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THE EFFECTS OF STATIC STRETCHING FOLLOWED BY DYNAMIC STRETCHING ON JUMPING PERFORMANCE

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CHAPTER I

INTRODUCTION

The warm-up prior to more intense exercise has consistently been identified as an essential aspect of a workout session. The American College of Sport Medicine recommends a warm-up consisting of 5-10 minutes of light to moderate intensity aerobic and muscular endurance activity. The purpose of the warm up is to help to prepare the body for exercise. It is a transitional phase that allows the body to adjust to the changing physiologic, biomechanical, and bioenergetic demands placed on it during the conditioning or sports phase of the exercise session (Pescatello & American College of Sports Medicine, 2014, p. 164).

In general, a warm-up alerts the body that exercise is beginning, from both physical and psychological perspectives. A proper warm up can also have positive effects on performance that result from faster muscle contraction and relaxation of both agonist and antagonist muscles, improvements in the rate of force development and reaction time, improvements in muscle strength and power, lowered viscous resistance in muscles, and improved oxygen delivery. These effects can combine to improve performance of a variety of activities (Baechle, Earle, & National Strength & Conditioning Association 2008, p. 296).

Proper warm-up can also help to reduce the possibility of injury. Woods, Bishops, & Jones (2007) discussed the relationship between the use of a warm-up period and injury prevention. They found that the warm-up was beneficial for injury prevention because of increased speed and force of muscle contractions resulting from increased nerve transmission speeds. The muscles become less viscous, which results in smoother contractions. Muscle temperature increases, which produces increased blood flow through active tissue and also facilitates the dissociation of oxygen from hemoglobin. Finally, a warm-up provides a protective mechanism to muscle by requiring a greater length of stretch and force to produce a tear in the warmed muscle. These factors may combine to facilitate the prevention of muscular and joint injuries.

Many people feel the need to perform static stretching prior to exercise and this may be because of the popular notion that stretching prior to exercise will reduce the risk of injury. Static stretching is the slow stretching of a muscle or tendon group and holding the position for a period of time (i.e., 10-30 s) (Pescatello et al., 2014). In 2010, McHugh and Cosgrave reviewed the role of stretching in injury prevention and found that stretching before performance may impact some types of injuries and not others. They stated that there is a good rationale for why stretching could impact the risk of sustaining a muscle strain. One plausible theory they gave was that stretching makes the muscle tendon unit more compliant, with the increased compliance allowing for greater relative force production at longer muscle lengths. Subsequently the enhanced ability to resist excessive muscle elongations may decrease the susceptibility to a muscle strain (McHugh & Cosgrave, 2010).

Researchers have also conducted studies investigating the relationship between static stretching and skill performance. Young and Elliot (2001) found that static stretching prior to jumping produced a significant decrement in jumping performance. Simic, Sarabon, and Markovic (2013) suggested that based off their meta-analytical review that there is clear evidence that static stretching before exercise has significant and practically relevant negative acute effects on maximal muscle strength and explosive muscular performance, and that use of static stretching as the sole activity during warm-up routine should generally be avoided.

Dynamic stretching is meant to mimic the movements of exercise. It is a functionally based stretching technique that uses sport specific movements to prepare the body for activity (Baechle et al., 2008). Amiri-Khorasani & Kellis (2013) looked at static versus dynamic stretching in soccer players, and concluded that dynamic stretching as compared to static stretching caused higher muscle activation to perform maximum effort due to post-activation potentiation. Hence, dynamic stretching during a warm up created higher ball kick velocity by higher muscle activation. The main finding was that dynamic stretching of the quadriceps resulted in increased quadriceps muscle activation, as well as maximum knee and ankle angular velocity and maximum ball velocity during an instep soccer kick. Furthermore, dynamic stretching elicited a higher increase in rectus femoris muscle activity as opposed to the vastus medialis and vastus lateralis muscles (Amiri-Khorasani & Kellis, 2013).

Leone et al. (2012) and Curry, Chengkalath, Crouch, Romance and Manns (2009) examined the effects of dynamic and static stretching separately within their studies. Leone et al. (2012) used between-subjects design utilizing a static stretching group, a dynamic stretching group and a non-stretching group and examined the effects on muscle activity. Before and after the stretching protocols, a maximal voluntary isometric contraction was completed using the bench press exercise. The static group performed stretches for two sets, with each set held for a duration of 30s with a 15s rest in between. The dynamic stretch group performed 10 repetitions with a slow-to-moderate velocity, for each of the two different dynamic stretching exercises, resulting in a total set duration of 60s. The results show that static stretching was shown to have a decrease in maximal isometric contractions by nearly 6%, and the average EMG of the pectoralis major, the long head of the triceps brachii and the lateral head, measured significant decreases of 16,4%, 17.4% and 9.5% respectively. These findings coincide with previous results found by Simic et al. (2013). The results also show negative effects for dynamic stretching as well, but not to the same magnitude (only 4% decrease in maximal isometric contraction and no change in EMG from pre- to post-stretching). But these findings only show performance based on isometric contractions not dynamic contractions.

Curry et al. (2009) used a within-subject design to compare three warm up protocols, static stretching, dynamic stretching and aerobic activity on maximum muscle production. For the static stretches, each stretch was held for 12 seconds and repeated 3 times, targeting six muscle groups in the lower extremities. The dynamic stretching protocol consisted of 10 minutes of controlled movement through the active range of motion for each muscle group. Finally, the aerobic protocol consisted of 10 min of cycling at 70 rpm. The results showed that the dynamic stretching protocol produced improved scores for a counter movement jump and time to peak force, while static stretching produce a decrement in performance. For all protocols, range of motion was measured, and all showed a similar and statistically significant increase in ROM.

Wong, Chaouachi, Lau, and Behm, (2011) looked at the combination of the two stretching types. In this study the goal was to examine the effect of different durations of static stretching followed by dynamic stretching on functional performance measures such as repeated sprint performance and change of direction. A within-subject design was used for this study, with static stretching durations of 10s, 20s, and 30s followed by 30s of dynamic stretching. The authors found that these combinations neither adversely affected nor facilitated performance in repeated sprint or change of direction, and attributed that result to counterbalancing of possible static stretching-induced impairments with possible dynamic stretch induced facilitation. They also indicated that the short duration of static stretching may not have elicited performance impairments. Similarly, the short duration of dynamic stretching may not have provided sufficient stimulus to elicit performance facilitation.

While dynamic stretching alone has been shown to facilitate jumping performance, no previous studies have shown that a combination of static stretching followed by dynamic stretching will impact the performance of counter movement jumping. Given the popular notion that static stretching will help to reduce the risk of injury if done prior to exercise, and given that there are acute negative effects of static stretching on performance, it is important to attempt to determine whether a balance can be struck between injury prevention and performance maintenance for this type of activity. Thus, the purpose of this study was to assess whether dynamic stretching conducted after static stretching would impact jumping performance. It was hypothesized that the negative effects of static stretching on jumping performance would be reduced with the addition of dynamic stretching immediately following the static stretching session. This is assuming that static stretching will negatively affect performance as shown in previous research.

CHAPTER II

METHODS

Experimental Design

A within-subject's design was followed for the study. The order of the tests was randomized and counterbalanced in order to account for any ordering effects. The participants were asked to come to the Cancer Rehab Lab on three different occasions. Prior to each testing period, each participant performed an aerobic warm-up consisting of a brisk walk at 3mph on the treadmill for 5 min, after which each participant completed a baseline jump with no stretching protocol. Once the baseline test was conducted the participants completed one of the three protocols, performed in random order: 1) static stretching; 2) dynamic stretching; and 3) static followed by dynamic stretching. Each stretching protocol was demonstrated and guided by the researcher to ensure it was performed correctly. During each testing session, participants performed a standing broad jump. A Nasco Broad jump mat was used to measure each attempt. For each protocol, the participants performed three jumps.

Participants

For this study, 20 participants (13 males, 12 female) were recruited on a volunteer basis from different college undergraduate classes. Informed written consent was obtained from each participant in accordance with the guidelines established by the University Human Subjects Committee.

Static Stretching

Following the warmup and baseline test, each participant completed a 10-minute static stretching protocol consisting of five stretches targeting the muscles groups in the lower body.

The stretching consisted of a hip flexor stretch, gluteal stretch, hamstring stretch, quadriceps stretch, and a calf stretch. Each stretch was held for 30 seconds (time was kept by the researcher). The stretches were performed for each leg, alternating sides from the hip down then repeated. Each stretch was performed to slight discomfort.

Dynamic Stretching

Participants followed the same warmup and baseline test followed by 10 minutes of dynamic stretching consisting of seven exercises. The dynamic stretches consisted of lateral leg swings, front leg swings, high knees, kickbacks, static lunges, body weight squats, and calf raises. Each exercise was performed for 10 repetitions each alternating sides from the hip down.

Static Followed by Dynamic Stretching

Participants conducted the same warm-up protocols as described above. Once the baseline had been established the participants followed the same 10-minute static stretching protocol and then an additional 10 minutes of dynamic stretching.

Post-Test Question

At the conclusion of all three tests, each participant, without knowing their results, was asked which of the three test conditions did they feel prepared them the best for the jump performance. This question was used gain perspective on which protocols, regardless of result, was preferred by each participant.

Data Collection and Analysis

A one-way repeated measures ANOVA was used to examine the jumping performance with the three different protocols. The independent variable for this study was the types of stretching each participant completed, the dependent variable was jumping performance as measured by distance in inches.

CHAPTER III

RESULTS

The baseline jumps were analyzed by one-way repeated measures analysis of variance. From this analysis, the intraclass R and the technical error of measurement were calculated. Once the reliability was assessed, a one-way repeated measures ANOVA was completed between the three conditions.

Reliability

The *R* was 0.988, technical error of measurement (TEM) was 3.536 and percent TEM was 4.89. The baseline data were found to be highly reliable.

Table 1

Treatments

	Count	Mean	Std. Dev.
Baseline	25	72.288	18.570
Static Stretching	25	72.680	19.950
Dynamic Stretching	25	73.280	20.123
Static then Dynamic	25	73.500	19.488

ANOVA

No statistically significant differences were found between baseline mean and any of the 3 condition means (Baseline v. Static: $p = 0.641$; Baseline v. Dynamic: $p = 0.152$; Baseline v. Static/Dynamic: $p = 0.239$) or between any of the three condition means ($p = 0.457$).

CHAPTER IV

DISCUSSION

The purpose of this study was to assess whether static stretching followed by dynamic stretching would impact jumping performance. The major finding of this study was that there was no statistical difference between any of the protocols and the baseline. These results, which coincide with a similar study (Wong et al., 2011), show that static stretching and dynamic stretching, or any combination of the two, does not seem to have any effect on jumping performance. This is important because the main goal of incorporating this into a warm up would be to help facilitate performance and to help prevent any muscular injury.

Wong et al. (2011) stated that this lack of difference could be attributed to the counterbalancing of the negative effects of static stretching, and the positive effects of the dynamic stretching, but the findings of the present study show that neither static nor dynamic stretching to have any significant effect on jumping performance. In the present study, a duration of 30s of stretching per body part was used, it is unclear if this is a long enough duration to facilitate a negative outcome. The duration was chosen based off the ACSMs recommendations for static stretching. Previous studies have used shorter times of 10s and found no conclusive results. It appears that longer duration stretching did not have an impact.

Although there was no significant difference in jumping performance, it is interesting to note the participant's reactions to the various protocols. The participants were unaware of the results of their various jumps, and were asked which of the protocols "…prepared them the best for the jump performance." Only one stated that the static protocol prepared them the best. This participant felt that static stretching loosened them up better than dynamic only, and that the combination was too cumbersome. Nine reported that the dynamic only protocol prepared them the best. They felt that the dynamic stretching warmed them up better than static stretching and that they never really felt warmed up with the static protocol. Two reported that they felt they did equally well on both static and dynamic protocols. They did not give a specific reason, just indicating they felt equally warmed up for both. Thirteen of the participants reported that the combination of static and dynamic stretching was the protocol that they believed gave them the best results. Most felt that more was better when it came to the warmup, and that they felt loosened up and warmed up the most with the combined static and dynamic protocol. Although the results were not statistically significant, this warm-up protocol did yield a slightly higher jump distance than the other two warm-up protocols.

Although there was no significant difference in the jump performance, the participant's response to each protocol is of interest for practitioners. The majority of the participants felt that the combination of the two was the best because of how they felt both physically and psychologically at the time of performance. This can have positive effects on performance from a psychological aspect. Increased confidence, based on a feeling of greater preparedness from the warm-up can potentially facilitate an increased feeling in the potential for a good performance. This can be true for any of protocols, of course, and, as stated earlier, the purpose of the warm up is to help to prepare the mind and body for exercise. Based off the responses from the participants, this can vary from person to person.

This research does have some limitations, age of participants was limited to college aged students, and there was no data collected from outside of this demographic. Because of the younger age, the participants were assumed to be in better overall physical condition. The mix of participants were assumed to have various levels of activity and training, so the results would be generalized to a general population not trained athletes specifically. These result also are limited to horizontal jumping performance. In this study, both male and females were chosen. Assessing only one sex or the other may show different results as the results could have been skewed by having both sexes represented, resulting in little to no change overall. Gender differences in stretching and skill performance have been assessed in high level athletes, but very little research has been done with untrained individuals. While jumping is assumed to be a skill that all college-aged students already understand, each participant was still instructed on how to perform the jump test. It is possible that some participants inherently continued to learn how to perform the jumps better, regardless of the stretch protocol. It is also hard to determine how intense each stretch was per individual. Some individuals might be able to hold an intense stretch longer than others, therefore, there is no way to generalize the stretch routine to ensure that each participant is conducting the stretch exactly the same. More research is still needed to determine at what stretching duration does performance begin to be hindered by static stretching and at what duration does dynamic begin to help performance.

CONCLUSION

Although there was no difference in protocols and performance, a warm up is still a very important part of the workout. Not only does it help prepare the body for exercise, and potentially help to prevent injury, it also prepares the mind, which could have some positive effects on performance. The responses from the participants would indicate that adding static stretching and dynamic stretching the most popular choice, but each person should find what is most comfortable for them and follow that.

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