



# Stretching and its Prospective in Muscle Flexibility and Body Fitness: An Exploratory Study

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DOI: <https://doi.org/10.70798/IJOMR/020040012>

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<p><b>Received</b> 28/04/2025</p> <p><b>Accepted</b> 15/05/2025</p> <p><b>Published</b> 09/07/2025</p>	<p><b>Abstract</b></p> <p><i>Over the past few decades, one of the most hotly contested issues in sport science literature has been the impact of static stretching (StS) on ensuing strength and power exercises. This paper carried out the objectives are (1) to compile recent and earlier research on the acute effects of StS impact muscle strength and power performances; (2) to refresh readers' understanding of earlier warnings; and (3) to go over the physiological mechanisms behind short-duration StS when used alone or in conjunction with a comprehensive warm-up regimen. StS has been regarded as detrimental to subsequent strength and power performances for the past 20 years. As a result, it has been advised against using StS before to exercises involving strength and power. Short-duration StS must be used carefully in high-performance athletes, though, because it has mild but noticeable detrimental effects on subsequent strength and power performances, which may affect performance during competition.</i></p> <p><b>Keywords:</b> Muscle Tendons, Power Performances, Static Stretching</p>
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## Introduction

'Stretching' which most of us are familiar with but today we will get to know about why do an individual need stretching? How does it really work in our day-to-day life and what are its benefits (Page, 2012, Hidayatullah et al., 2022, Konrad et al., 2024, 2022, Page, 2012 & Salian et al., 2022, Turci et al., 2023). Stretching is one of the greatest activities of our human body which involves nerves, muscle tendons and maintain a range of motion in between the joints. It keeps our body flexible and healthy (Mcatee, 2014; Arajol, 2014; Gill et al., 2021; Stove et al., 2024). The activity of stretching keeps our body movement swift strengthening the pivotal joints in our body and avoid various parts of our body (muscle groups) from getting stiffed. Stretching of the muscles directly after waking up in the morning after a long sleep is not correct at all. It should be done systematically with proper guidance according to your activities and sports that you are involved in. The various sports activities like football, cricket, gymnastics, aerobics, dance, weightlifting

etc. needs stretching. Muscle groups of our body need to get warmed up before they get involved in any types of stretching or else it may get hurt. When our body remains cold or kept in a relaxed condition for a long time the fibers are not prepared and may get damaged if stretching activities are done directly. Before stretching we need to warm up our body parts with running, jogging or walking with a fast pace in comparison with your normal walking speed (Arntz et al., 2024; Warnake et al., 2022, & Zvetkova et al., 2023). It makes the body tissues more pliable and amendable to change. In some activities we can often see that after stretching (cool down stretching) is often necessary for our muscle groups to get relaxed. Tensions are created and can be felled during the stretching activities but pain can't be felt which is something different. Stretching is needed and focused in the body parts which are critical for mobility. Especially in the different regions of our lower bodies included.

Stretching the other body parts such as neck, shoulders and lower back is also beneficial. Minimum three and maximum four sessions should be done per week on stretching activities to earn flexibility. Nowadays, during different physical activities and muscular activities injuries are a very common factor which can be seen leading to muscular injury and fatigue conditions. Especially due to high intensity training loads the risk of injury increases. Keeping in mind the relevance of fatigue and the muscle group injuries which remains non-contact for e.g. (hamstrings strain injury, anterior cruciate ligament tear etc.) several recovery techniques and strategies are suggested by the different experts which includes the sports performance of a person. Many times or mostly the stretching are used as a tool of recovery from these injuries. Stretching techniques are used to increase the Range of Motion (ROM) and prevents musculotendinous injuries. It can be hypothesized that flexibility training such as stretching enhances elasticity which may results in a stronger contraction force.

### **Review of Literature**

According to the past literature it can be seen that athletes and sports persons are more often exposed to the injuries due to the decrease of athletes' strength, performance and neuromuscular coordination. Researchers are now get involved to the topics on how to reduce the risk by injury by using different stretching techniques and how is it effective on the performance and durability in future competitions.

The next aim is to compare the different stretching techniques and it's usefulness. Such as the effects of slow dynamic stretching and static stretching on the recovery of performance, range of motion, balance and joint positions. Anyhow the present study shows that after fatigue the slow dynamic stretch, fast dynamic stretch and static stretch no difference is significant enough to show the sign of recovery factors of function and balance in the life of healthy adults. The researchers are looking for a response to the question "Which is the most effective stretching techniques that can be used in recovery of sports performances? (Hume & Kolt 2014). From the viewpoint of Chaabene et al., (2019), more recent evidence suggests that when performed as a single-mode treatment or when integrated within a full warm-up routine including aerobic activity, dynamic-stretching, and sport-specific activities and short-duration StS (Static Stretching). Short-duration (Static Stretching) StS has to be applied with caution due to its negligible but still prevalent negative effects on subsequent strength and power performances, which could have an impact on performance during competition. A study conducted by the After et al., (2024), searching PubMed,

Scopus, Web of Science, and Sport Discus for relevant research, a random-effect meta-analysis was used to evaluate the findings from 77 studies and 186 effect sizes. Moreover, the researchers conducted their corresponding subgroup analyses using a mixed-effect model. In order to identify possible correlations between impact magnitude and age or stretch duration have been chosen for the purpose of the study. In the present study researcher carried out a meta-analysis. After searching PubMed, Scopus, Web of Science and Sport Discus for relevant research, a random-effect meta-analysis was used to evaluate the findings from 77 studies and 186 effect sizes. Moreover, we conducted the corresponding subgroup analyses using a mixed-effect model. In order to identify possible correlations between impact magnitude and age or stretch duration.

### Objectives of the Study

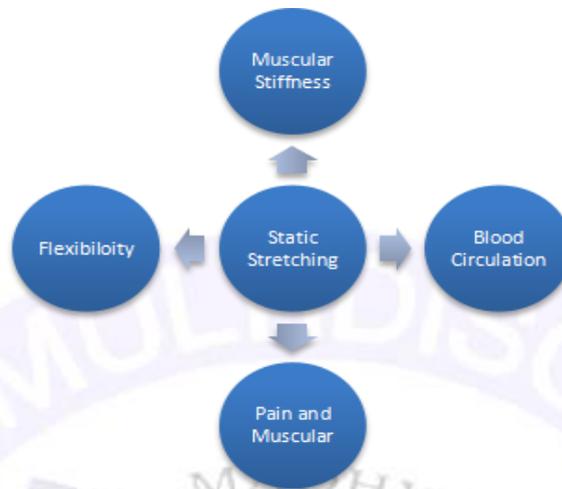
- To understand the nature and importance of different forms of stretching.
- To determine the body flexibility and Range of Motion (ROM) is affected in joint muscles
- To find out the relevance of Hip flexors and lower body stretching in body development.
- To examine the importance of stretching for injury recoveries.

### Research Questions

#### How different forms of stretching are important for our body system?

Static Stretching engages the muscle groups especially the parts of tendons and ligaments and between the joints where a muscle is connected with each other. It is the maximum comfortable Range Of Motion (ROM) and holding that position for few seconds i.e typically 20-30 seconds which improves flexibility, elasticity and Range Of Motion (ROM). Static stretching (SS) are done as a cooling down exercises to prevent injury. If these Static Stretching (SS) exercises are done before may intense activities then it may temporarily reduce the muscle strength and performance. Stretching at the end of your workout session will help you to increase the Range Of Motion (ROM) in any joint which is focused like your hip and knees. It makes person to move more freely and comfortably with greater flexibility and Range Of Motion. Static Stretching (SS) effectively reduces pain and stiffness from the tight muscles. Due to stress the muscle may feel tense and tight. Stretching can be combined with mindful breathing exercises that leads to reduce mental tensions and anxiety. Increase in blood flow helps the muscles in speedy recovery after exercises. Static Stretching (SS) always aims in a athlete's flexibility and enhances one's agility, speed and muscular power. It helps a athlete and take his/her performance to another level when they work or play a specific post.

Here we can firstly start with Static Stretching (SS) which is one of the most important stretching especially needed by the athletes. Static stretching aims in helping in recovery of athletes from different injuries that they go through during their training sessions. Meta analysis of 41 controlled trials has shown that chronic static stretching improved the muscle strength and power. Various other emerging evidence can be found on the muscle hypertrophy which plays an important role in developing strength improvements after chronic Static stretching (SS). (Arntz et al.2024). However, it has been observed that using the Static Stretching (SS) exercises muscle strength and power have yet to be fully identified. A research in 2018 shows that how blood circulation gets improved due to regular stretching.



### **Benefits of Static Stretching (SS)**

- Increase in flexibility and Range of Motion.
- Reduction of pain and muscular stiffness.
- Reduce in stress.
- Improve in Blood circulation.
- Better performance level.

Next, we can jump to the another most important part of the stretching technique that is the Dynamic Stretching (DS). It involves the active movements of the body muscles and help to stretch their full range of motion (ROM). Dynamic Stretching (DS) involves our body and individuals to go through more intense training. Dynamic Stretching (DS) exercises are done before performing explosive exercises for warming up. As we should keep in mind that there are few dynamic stretches (DS) which are not suitable for the people with certain health issues. For example, doing dynamic exercises like squats may stress the knee joints and are not ideal for the people who are suffering from any knee injuries or arthritis. A review of studies showed that dynamic stretch are good for those who does a lot of running and jumping activities. It includes the upper body exercise such as: arm swings, arm circles, cat and cow postures, hip twists. Further the runners or the athletes those who work on speed and agility does the warms up Dynamic Stretching (DS) exercises like: High knees, walking lunges, leg swings. The speciality of Dynamic Stretching (DS) is that you are performing the stretches or the dynamic exercises while move where in Static Stretching (SS) it's just all about standing and performing the exercises at a particular spot. Athletes' kinesthetic awareness gets improved or where your body is with time and space. It's helpful and activates your mind into getting ready for a good workout. Dynamic Stretching (DS) looks more like strength training exercises where we want the muscles to get contracted because that gives us the part of benefits. Questions arises that how Dynamic Stretching (DS) helps to improve your performance and prevent the risk of injuries?

Firstly, because your are activating your muscles, you are using your muscles to actively move you, you are using the circulation to them; they get to wake up and contract better, and you

also get a lengthening, or they increase in flexibility; so you get range of movement in your muscles. Secondly, it warm up your joints. Joints don't have arteries in and out of them. So, they rely on movement to get their fluid in and out them to get supple. Thirdly, it works through waking up the nervous system and this is the part we don't always think about. But a person's muscle can be as strong as they want to be but if attention is not paid towards the nervous system then it cannot be controlled properly. What Dynamic Stretches (DS) don't do is, they don't really reduce the amount of delayed muscle soreness that you feel the day after you take heavy sports or heavy loaded workouts - we call it DOMS. So although doing a good warm-up prevents injuries and helps you to perform better, if you are doing a really hard session, doing a good warm-up will never prevent you from feeling sore the day after your session.

### **Benefits of Dynamic Stretching (DS)**

- Prevents injuries.
- Helps in gaining a better posture.
- Activates nervous system and muscles.
- Improves joint movements and flexibility.
- Improves balance and control.

Lastly, the third main stretching is the Pre Contraction Stretching (PNF) which highly involves the contraction and stretching of the muscles. It has been developed for relaxing the muscles and increasing the muscle tone. Proprioceptive Neuromuscular Facilitation is one of the contract relax procedure a muscle is held by a partner in a stretching position and the muscle is contracted for 4-5 seconds followed by 2-3 seconds of relaxation period. After this again more stretching is done that is the stretch will be increase in which the partner will progressively push the stretch further than the initial position. This time the time period will be a bit longer than the earlier one. It will be held for a minimum of 10-20 seconds. There are few other pre-contraction stretching which is Post – Isometric Relaxation (PIR) and Post- Facilitation Stretch (PFS). There are various other PNF Stretching techniques which focuses on the muscle Stretches to its limits. Most of the PNF stretches can be done alone or with a partner assisting it. The muscle stretching triggers the inverse stretch reflex that returns the muscles to its initial position to prevent injuries.

### **Benefits of Proprioceptive Neuromuscular Facilitation (PNF) stretching**

- Develops muscular strength and endurance.
- Helps in joint stability.
- Increases mobility.
- Develops neuromuscular control.
- Develops coordination.

### **How body flexibility and Range of motion (ROM) is effect in joint muscles?**

Each and every joint in our body requires movement by the range of motion (ROM). It maintains the cartilage, increases the blood supply and nutrients in the joints. It also helps to increase the quantity of synovial fluid (oil in the crank case) in between the joints. This effect can be noticeable in weight bearing joints such as the hips and the knees. The muscles that are not

flexible get tired very fast when engaged in any activity causing other groups of muscle to work harder. This leads to muscle fatigue and muscular injuries. On the other hand, it becomes difficult to protect joints from severe injuries. Decreased flexibility in the muscle groups can lead to abnormal stress on structures and tissues. The range of motion (ROM) can be measured with the devices such as Goniometer and Inclinator. With the use of this devices the range of motion (ROM) can be measured in degrees and can be compared with normal values. After testing the range of motion (ROM) inflexibility in certain areas of the muscular groups and joints can be identified in places such as: hip joints, hip flexor, hamstrings, lower back joints, knee joints and the neck areas. The typical areas for testing include hamstrings, lower back, iliotibial band (IT Band) and hip. A regular stretching routine should be adopted by each and every one of us in our day-to-day life. Consistency and daily stretching leads to gaining in flexibility. Stretching after training sessions involves the largest joints in our body. Stretching regularly is also very beneficial. After performing the hard training sessions, one should move in with stretches as it will specifically target the areas of inflexibility. There are several numbers of stretches that can be performed which targets the different muscle groups and joints but there are specific guidelines that need to be maintained while doing them.

The stretch position should be maintained for 30 seconds. Stretching should be completed statically. Static Stretching (SS) are done by stretching through a muscles full range of motion (ROM). It should be hold or done until one feels resistance or mild discomfort. After this point one should gradually release the stretch. One should maintain this stretch routine at least 3 times per week. We must always make sure that while stretching each of the specific muscle groups must be included in our stretch routine that are being utilized in a sport or activity. Maintenance of breathing pattern should be also kept in mind while stretching. While stretching a particular muscle group we have to keep in mind that other muscle group that is not involved in stretching activities should be minimized. There's a debate of 'When to perform a stretching routine?' is controversial. It has been agreed to the fact that most of the time stretching is good after training sessions during cooling down. Moreover, it's also been suggested by the trainers that stretching at the end of training sessions are very beneficial. On the other hand, it is also been said that Dynamic Stretching (DS) should always be performed before training sessions but one should keep in mind that Dynamic Stretching (DS) should be preceded by a 5-minute of a cardiovascular warm-up exercises. Therefore, warming up before stretching increases the blood flow and temperature of the muscles, ligaments and tendons, improving the elasticity and optimal functioning of the muscles and connective tissues. Starting stretching in a cold body and in a relaxed condition may led to injuries like muscle pull and strains. Stretching should be done slowly and in a gentle manner to the point of tightness and slowly beyond the level where one might feel discomfort. Stay relaxed and hold that particular position for a limited period of time and do not bounce back.

### **What Hip Flexors effects in lower body stretching?**

Stretching covers a large area in the hip flexor region which engages the mid-section of our body and connects with the leg muscle areas. Firstly, we have to know what is hip flexor muscle and why do we need to stretch it and train it properly. Hip flexors are the group of muscle which is responsible for moving the hips, flexing it or bringing the leg upward direction towards the upper

body. The primary hip flexor muscle are known as psoas major and iliacus which collectively called iliopsoas. The psoas originates from the lower 6<sup>th</sup> vertebrae of the spinal bone in a human body. They meet and get inserted at the top of the upper leg bone known as femur. The iliopsoas muscle group gets engaged while lifting, pushing and pulling. An example of this is when we swing our leg forward while doing running and activities similar to that. It also gets engaged when performing kicking movements such as kicking movements in sports like soccer and martial arts. The exercises that can be done to make ones hip flexors better and flexible are divided into two categories: 1. Hip flexor stretching 2. Hip flexor strengthening. The exercises that can be done for stretching the hip flexor muscles are: Half kneeling hip flexor stretch, Knee to chest stretch, Pigeon pose stretch and Bridges. The exercises that can be done for strengthening the hip flexor muscle are: Lunges, Floor sliding mountain climbers, Straight leg raises and Knee lift holds or Psoas holds.

Tight hips are often caused due to some activities such as overuse it beyond its limit and sometimes due to inactivity. Tight hips makes a person uncomfortable to move your legs and adds pressure on knees and lower backs leading to lower back cramps and strains. If a person run, cycle or sit whole day at work in a same posture from a long period of time it might cause a problem of tight hips. It is essential for a person to work on these muscle groups. Neglecting the hip flexor muscle leads to many problems such as pains, decrease in mobility and quality of life.

### **Benefits of Stretching and maintaining the Hip Flexors**

Stay in a relaxed condition or in a certain position for a long time can make your muscles tight and stiff. While being seated for a long time our hip flexors get compressed which causes them to get shorten and tighten up decreasing its elasticity and flexibility. Thus, the hip flexor stretches prevents us from facing these muscle stiffness and tightness. It helps us to improve the mobility of the hips as well as the lower back too. It helps in:

- It helps in the pain reduction and muscular stiffness when one stands up from a seated position.
- It gets easier for a person to pick up something from a grounded position.
- Gets easier to move the leg or knee in upward direction and downward direction. E.g.- While climbing the stairs.
- Helps in performing the activities such as running and cycling.
- Hip rotation gets easier.
- Prevents pain in hips and lower back.

### **How does stretching helps us in recovering from injuries?**

We can't ignore that increase in flexibility of a muscle tendon unit helps in better performances by decreasing the number of injuries. Stretching exercises should always be included in warm-up and cooling-down. Many suggestions can be seen by the different authors who have repeatedly suggested that stretching has beneficial effects on injury prevention. In contrast, it has been reported that stretching before exercises prevents us from getting fatal injuries. It is not scientifically prescribed that stretching exercises exists and also there is no conclusive statements that can relate stretching and athletic injuries. There are many stretching exercises which are misguided by misconceptions and conflicting research reports. It can only be explained by the type of exercises or activities an individual is involved in. Sports with high

intensity of stretching-shortening cycles (SSC's) which involves a bouncing and jumping activities are: soccer and football. Here a muscle tendon unit stores and release high amount of elastic energy which is beneficial for performance in such kinds of sports. If a player or athlete who belongs to these kinds of sports have an insufficient compliant muscle-tendon unit the energy absorption and release may rapidly increase the capacity of the muscle tendon unit. Therefore, this may increase the risk of injury. Studies in recent days has shown that stretching can significantly influence the viscosity of the tendon and when a sports demands SCC's of high intensity stretching plays an important role for injury prevention. During recovery the injured tissue can be broken down into several phases and for each phase different types of stretching exercises are needed for that particular muscle groups.

The most effective treatment for the soft tissue injury is the R.I.C.E.R regimen which can be used directly after the occurrence of injury. It means (R) rest, (I) ice, (C) compression, (E) Elevation and obtaining a (R) referral for exact medical treatment. When this process is applied directly after the occurrence of injury it significantly reduce the injury time. R.I.C.E.R is the most important stage of injury rehabilitation. However, during this rehabilitation phase stretching can't be done. It puts additional stress to the injured part of the muscle. During the early stage of rehabilitation stretching can cause damage to injured tissues and is one of the most common stretching mistakes. During this condition stretching should be avoid for the time period of 72 hours. After the passage of 72 hours slowly the initial swelling will get subsided and one can start over with some gentle active rehabilitation techniques. The effective treatment at this point of time will be the use of heat and cold following by gentle massage. It can also include gentle static and passive exercises after the heat and massage treatment which will help to speed up the recovery process. Next, we will move on to the Static Stretching and its functions during recovery.

Static Stretching (SS) is done in a manner by placing your body in such a position where the muscle groups are stretched under a tension. The muscle groups and the muscle that is involved in stretching are relaxed. Slowly and cautiously the body is moved increasing the tension of the stretched muscle groups. Holding at this point helps the muscle to lengthen. Next, we will be discussing how the Passive Stretching (PS) works. It is very much similar to Static Stretching (SS). In Passive Stretching (PS) another person is used to help in further stretching that is stretching beyond ones comfort zone. These types of stretching should be done more cautiously as a greater force is applied to the muscles. Therefore, during using partner for performing this type of stretching no jerky or bouncy force should be applied to the stretched muscles. The important point that should be kept in mind is during the rehabilitation phase the stretching should be done gently that means without putting extra pressure. Never do any activity that hurts the injured area. Never push yourself to the point where you're feeling pain. Pain is the warning so don't avoid it. The aim of this phase of rehabilitation is to regain all the fitness components which gets weaken during the injury period. The prime focus should be on gaining the components such as: flexibility, strength, power, endurance, balance and coordination. Without the phase of rehabilitation there is no hope of recovery from this kind of injuries. During this phase one should stick to static and passive stretching exercises but also include PNF Stretching. PNF or Proprioceptive Neuromuscular Facilitation, is a more advanced form of flexibility. The activity involves both stretching and contraction of the

targeted muscle groups PNF Stretching are especially done for the rehabilitation process and it is very effective. It works on three main things: 1. Target muscular groups. 2. Increases flexibility. 3. Improves muscular strength. The types of stretching on should do during this period of time are: Dynamic Stretching (DS) and Active Stretching (AS). Dynamic Stretching (DS) are done to activate the body and its muscles before getting involved in a high intensity training. Dynamic Stretching (DS) involves a controlled, soft bounce or a swinging motion. Here the force of bounce and swing is gradually increased but should never become uncontrolled. Active Stretching (AS) is a type of stretching which an individual does without any assistance. In this type of stretching an internal strength is needed. During Active Stretching (AS) the strength of the opposing muscles generate a stretch within the targeted muscle groups. The example of an Active Stretching (AS) is one where an individual raises one leg straight out in front as high as possible and then maintains that position without assistance.

### Conclusion

In order to account for potential moderating factors, this study was the first to do a thorough meta-analysis on all joints and stretching modalities including sex, age, and or trained-state-specific adaptations to stretch training, as well as the stretching technique, intensity, duration, and muscles stretched. In comparison to the control groups, the primary meta-analysis demonstrated that stretch training increased range of motion. A substantial difference between the stretching techniques and the effects between the sexes was revealed by subgroup analysis. Future study and sports practice may benefit from the discovery that stretching volume, intensity, and weekly frequency may not significantly affect range of motion gains. As a result, prior claims on the detrimental effects of StS on strength and power performances need to be updated. In general, coaches are encouraged to think about short-duration StS as a crucial part of the warm-up for leisure sports since it may improve flexibility and reduce the risk of musculotendinous injuries. Minimal performance variations, however, can significantly affect an athlete's competitive success in high-performance sports. High performance athletes should use StS sparingly due to the negligible detrimental effects of brief StS on following strength and power tests. Revisions to StS recommendations are urgently needed in light of these findings. Evidently, brief ( $\leq 60$  s per muscle group) StS has a minimal risk of impairing performance and may have a beneficial effect on flexibility and the incidence of musculotendinous injuries in physically active people when done as part of a thorough warm-up before strength and power-related activities. However, short-duration StS must be used carefully in high-performance athletes, especially prior to competition, because of its marginally detrimental but still prevalent.

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