*IOSR Journal of Sports and Physical Education (IOSR-JSPE)*
*e-ISSN: 2347-6737, p-ISSN: 2347-6745, Volume 3, Issue 2 (Mar. – Apr. 2016), PP 13-18*
*www.iosrjournals.org*

# Effect Of Acute Dynamic And Static Stretching On Maximal Muscular Power In Recreational Athletes

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***Abstract:****Stretching promotes increased ROM, muscle temperature, and decreased stiffness of the exercised muscle. It reduces the risk of injury, alleviates pain, and improves athletic performance. The most common stretching types used prior to exercise are static and dynamic. By identifying the most beneficial type of stretching for a given exercise bout, therapists can utilize techniques to enhance stretches as they relate to strength and power performance. The purpose of this study was to determine the acute effect of dynamic and static stretching on maximal muscular power which is evaluated by peak jump height in college age recreational athletes.60 participantsmeeting the inclusion and exclusion criteria were allocated into 3 groups 20 each. Group A: Warm up+Dynamic Stretching, Group B: Warm up+Static Stretching, Group C: [Control group]: Warm up+no stretching. Stretching of Gluteus maximus, Quadriceps, Hamstrings, Hip flexors, Dorsiflexors, Latissimus dorsi were done. Pre intervention verticaljump height for Group A, B and C was compared to their post intervention verticaljump height showed significant improvement. On comparison Group A showed significant improvement as compared to Group B and C. The study concluded that dynamic stretching improves the maximal muscular power and thus providing opportunities to act preventively with appropriate training program and to prevent adverse strength deficit.*

***Keywords:****Dynamic stretching, Maximal muscular power,Static stretching, Vertical jump*

## I. Introduction

Is stretching beneficial to athletes when performing explosive type activities? This question has become a hot debate topic among physical trainers over the past years.[1]The warm-up prior to the performance of physical activity is widely accepted as a contributor to achieving maximal muscular power production, and ultimately, optimal athletic performance.[2] An active warm-up prepares the body to increase elasticity and contractibility of muscles, increase the efficiency of respiratory and cardiovascular systems, and improve coordination.[3] Warm-ups typically contain two components: low intensity aerobic activity; and stretching. Low intensity aerobic activity is widely accepted as a method that gradually raises metabolism by increasing cardiorespiratory demand, and allows for increased work output in strength and power activities such as weight training or jumping. Stretching promotes increased range of motion, muscle temperature, and decreased stiffness of the exercised muscle. [4] For many years, stretching before athletic competition has been recommended to prepare the athlete for the event. It is thought that stretching reduces the risk of injury, decreases muscle stiffness, increases range of motion, alleviates pain, and improves athletic performance. Despite recent inconclusive evidence of the benefits of stretching, the American College of Sports Medicine (ACSM) still adopts the idea of stretching before or after competition. In addition, the National Strength and Conditioning Association (NSCA) guidelines state that stretching before competition will improve performance and functional abilities. Other research has been conducted to determine which type of stretching, static or dynamic, is better for improving strength, speed, power, and force production. To my knowledge, very few studies have looked at the effects of static versus dynamic stretches on vertical jump and standing long jump, two of the most common ways to measure lower extremity power production. [5] Stretching exercises are commonly prescribed during warmup and cool-down protocols, and training and rehabilitation programmes, with the aim of improving muscle extensibility and joint range of motion (ROM). [6]

An individual's ability to produce the greatest amount of force in the shortest amount of time is highly predictive of performance in activities that require stretch shortening properties of the muscle-tendon unit, such as vertical jumping or sprinting [7]. So in this study in order to measure the maximal muscular power vertical jump test is used. Also for measuring the explosive strength and power various *isokinetic devices* and high level equipment's are required with proper laboratory settings whereas Vertical jump test has advantage that can be easily used for *on field* testing with minimal equipment's. The test is simple and very easy to perform and cost effective.

The most common stretching types used prior to exercise are static and dynamic. Static stretching methods are classified as active and passive and are used to develop static flexibility. Static active stretching involves taking a limb to its fullest range of motion and holding it without any external force. [8] This method uses tension of the agonists and synergists while the antagonists are being stretched. Static passive stretching involves taking a limb into its fullest range of motion and holding it by the use of external force. This method uses one's own bodyweight or the use of a partner to maintain a stretched position. The effectiveness of static passive stretching of the lower limbs prior to maximal knee extension and vertical jump has been demonstrated by increased range of motion and decreasing stiffness at a joint. In contrast, passive static stretching has shown decreased force production, velocity, as well as power production suggesting a decline in the performance. [9]

Dynamic stretching involves moving the limb repeatedly through its fullest range of motion by gradually increasing distance and speed of movement. Unlike static stretching, the agonist and synergist muscles actively contract (shorten and lengthen) while an antagonist relaxes. Dynamic stretching does not appear to decrease power production, and in most cases has shown improvements in power production relative to vertical jump and sprint performance. [7]

To date, there is scarcity of studies which evaluatedthe effects of an acute bout of dynamic or static stretching on power performance in recreational athletes in college going population. Based on previous literature, dynamic stretching appears to have no power performance decrements compared to static stretching. [13] The change in maximal power due to an acute dynamic and static stretching protocol prior to maximal vertical jump may offer insight to neuromuscular adaptations associated with execution of maximal muscular power exercise movements. This may help the recreational athletes who are unaware and not trained properly to know the appropriate type of stretching needed to improve their on-field performance.

## II. Methodology

60participants were randomly selectedfrom Dr.A.P.J. AbdulKalam College Of Physiotherapy. The sample group included participants who fulfilled the inclusion criteria of age 18-25 years, able to understand the instructions, individuals with normal body mass index values (18- 25) and individuals involved in any kind of recreational athletic activities. Those individual with previous lower extremity injuries and bone or joint disorders and individuals not involved in any kind of recreational athletic activities were excluded from this study.

### a. Materials

Consent form, Data collection sheet, Weighing machine, Static cycle, Plinth, Stopwatch, Measuring tape, Chalk to mark on the wall

### b. Procedure

A prospective comparative design compared the effects of an acute stretching routine on muscular power in a sample of recreational college age athletes.Ethical approval was obtained from Institutional Ethical committee(Intern/2015/01). Participants were randomly assigned into one of three groups: 1) General warm-up + dynamic stretch; 2) General warm-up + static stretch; and 3) Control Group (General warm-up + no stretch) with sample size of 20 in each group. Participants reported individually for testing on two separate days. On the first visit, participants were provided an overview of the study. Potential risks and benefits and underlying rationale for the investigation were explained to all participants where upon their informed written consent to participate were obtained. Practise session of vertical jump test was also given. Consent, anthropometrics, a practice orientation session was conducted. On the second visit, pre-testing assessment was done and then the stretching protocol program was conducted followed by post-testing.

**Diagram#1**

| SESSION 1 (Orientation) | SESSION 2 |
|---|---|
| • Informed Consent<br>• Anthropometric<br>• Orientationpractice session | • GeneralWarm-up<br>• Pre test<br>  ○ Vertical jump<br>• Stretching Session<br>• Post test<br>  ○ Vertical jump |

❖ **Pre-intervention Assessment**

➢ **Vertical Jump**

To prepare for vertical jump testing, participants performed three to five submaximal practice jumps to ensure proper technique.

The individual stands side on to a wall and reaches up with the hand closest to the wall. Keeping the feet flat on the ground, the point of the fingertips is marked or recorded. This is called the "Standing Reach Height".

The individual then stands away from the wall, leaps vertically as high as possible using both arms and legs to assist in projecting the body upwards. The jumping technique can or cannot use a countermovement. Attempt to mark with the chalk on wall at the highest point of the jump. The difference in distance between the standing reach height and the jump height is the score. The best of three attempts is recorded. [14]

All treatment groups (control, static, and dynamic) began with the pre-test and then with a five-minute warm-up on an upright cycle at a speed of 70 revolutions per minute and a resistance that raised the heart rate to 110 + 5 beats per minute in order to raise muscle temperature prior to their treatment program. Following the warm-up period, participants immediately began their stretching treatment that lasted approximately 12 minutes. The control group remained seated for the 12 minutes.

For the static stretching protocols, participants stretched the specified muscle of the right leg and held it for 20 seconds. After a 10 second rest period the same stretch was repeated for the left leg. For dynamic stretching protocols, participants contracted the antagonist of the target muscle. Flexion and extension of the joint occurred every two seconds for 20 seconds (approximately 10 repetitions) to allow the target muscle to be placed on a stretch. The procedure was performed on the right leg first followed by the left leg with a rest period of 10 seconds. Following the stretching protocol, vertical jump was measured within the five minutes.

The order and description of static and dynamic stretching protocols was as followed:

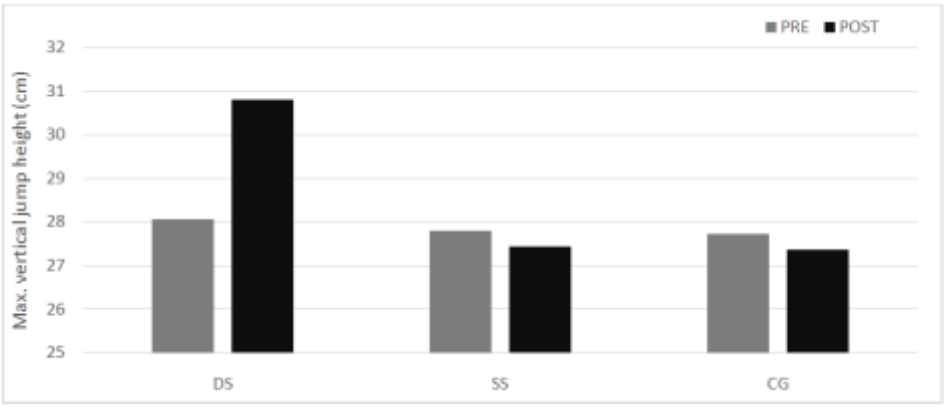
1. Supine hip flexion with bent leg- *Static*- Subject will lie supine with legs extended. They will bend the knee and grab underneath the left thigh while bringing the knee into the chest to stretch the gluteus maximus. *Dynamic*- Subject will lie supine with legs extended. They will repeatedly bend the knee into the chest and return to full extension without pausing to stretch the gluteus maximus.
2. Supine hip flexion with straight leg- *Static*- Subject will lie supine with legs extended. They will grab underneath the left thigh and bring the straight leg into the chest to stretch the hamstrings. *Dynamic*- Subject will lie supine with legs extended. They will repeatedly swing the straight leg into the chest and back to the floor without pausing to stretch the hamstrings. Head and neck will remain on the floor during either stretch.
3. Knee flexion- *Static*- Subject will lie on their side with both legs extended. They will grab their left shin with their left hand and bring their heel to their buttocks to stretch their quadriceps. *Dynamic*- Subject will lie on the chest with arms at side and both legs extended. They will repeatedly bend their knee to touch the heel to their buttocks and back to the floor without pausing to stretch the quadriceps. Head and neck will remain on the floor during either stretch.
4. Lunge with knee on floor- *Static*- Subject will start with right knee forward and bent with the left knee back and bent on the floor to stretch the hip flexors. They will slowly push their left hip forward with their hands resting on their right thigh. *Dynamic*- Supine hip extension- Subject will lie on the chest with both legs extended. They will repeatedly raise one leg off the floor and back without pausing to stretch the hip flexors.
5. Supine dorsiflexion with cord- *Static*- Subject will sit on floor with left leg extended and right leg bent perpendicularly to the left knee. Subject will lean forward and place the cord around the left toes and pull the toes toward their body to stretch the calves. *Dynamic*- Subject will sit on floor with left leg extended and right leg bent perpendicularly to the left knee. Subject will repeatedly dorsiflex ankle toward their body without pausing and no external resistance to stretch the calves.
6. Standing hip flexion with bent knee. *Static*- Subject will stand and grab below left knee and raise their bent left leg to their chest to stretch the gluteus maximus. *Dynamic*- Subject will stand while repeatedly raising their bent knee into chest and back to the floor without pausing to stretch the gluteus maximus.
7. Standing hip flexion with straight leg- *Static*- Subject will stand and raise their straight leg towards their chest and place it on a platform no higher than hip level to stretch the hamstrings. *Dynamic*- Subject will stand and repeatedly raise their straight leg toward chest and back to the floor without pausing to stretch the hamstrings. Lower back will remain in neutral position throughout both stretches.
8. Standing knee flexion- *Static*- Subject will stand (holding on to a chair), then grab shin and bring their heel to their buttocks to stretch the quadriceps. *Dynamic*- Subject will stand while repeatedly bending their knee so heel will touch their buttocks and back without pausing to stretch the quadriceps. Lower back will remain in neutral position throughout both stretches.
9. Standing Lunge- *Static*- Subject will start with left leg forward and right leg in back with left knee off the floor slowly push left hip forward with hands resting on their right thigh to stretch the hip flexors. *Dynamic*-

Standing Hip Extension- subject will stand while repeatedly extending hip (knee locked) and back to the start position without pausing to stretch the hip flexors.
10. Standing dorsiflexion- *Static*- Subject will stand arm's length away from the wall with left leg forward (bent) and right leg back (straight). They will push the arms straight against the wall while pushing the left hip forward and pressing the left heel to the ground to stretch the calves. *Dynamic*- Subject will stand facing the wall with arms extended on wall while repeatedly raising heels off the ground and back without pausing to stretch the calves.
11. Standing shoulder flexion- *Static*- Subject will stand while raising their arms above their head and interlocking their fingers to stretch the latissimus dorsi. *Dynamic*- Subject will stand while repeatedly raising arms above their head (elbow locked) and back to start position without pausing to stretch the latissimus dorsi.
12. Standing shoulder extension- *Static*- Subject will stand while extending their arms behind them to interlock the fingers and raise arms to chest level to stretch the chest. *Dynamic*- Subject will stand while repeatedly extending arms behind them without pausing to stretch the chest.

TABLEChange in maximum jump height pre and post test in all the three groups.

| STRETCHING TECHNIQUES | No. of participants | Vertical Jump Height (in cm) | | | |
|---|---|---|---|---|---|
| | | PRE | | POST | |
| | | MEAN | SD | MEAN | SD |
| Dynamic Stretching (DS) | 20 | 28.05 | 9.892 | 30.79 | 10.512 |
| Static Stretching (SS) | 20 | 27.785 | 6.416 | 27.435 | 6.525 |
| Control Group (CG) | 20 | 27.71 | 8.825 | 27.36 | 8.925 |

*Warm-up was given to all the three groups




*Changes in max. jump height pre and post test*

Results of the studyshowed mean of the jump height of dynamic stretching group has increased considerably as compared to that of the static stretching and control group, which shows that dynamic stretching helps to increase the maximal muscular power so as to increase the max. jump height. The analysis of all the three groups was done by using ANOVA. The mean of peak jump height of Dynamic stretching group is 28.05, Static stretching is 27.785, Control group is 27.71 and the P value calculated by ANOVA is 0.8124, so it is considered not significant. Variation among maximum jump height means is not significantly greater than expected by chance.

## III. Discussion

The purpose of this study was to determine the effect of acute dynamic and static stretching on maximal muscular power production, jump height in college age recreational athletes.

The main hypothesis was that dynamic stretching for 20 seconds would increase power and jump height compared to static stretching. Results revealed that mean peak power production measured via peak jump height improved following a static (SS) and dynamic (DS) stretching protocol. The DS protocol significantly improved maximum jump height. However, results for mean jump height did not support the hypothesis that dynamic stretching would increase power and jump height. Yet, maximum jump height did significantly improve from dynamic stretching compared to static stretching.

Evidence has shown that muscular peak power performance following static stretching declines compared to no stretching or dynamic stretching routines when major lower body muscle groups were statically stretched for 1-3 sets of 30 seconds with total stretching lasting between five and 10 minutes [7]. Brill, et al.

[20]reported that static stretching of the hamstrings, quadriceps, and calves for 4 ½ minutes (3 sets of 30 seconds) reduced vertical jump performance in male soccer players compared to a no stretch condition. Yamaguchi et al. [12] reported that static stretching of the hip and knee flexors and extensors for 5 minutes (5 exercises of 1 x 30 seconds) demonstrated lower leg extension power compared to dynamic stretching, but were not different than non-stretching. McMillian et al. [20] reported that static stretching of the major muscle groups for eight minutes (8 exercises of 1 x 20-30 seconds) demonstrated lower five step jump performance compared to a dynamic stretch warm-up, yet demonstrated a higher five step jump performance when compared to a no stretch condition. Wilson et al. (1994) suggested that a more compliant system could result in a loss of force production by the contractile component due to altered intramuscular length and velocity conditions. Specifically, these researchers surmise that at a given magnitude of contraction a compliant musculotendinous unit would go through a period of rapid and virtually unloaded shortening which would continue until the elastic components were altered sufficiently to transmit the generated force to the bone.

The apparent mechanisms for performance improvements from dynamic stretching may be due to increased range of motion, avoidance of Golgi tendon organ activation, greater muscle spindle activation, and increased muscle temperature.[10] The increase in range of motion due to dynamic stretching attributes to decreased muscle stiffness in addition to an increase in stretch tolerance.[11] In a study by Yamaguchi[12], et al., a sample population of male recreational athletes improved leg extension power following five dynamic stretching exercises that totalled 4 minutes in duration. Studies of similar sample populations have demonstrated improvements in vertical jump and sprinting following 10 minutes of dynamic stretching. [7] The benefits of dynamic stretching are believed to be the result of greater muscular temperatures and voluntary contraction of the antagonist muscle leading to greater recruitment of fast twitch muscle fibers. [13]

While research supports the effect of stretching, it has been suggested that improvements gained from stretching programmes are short-lived and start to diminish following the cessation of stretching (Rubley et al 2001, Willy et al 2001). Hence it is very important for the trainers to know which type of stretching will be beneficial. In this study the study group is recreational athletes as they are not well trained and unaware of all the professional techniques used for better performance and also these individuals require the effect immediately and for very short bouts. This study will help these athletes to increase their maximal muscular power by acute bouts of dynamic stretches and will thus help them to improve their performance accordingly.

## IV. Conclusion

This study concluded that dynamic stretching given along with warm-up shows significant improvement in results of maximal power than static stretching or no stretch group along with warm-up in recreational athletes who were students of Dr.A.P.J. AbdulKalam College Of Physiotherapy. There was no significant difference between the three test groups. But the means of dynamic stretching group has shown comparatively good improvement in the maximum jump height then compared to the static and the no stretch group.

The limitations of this study are in the present study, it is possible that the static stretching routine was not intense or long enough to sufficiently alter the length tension relationship in order to impair muscle activation and reflex sensitivity, and decrease force production. It is possible that the speed of stretch (2 seconds per stretch) was not adhered to by the subjects and not reinforced consistently by the examiners while dynamic stretch. Instructions provided stated to "stretch until you feel discomfort in the target muscle, but not pain". There are also chances that participants may not have stretched to discomfort given a lack of training or experience with stretching. Sample size may not have been sufficient to show significance between groups for jump height. There are chances of human errors from the examiner as well as from the participants while measuring the height of vertical jump and while marking the highest point on the wall respectively.Further study on the optimum duration of stretching required to increases the muscular power performance can be done.

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