Research reviews insight into flexibility the pros and the cons of stretching prior to exercise

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Abstract
Flexibility is an essential fitness component that decreases with age and physical inactivity. Traditionally, including stretching especially static stretching as a warm-up has long been recommended for individuals who engage in exercise for rehabilitation, injury prevention, health improvement and athletic performance enhancement (American College of Sports Medicine [ACSM] 2006, Kovacs 2006, Shrier 2004). The proposed goals of acute stretching prior to physical activity are to enhance performance include improved coordination and proprioception, increased range of motion (ROM), reduced injury potential, improved circulation and decreased muscle viscosity, which leads to smoother muscle contractions (Fredette 2001). However, in recent years there has been growing concern about whether or not stretching should be included in the warm-up phase. Mounting evidence suggests that pre-exercise stretching plays a limited role in injury prevention and performance enhancement. Static stretching impairs performance, Static Stretches Don’t Reduce muscle Soreness, Static Stretches Don’t Warm-up Your Muscles and Static Stretches Don’t Put You in the Right State.

Keywords: Flexibility, stretching

Introduction
Flexibility is an essential fitness component that decreases with age and physical inactivity. Traditionally, stretching as a warm-up has long been recommended for individuals who engage in exercise for rehabilitation, injury prevention, health improvement and athletic performance enhancement Kovacs 2006, Shrier 2004 [15, 27]. Proposed goals of acute stretching prior to physical activity to enhance performance, improved coordination and proprioception, increased range of motion (ROM), reduced injury potential, improved circulation and decreased muscle viscosity, which leads to smoother muscle contractions (Fredette 2001) [9]. However, in recent years there has been growing concern about whether or not stretching should be included in the warm-up phase. Growing evidence suggests that pre-exercise stretching plays a limited role in injury prevention and may unfavorably impact exercise performance. A lot of people warm-up using static stretches. I’ve been advocating dynamic stretches for some time, with reasons. But it needs to conduct carefully monitored research. Unfortunately I can't. What I can to do is reviewing and evaluating the literatures. When reviewing I try to evaluate critically the method and material used grouping and results.

By focusing on a broad range of studies relating to post-stretching performance, the study seeks to clarify current understanding of stretching benefits and downsides. While certain performance benefits previously ascribed to stretching have not been born out in the material this study reviews, nevertheless, goal-directed stretching for specific purposes and under particular timing conditions may be beneficial. Areas for further research are also considered. Stretching-induced force deficits have been observed in a number of studies. The present article suggests both mechanical and neural factors which may be responsible. On the mechanical side, temporary loss of muscular stiffness following stretching is believed to cause decreases in force and power production. Neural factors include decreased neuromuscular activation, (though the precise mechanism leading to decreased force and power production remains poorly understood).
Performance deficits from pre-exercise stretching appear in cited studies relating to muscle strength and power, maximal voluntary contraction (MVC) of the plantar flexors, peak torque and mean power output, jumping performance, running speed and economy, and muscular strength endurance.

**Purpose of the study**
This study provides an extensive review of literature relating to pre-exercise stretching and its effect on athletic performance. In addition to acute static stretching, the study considers the effects of proprioceptive neuromuscular facilitation (PNF), ballistic and dynamic stretching. While each of these techniques has shown effectiveness in various studies examining ROM, they appear to differ in their impact on exercise performance.

The article begins with a helpful primer on the physiology of acute stretching, outlining the mechanical and neural factors believed to be involved in post-stretching muscular deficit. The review reiterates the evidence of recent research which suggest that pre-exercise stretching may be used to prevent injury and further, may unfavorably impact athletic performance.

Finally, a holistic assessment is provided to help athletes determine the timing, duration and form of stretching best suited to achieving particular goals. Dynamic rather than static stretching is favored in general for positive results.

**Reviews**
Static Stretches Impair Performance. Stay away from static stretches right before explosive movements like weight lifting, sprinting, jumping, and endurance events etc. PubMed has plenty of research why, examples:-

Before we review the effects of pre-exercise stretching on muscular-force development, we must first understand the physiology behind this phenomenon. Scientists theorize that stretching-induced force deficits involve mechanical factors and neural factors. Most authors agree that both factors interact and contribute to create a muscular-force deficit following stretching.

The mechanical factor most responsible for decreases in force and power production is the temporary loss of muscular stiffness following stretching (Kokkonen, Nelson & Cornwell 1998, Marek et al. 2005, Shrier 2004) [14, 17, 27]. The loss in stiffness increases the length of sarcomeres within individual muscle fibers and decreases the contact between actin and myosin, thereby altering the length-tension relationship and decreasing force (Nelson et al. 2001) [18, 19].

In addition, the muscle fibers must shorten over a longer distance to reach maximal contraction. This can pose a problem for explosive-power performance because the muscle can’t contract rapidly or generate maximal force. Decreased stiffness also affects eccentric force development and alters the stretch- shortening cycle, thus affecting power development during plyometrics or jumping (Young & Elliott 2001) [32].

Deficits in strength and power measurements following static stretching have ranged from 5% to 30%, according to (Young and Behm 2003) [31]. Other researchers who measured one-repetition maximum (1RM) performances for knee flexion and knee extension found reductions of 7.3% and 8.1%, respectively, following acute static stretching (Kokkonen, Nelson & Cornwell 1998) [14]. A third study showed decrements in 1RM scores for knee extension (-5.7%) and knee flexion (-3.6%) following an acute bout of static stretching in individuals who had also just finished a 10-week flexibility training program (Nelson, Kokkonen & Eldredge 2005) [20, 21, 22].

The neural factor most responsible for reduction in force and power production is decreased neuromuscular activation. The leading thought is that stretching induces a neuroinhibitory mechanism that affects neural input to the muscle (Mark et al. 2005) [13]. The decrease in muscle activation is partially responsible for a decrease in muscle force (Behm, Button and Elliott 2001) [2].

Reviews in this area were conducted in line with why performance reduces following stretching.

**Jumping Performance**
Numerous researchers have reported that jumping performance is impaired following an acute bout of static stretching. One study found that drop jump performance decreased by 6.9% in subjects who warmed up with a static-stretching routine compared with a group of controls who warmed up without stretching (Young & Elliot 2001) [13]. These authors concluded that static stretching reduced eccentric muscular-force development and thus decreased the muscles’ stretch-shortening cycle, which is crucial to maintaining jumping performance. Similarly, another study reported that vertical-jump performance decreased by 1.5% following an acute bout of pre-exercise static stretching (Church et al. 2001) [4].

Shrier (2004) [27] has suggested that the average decrease in vertical-jump performance following static stretching is 2.5%. During each condition, measurements of VJ height and EMG activity during the VJ were recorded analysis of variance and post hoc analysis indicated that VJ height was significantly less (4.19 ± 4.47%) after SS than NS (p<0.05) and significantly greater (9.44 ± 4.25%) in DS than SS (p<0.05). There was significantly greater EMG amplitude in the DS compared with the SS (p<0.05). The results demonstrated that SS has a negative influence on VJ performance, whereas DS has a positive impact. Increased VJ performance after DS may be attributed to post activation potentiation.

**Sprint Time and static stretching**
Static stretching inhibits the stretch reflex: the ability to store kinetic energy in your muscles during the eccentric. More than enough articles were reviewed. Soccer players, sprinters, college athletes are found researched. RSA, 20m ST,30m ST, 40m ST was seen same result is found there is a significant difference b/n groups of NS and SS in ST. sprinting time of NS group mean is less than SS group mean at (p<0.05) & (p<0.01).

Dawson, et.al (2009) [5] Thirteen male team sport players completed a repeated sprint ability test consisting of three sets of maximal 6 × 20-m sprints (going every 25 seconds) after performing one of three different warm-up protocols in a within-subjects counterbalanced design. Each warm-up protocol involved an initial 1000-m jog, followed by either dynamic activity only (D), static stretching followed by dynamic activities (S-D), or dynamic activities followed by static stretching (D-S). First (FST), best (BST) and total (TST) 20-m were evaluated. The mean values for TST in all individual sets and overall were generally slowest in the D-S condition (D = 60.264 ± 1.127 seconds; S-D = 60.347 ± 1.774 seconds; D-S = 60.830 ± 1.786 seconds). Overall, these results suggest that 20-m RSA may be compromised when SS is conducted after dynamic activities and immediately prior to performance (D-S).
Muscular Strength Endurance and static stretching

Stretching before an endurance event may lower endurance performance and increase the energy cost of running. Articles in this area are in scarce and needs more research. From review of same groups NS & SS were statistically compared. In 60-minute treadmill run NS running covers more distance with little expenditure of energy than SS running in 30-minute 65% VO2 max preload followed by a 30-minute performance run where participants ran as far as possible without viewing distance or speed.

One study investigated the effects of an acute bout of static stretching on knee-flexion muscle strength endurance in a group of males and females (Nelson et al. 2005) [20]. Muscle strength endurance was 28% lower after the stretching bout than it was after no stretching. The authors’ recommendation: Avoid heavy static stretching prior to maximal muscle strength endurance exercises.

Collectively, present research findings suggest that there are no ergogenic benefits, and there are potentially detrimental effects, to incorporating static-stretching exercises into the warm-up routine. These findings are consistent among different populations and research designs (Shrier 2004) [27].

Static Stretches Don’t Lower Risks of Injury

Since the early 1980s, static stretching has been widely promoted before performing physical activity as a method to prevent injury and improve physical performance. It has become a popular routine included in the warm-up to exercise as it is believed that the slow, controlled movement allows the stretch to be performed easily and safely, with reduced risk of injury compared with other forms of stretching (Smith 1994) [29].

There currently appears to be little sound empirical evidence to substantiate these claims, however, with literature on the subject being scarce and often contradictory. Moreover, some research appears to indicate that static stretching prior to exercise even may increase the risk of injury (Shrier 1999) [20].

Two common factors associated with exercise-related musculoskeletal injury are muscle stiffness and lack of ROM both of which may be addressed by the static stretching technique to help reduce injury risk. The effect of static stretching on muscle stiffness has been well documented and shown to correlate highly to the incidence of muscle injury. Correlation, however, does not infer causation.

The relationship between stretching and injury prevention has been substantially researched, and several systematic reviews have been conducted, with the general census showing stretching to have no positive effect on preventing injury (Herbert, RD and Gabriel, M. 2002) [24].

A computer-aided literature search was performed using MEDLINE, SPORT Discus, Pub Med, and Science Direct databases, selected as they all contain large amounts of relevant literature in the areas of sport and physical activity.

Results seem to indicate that: There is moderate to strong evidence that routine application of static stretching does not reduce overall injury rates. There is preliminary evidence, however, that static stretching may reduce musculotendinous injuries.

Static Stretches Don’t Reduce Soreness

Some people stretch post exercise to reduce delayed onset muscle soreness (DOMS). If lifting caused DOMS, you’ll be sore the next day, whatever stretching you do. Many people stretch before or after engaging in athletic activity. Usually the purpose is to reduce muscle soreness after exercising (with delayed onset), to reduce risk of injury, and improve athletic performance (Rob D 2002) [24].

Studies on this issue were systematically reviewed. Some studies were done between subjects, others are within subjects. Some group include static stretching in warming up others did not. Muscle soreness was measured 24 hour 48 hour and 72 hour after football training athletics training and other sports.

This systematic review finds clear evidence from five studies of nominally moderate quality that stretching before or after exercising has no effect on delayed onset muscle soreness DOMS.

Static Stretches Don’t Warm-up Your Muscles.

Warm muscles are harder to injure than cold ones. Static stretches don’t raise your body temperature. This method, however, doesn’t let you practice movements. So you lost 20 mins doing something that isn’t optimal while 10 mins dynamic stretching would have increased flexibility, raised body temperature and grooved motor patterns. SS increased the time needed for warming up. In order to compensate the time needed for stretching, you’ll have to add 10 mins stationary cycle or light jogging. For this additional light jogging or stationary cycle you’ll have to invest additional energy so that the total energy cost increases.

SS increased the energy cost to warm up the muscles. Findings suggest that stretching before an endurance event may lower endurance performance and increase the energy cost of running.

Static Stretches Don’t Put You in the Right State.

To get best results from SS you must relax your whole body, release tension. That’s why static stretches, including yoga, are great to de-stress. But they aren’t great to prepare yourself for heavy Deadlifts, sprinting, MMA (mixed martial arts) or any other sports where you need to be fast, explosive and aggressive. You want to be fired up, not relaxed.

Summary of Results

With respect to acute static stretching, the study summarizes their results as follows: “Collectively, present research findings suggest that there are no ergogenic benefits, and there are potentially detrimental effects, to incorporating static-stretching exercises into the warm-up routine.” That being said, the study does find benefit in dynamic stretching, which involves movements designed to mimic specific actions occurring during athletic performance.

Conclusion

No more static stretching within an hour prior to exercise or competition for activities involving a force or power component. If a client’s goal is to improve ROM, & stiffness then static stretching following exercise is best for...
maximizing flexibility without affecting performance. Areas that future studies may address include molecular mechanisms behind stretching-induced force and power declines; the effects of regular stretching and performance; and the effects of stretching on performance during an injured state.

References