this study was to determine if a specific stretching protocol had a greater effect on short term power in active college aged students. This study aimed to assist coaches make more informed decisions on the stretching protocol to use in the warm-up. With almost all sports and activities, stretching should be performed before participation, in hopes that it will increase the level of performance by the participant (Carvalho et al., 2012). Through much of the research on stretching, dynamic and static stretching protocols are most often studied, and most conclude that dynamic stretching is more beneficial for the production of short term power. The concern with the previous literature is the activities that many researchers are using in the “dynamic” protocol are ballistic movements. Faigenbaum et al. (2006) suggests that one way that dynamic has an improved performance in majority of research is due to post activation potential. This occurs when moderate to high intensity stretches are completed leading to an environment suitable for force production. By increasing the fast twitch response to power activity, an exercise that requires large amount of power fast could benefit from the potential to improve performance. This would also be true for ballistic movements, thus providing the rationale for our purpose and hypothesis.

From the results, it was found no difference in vertical jump or long jump scores across the four stretching protocols (static-only, dynamic-only, ballistic-only, and dynamic-plus-ballistic). Previous literature has shown increase in short term power in dynamic stretching protocols when compared to static stretching protocols, and in a combination of dynamic and ballistic stretches Andrejic, 2012; Behm, et al., 2011; Bishop & Middleton, 2013; Carvalho, et al., 2012; Faigenbaum, et al., 2005; Ertugrul, 2011; Hough, Ross, & Howatson, 2011; McMillian, Moore, Hatler, & Taylor, 2006; Pagaduan, Pojskic, Uzicanin, & Babajic, 2012; Ryan et al., 2014; Sudhakar & Padmasheela, 2012; Taylor et al., 2009; Vanderka, 2011). Other research by Paradisis et al. (2014) and Turki-Belkhira et al. (2014) supported this study’s findings when they found that dynamic stretching had no improvement over static stretching when compared to vertical and long jump. The data collected on long jump in the current study, also, did not support previous research that showed long jump improving with dynamic stretching and decreasing with static stretching (Faigenbaum et al., 2005).

It is possible that our participants experienced a learning effect on their jumping. The effect was minimized due to practice jumps, but participants may have become for comfortable with the test the more sessions they attended. It is possible other confounders affected our data collection. Participants were exercise science students from a particular class, and even in smaller groups, there was a wait period for participants to complete the vertical jump assessment. Additionally, it is possible that allowing the participants multiple jumps for each test created an additional “warm-up” effect. This effect could have been minimized by allowing the participant no more than two jumps for each test, with the highest score recorded. This would also be more generalizable, as game-like or activity conditions may not allow for repeated attempts at muscular power production. There was a high percentage of attrition of those that started the study (n=55) but did not complete all four protocols (n = 17; 32%).

Limitations of this study included the attrition of participants across the protocols, effort put forth by participants during each test, inability to blind participants to which group they belonged. Finally, participants were healthy college students, not athletes. This limits the ability to generalize our findings to the athletic population.

Strengths of the study include the sample size and the cross-over treatment design. Most research on stretching protocols have used sample sizes of 10 – 30 participants. The robust sample of 38 shows to be a strength of the current study. Additionally, because there was a randomized, cross-over design, can be confident there was no unexplained differences between groups. The use of healthy college males and females allows generalization to generalize to the entire general population.

Conclusion

The results of this study suggest that static-only stretching, dynamic-only stretching, ballistic-only stretching and combination of ballistic and dynamic stretching will not improve vertical jump heights, or long jump distance for participants. These findings are similar to the studies by Paradisis et al. (2014) and Turki-Belkhira et al. (2014). This study's findings suggest that participants can complete any of the four stretching protocols in their warm-up and not influence their overall performance in power activity. Future research should continue to compare all protocols, specifying differences in static-only, dynamic-only, and ballistic-only stretching.

Table 1

Static-only Protocol

Static Stretches	**Description**	**Time Held / Reps**
Quadriceps stretch	In the standing position bend one knee and bring the heel to the buttocks then grab and hold the heel with the same side hand.	30 seconds / 2
Hip Flexor and Calf stretch	In the standing position participant puts left leg out while lunging towards the left leg, while attempting to push heel towards the ground. Then switch.	30 seconds / 2
Hamstring stretch	In a seated position have both legs out in front, and the participant leans forward towards their toes while keeping their back straight.	30 seconds / 2
Figure four stretch	In a supine position bring the left ankle over the right knee, then pull the right knee up towards the right shoulder while bringing the left knee to the left shoulder. Repeat on the opposite side.	30 seconds / 2
Adductor stretch	While seated the participant brings the bottom of their feet together and pushes their knees outward towards the ground.	30 seconds / 2

Note: Stretches from Faigenbaum et al., 2005; Ertugrul, 2011

Table 2

Dynamic-only Protocol

Dynamic Stretches	**Description**	**Distance/Reps**
Knee Hug	While walking forward bring knee to chest and pull knee towards chest with hands, and each step alternate	Half a basketball Court/ 1
Walking quad pull	While walking forward, participant pulls leg towards, then alternates legs.	Half a basketball Court/ 1
Toe touch kicks	Participant walks forward kicking leg straight out and up till it hits their hands that are out straight. Repeat on opposite leg.	Half a basketball Court/ 1
Walking lunge	Participants moved forward while going into a lunge position, then returning to starting position and using opposite leg	Half a basketball Court/ 1

Note: Stretches from Faigenbaum et al., 2005; Ertugrul, 2011; McMillian et al., 2011

Table 3

Ballistic-only Protocol

Ballistic stretches	**Description**	**Distance/Reps**
Butt kick	Heel ups. Rapidly kick heels towards buttocks while moving forward	Half a basketball Court/ 1
Carioca	Participant moves laterally while crossing feet in front of each other. Repeat in opposite direction	Half a basketball Court/ 1
High knee run	While jogging forward bring knee to chest, and each step alternate	Half a basketball Court/ 1
Power Skip	Leading with your right leg, skip as high as you possibly can by raising your right knee to hip height and simultaneously extending your left arm straight overhead	Half a basketball Court/ 1

Note: Stretches found from Faigenbaum et al., 2005; Ertugrul, 2011; McMillian et al., 2011; Turki-Belkhiria et al., 2014

Table 4

Combination Protocol

Combination Stretch	**Description**	**Distance/Reps**
Knee Hug	While walking forward bring knee to chest and pull knee towards chest with hands, and each step alternate	Half a basketball Court/ 1
Walking Quad Pulls	While walking forward, participant pulls leg towards, then alternates legs.	Half a basketball Court/ 1
Walking Lunge	Participants moved forward while going into a lunge position, then returning to starting position and using opposite leg	Half a basketball Court/ 1
Toe Touch Kicking	Participant walks forward kicking leg straight out and up till it hits their hands that are out straight. Repeat on opposite leg.	Half a basketball Court/ 1
Butt kick	Heel ups. Rapidly kick heels towards buttocks while moving forward	Half a basketball Court/ 1
Carioca	Participant moves laterally while crossing feet in front of each other. Repeat in opposite direction	Half a basketball Court/ 1
High knee run	While jogging forward bring knee to chest, and each step alternate	Half a basketball Court/ 1
Power Skip	Leading with your right leg, skip as high as you possibly can by raising your right knee to hip height and simultaneously extending your left arm straight overhead	Half a basketball Court/ 1

Table 5

Descriptive Statistics

	Mean	SD	N
LJ Static	76.342	1.58818	38
LJ Dynamic	77.500	1.56771	38
LJ Ballistic	77.32	1.5724	38
LJ Combination	78.42	1.5629	38
Vertical Jump Static	22.329	5.0273	38
VJ Dynamic	22.17	4.311	38
VJ Ballistic	22.12	5.212	38
VJ Combination	22.12	5.155	38

Note: LJ= long jump; SD= standard deviation; N= number of participants

Table 6

Tests of Within-Subjects Effects Vertical Jump

	Source	Type III Sum of Squares	df	Mean Square	*F*	Sig.
tests	Sphericity Assumed	1.625	3	.542	.310	.818
	Greenhouse-Geisser	1.625	2.595	.626	.310	.789
	Huynh-Feldt	1.625	3.000	.542	.310	.818
	Lower-bound	1.625	1.000	1.625	.310	.582
tests * Group	Sphericity Assumed	15.879	9	1.764	1.009	.438
	Greenhouse-Geisser	15.879	7.785	2.040	1.009	.434
	Huynh-Feldt	15.879	9.000	1.764	1.009	.438
	Lower-bound	15.879	3.000	5.293	1.009	.401
Error(tests)	Sphericity Assumed	178.365	102	1.749		
	Greenhouse-Geisser	178.365	88.233	2.022		
	Huynh-Feldt	178.365	102.000	1.749		
	Lower-bound	178.365	34.000	5.246		

Table 7

Tests of Within-Subjects Effects Long Jump

	Source	Type III Sum of Squares	df	Mean Square	*F*	Sig.
tests	Sphericity Assumed	194.509	3	64.836	1.252	.302
	Greenhouse-Geisser	194.509	1.300	149.607	1.252	.291
	Huynh-Feldt	194.509	1.657	117.376	1.252	.297
	Lower-bound	194.509	1.000	194.509	1.252	.281
tests * Group	Sphericity Assumed	466.889	9	51.877	1.002	.453
	Greenhouse-Geisser	466.889	3.900	119.703	1.002	.429
	Huynh-Feldt	466.889	4.971	93.915	1.002	.437
	Lower-bound	466.889	3.000	155.630	1.002	.419
Error(tests)	Sphericity Assumed	2330.558	45	51.790		
	Greenhouse-Geisser	2330.558	19.502	119.503		
	Huynh-Feldt	2330.558	24.857	93.758		
	Lower-bound	2330.558	15.000	155.371		

Appendices

Appendix A
Informed consent & Debriefing Form

Winthrop University
Informed Consent Agreement

Researcher: Zachary Hartman ☒Graduate Student ☐Undergraduate Student
Faculty Advisor: Dr. Joni Boyd Faculty Advisor's Position: Associate Professor for PESH

Title of Study: Effects of Different Dynamic Stretching on Short Term Power

You are invited to take part in a research study. Before you decide to be a part of this study, you need to understand the risks and benefits. This consent form provides information about the research study. I will be available to answer your questions and provide further explanations. If you take part in this research study, you will be asked to sign this consent form. Your decision to take part in this study is voluntary. You are free to choose whether or not you will take part in the study. If you should decide to participate, you may withdraw from the study at any time.

Purpose of the research study:

Examine if flexibility dynamic stretching or power specific dynamic stretching (ballistic) will have a greater effect on short term power. Power will be tested with the Vertical Jump Test, and Standing Long Jump Test.

Procedures or methods to be used in the study:

Volunteer participants will be randomly assigned to one of four treatment groups: static stretching only, dynamic stretching only, ballistic stretching only, and dynamic and ballistic stretching combination. Participants will complete a jog at their own pace before they begin each protocol. Groups will meet four times, and go through specific protocol of each stretching treatment. Following treatment, groups will then be tested on power through the vertical jump test and standing long jump test. The vertical jump test will have participants jump multiple times attempting to hit slats on the vertec apparatus. The test will be over after the participant fails to hit a higher slat after two consecutive jumps. The standing long jump will have the participant jump as far forward as they can three times. The best jump will be recorded.

Possible Risks/Benefits Associated with Participating in Study:

Possible risks include, fatigue, loss of breath, injury from stairs or falling, sweating, strained muscles or sprains. These injuries may occur due to incorrect landing during the standing long jump or vertical jump. Both of these tests will minimize the risk by having a spotter during each jump. Any injury occurances during the study must go through your own insurance. Possible benefits is aiding research understand if dynamic or ballistic stretching give better results for short term power.

Possible Costs/Compensation Associated with Participating in Study:

Participants will have no cost to them. If injured, and require medical attention; the participant will need to pay for that care through their own insurance.

Number of questions in the survey/questionnaire and anticipated time to complete the survey/questionnaire: Participants will complete two questionnaires that are designed to make sure they are healthy enough for participation in the study. It should take about five minutes to complete both questionnaires.

Right to withdraw from the study:

You have the right to withdraw from this study at any time without penalty. Participants also have the right to refuse participation in this study.

Privacy of records or other data collected in the study:

All records and data obtained will be visible only to those involved in the research (Zachary Hartman and Joni Boyd). All names will be assigned a randomized number to keep their privacy.

Questions – contact information:

If you have any questions about this study, you may contact me using my Winthrop email account: Zachary Hartman

Or through my faculty advisor:
Address: 216L West Center
Work Phone: Email:

You may also contact:

Deborah Broome, Compliance Officer 803-323-2398
Sponsored Programs and Research broomed@winthrop.edu
Winthrop University
Rock Hill, SC 29733

Signatures:

By signing this consent agreement, you agree that you have read this informed consent agreement, you understand what is involved, and you agree to take part in this study. You will receive a copy of this consent form.

____ ________

Signature of Participant Date

____ ________

Signature of Researcher Date

Debriefing Form

Thank you for participating in our The Effect of Four Different Stretching Protocols on Muscular Power!

Dynamic stretching has shown to be superior to static stretching in research thus far. What has not been researched enough, is if flexibility-specific dynamic stretching is better than power-specific dynamic stretching for short term power tests. The purpose of the study is to compare how the different stretching protocols effect power results. The Speed Test, Vertical Jump Test, Margaria Kalaman Test and Long Jump Test will accurately assess the different effects that specific dynamic stretching has on the participant's body. The results will aid us in determining if one type of stretching has any significant changes in short term power.

If you are interested in learning the results of this study, please contact the researchers after April 30th

Researchers:

Zachary Hartman

If you have any concerns regarding this study, please contact the faculty advisor or the Director of Sponsored Programs and Research.

Faculty Advisor:

Dr. Boyd

Sponsored Programs & Research:
Deborah Broome, Compliance Officer
(803) 323-2398
broomed@winthrop.edu

If anything about this survey caused you to feel uncomfortable, health and counseling services are available to you on the 2nd floor of Crawford. You can reach Counseling Services at (803) 323-2233 or get information at http://www.winthrop.edu/hcs/counselingservices-home.htm. All counseling services are free and confidential.

Appendix B
Health Screening Questionnaire, PAR-Q, & Injury Questionnaire

AHA/ACSM Health/Fitness Facility Preparticipation Screening Questionnaire*
(Medical History Form)

Assess *your health status by marking all true statements*

History

You have had:

a heart attack
heart surgery
cardiac catheterization
__ coronary angioplasty (PTCA)
__ pacemaker/implantable cardiac defibrillator, or rhythm disturbance
__ heart valve disease
___ heart failure
___ heart transplantation
___ congenital heart disease

Symptoms

You experience chest discomfort with exertion. You experience unreasonable breathlessness. You experience dizziness, fainting, or blackouts. You take heart medications.

Other Health Issues

You have diabetes.
___ You have asthma or other lung disease.
___ You have burning or cramping sensation in your lower legs when walking short distances
You have musculoskeletal problems that limit your physical activity
You have concerns about the safety of exercise.
You take prescription medication(s).
___ You are pregnant.

If you marked any of these statements in this section, consult your physician or other appropriate health care provider before engaging in exercise. You may need to use a facility with a **medically qualified staff.**

Cardiovascular Risk Factors

You are a man older than of 45 years.
You are a woman older than 55 years, have had a hysterectomy, or are postmenopausal.
You smoke, or quit smoking within the previous 6 months.
Your blood pressure is > 140/90 mmHg.
You do not know your blood pressure.
You take blood pressure medication.
Your blood cholesterol level is > 200 mg/dl.
You do not know your cholesterol level.
You have a close blood relative who had a heart attack or heart surgery before age 55 (father or brother) or age 65 (mother or sister).
___ You are physically inactive (i.e., you get < 30 minutes of physical activity on at least 3 days per week.)
___ You are > 20 pounds overweight.

If you marked two or more of the statements in this section you should consult your physician or other appropriate health care provider before engaging in exercise. You might benefit from using a facility with a **professionally qualified exercise staff*** to guide your exercise program.

None of the above

You should be able to exercise safely without consulting your physician or other appropriate health care provider in a self-guided program or almost any facility that meets your exercise program needs.

** Professionally qualified exercise staff refers to appropriately trained individuals who possess academic training, practical and clinical knowledge, skills, and abilities commensurate with the credentials defined in Appendix F of the ACSM Guidelines 2000.

*Modified from American College of Sports Medicine and American Heart Association. (1998).

Physical Activity Readiness Questionnaire (PAR-Q) and You

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their doctor before they start becoming much more physically active.

If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below. If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start. If you are over 69 years of age, and you are not used to being very active, check with your doctor.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly:

YES	NO		
☐	☐	1.	Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?
☐	☐	2.	Do you feel pain in your chest when you do physical activity?
☐	☐	3.	In the past month, have you had chest pain when you were not doing physical activity?
☐	☐	4.	Do you lose your balance because of dizziness or do you ever lose consciousness?
☐	☐	5.	Do you have a bone or joint problem that could be made worse by a change in your physical activity?
☐	☐	6.	Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?
☐	☐	7.	Do you know of any other reason why you should not do physical activity?

If you answered:

YES to one or more questions

Talk to your doctor by phone or in person BEFORE you start becoming much more physically active or BEFORE you have a fitness appraisal. Tell your doctor about the PAR-Q and which questions you answered YES.

- You may be able to do any activity you want – as long as you start slowly and build up gradually. Or, you may need to restrict your activities to those which are safe for you. Talk with your doctor about the kinds of activities you wish to participate in and follow his/her advice.
- Find out which community programs are safe and helpful for you.

NO to all questions

If you answered NO honestly to all PAR-Q questions, you can be reasonably sure that you can:

- Start becoming much more physically active – begin slowly and build up gradually. This is the safest and easiest way to go.
- Take part in a fitness appraisal – this is an excellent way to determine your basic fitness so that you can plan the best way for you to live actively.

Delay becoming much more active:

- If you are not feeling well because of a temporary illness such as a cold or a fever – wait until you feel better; or
- If you are or may be pregnant – talk to your doctor before you start becoming more active.

Please note: If your health changes so that you then answer YES to any of the above questions, tell your fitness or health professional. Ask whether you should change your physical activity plan.

Informed use of the PAR-Q. Reprinted from ACSM's Health/Fitness Facility Standards and Guidelines, 1997 by American College of Sports Medicine

Injury Questionnaire

Have you injured or had surgery on your lower extremity within the last six months?

YES NO

If YES, please describe

Appendix C
Flyer

FALL 2016
PARTICIPATE IN POWER RESEARCH

Power Testing
Opportunity to participate in graduate research looking at power in college students ages 18-25.

- Are you a male between the ages of 18-25?
- Is you BMI between 18.5 and 30?
- Have you been injury free from orthopedic problems, chronic diseases such as coronary heart disease, diabetes and lung disease?

If you meet below criteria, please contact us to participate

Participants will complete a warm-up, stretching protocol, and 2 power jump tests.

CONTACT:
Zachary Hartman

References

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