SHOULD ATHLETES STRETCH BEFORE EXERCISE?

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KEY POINTS

- Traditional stretching routines performed during warm-up procedures before exercise can increase flexibility for a short time, but there is little scientific evidence that such routines can improve exercise performance, reduce delayed-onset muscular soreness, or prevent injuries.
- Stretching on a regular basis, e.g., 3-5 days/week, away from the exercise environment may be effective in improving flexibility and some types of exercise performance, and it may reduce injury risk, but further research is required to validate this concept.
- Passive stretching for 15–30 seconds is more effective for increasing flexibility than stretching for shorter durations and is equally effective as stretching for longer periods.
- Increased flexibility is important for sports like ballet, gymnastics, and swimming, but it may decrease running economy and be inappropriate for line play (football) and other sports where joint stability is critical.
- Stretching just before exercise may cause temporary strength deficits.
- Risk of injury to muscles, tendons, and ligaments appears to be lower in athletes who are more aerobically fit.

Each day at sporting venues throughout the world, athletes prepare for competition with a familiar ritual of stretching the major muscle groups used in their sports. These pre-exercise routines usually incorporate a variety of stretching techniques and warm-up exercises. Sports medicine texts, journal articles for health professionals and coaches, and lay publications tout stretching as a key to reducing injury risk.

With such widespread acceptance of pre-exercise stretching, one might assume that strong scientific evidence supports its effectiveness for injury prevention or improved performance. However, many scientific publications question the conventional wisdom of pre-exercise stretching. This article summarizes recent research findings on stretching, flexibility, and warm-up.

STRETCHING TECHNIQUES

A wide variety of types of stretching have been proposed. Active or dynamic stretching requires individual athletes to contract certain muscles to cause stretching of others. Sub-types of active stretching include static, isometric, and ballistic. Passive stretching and stretching by proprioceptive neuromuscular facilitation usually involve a partner who assists with the activity. Regardless of the type of stretching used, it appears that stretching is most effective for increasing range of motion when performed after the muscle is warmed by preliminary exercise or by passive heating, e.g., with hot packs or ultrasound.
• **Static stretching** is a slow, sustained muscle lengthening that most athletes hold for 15–60 s. An example is stretching the hamstrings and back by slowly reaching forward to grasp and hold the ankles or feet while sitting with the legs fully extended in front. Static stretching is used by most athletes and is incorporated into many pre-competition regimens.

• **Isometric stretching** is a form of static stretching where the athlete contracts the muscle while exerting against a fixed resistance. In the example of static stretching, if the athlete were to contract the hamstrings while holding the stretch, some of the fibers in the contracting hamstrings would be further lengthened as other fibers attempted to shorten. The concept is that holding the isometric contraction for a few seconds would then allow increased static stretching to further lengthen the muscle.

• **Ballistic stretching** involves rapid muscle lengthening, often with bouncing or repetitive motions. A typical example is the hamstring stretch of repeated bouncing movements to touch the toes while standing with the legs straightened. Few athletes use ballistic stretching, but the technique remains in favor in certain sports. Anecdotal reports of soft tissue injury during ballistic stretching have led many fitness instructors and therapists to condemn its use.

• **Passive stretching** is an assisted stretching technique. The athlete does not actively contract muscles to stretch antagonists; rather, gravity, a machine or, more typically, a partner applies steady pressure to cause a movement that slowly increases the range of motion. Assisted hamstring stretching, wherein an athlete is seated with legs outstretched and a partner slowly pushes on the athlete’s back, is a common practice and a good example of this technique.

• **Proprioceptive neuromuscular facilitation** (PNF), another assisted stretching technique, utilizes a partner who briefly resists contraction of stretched muscle groups, after which the muscles are relaxed while the partner passively stretches the muscle group beyond its normal range of motion. Again using the example of a hamstring stretch, with the athlete lying on her back, an assistant raises the athlete’s extended legs upward and toward the trunk to stretch the hamstrings for 20–30 s. Next, the athlete attempts to contract the stretched hamstrings (i.e., tries to lower the legs) for 5–6 s while the assistant resists the contraction to inhibit movement. The contracted muscle groups are then relaxed and the assistant again slowly stretches the hamstrings, presumably further than the original stretch allowed. This process is repeated 2–4 times.

**BRIEF RESEARCH REVIEW**

Stretching routines performed before exercise can increase flexibility for up to 90 min, but there is scant scientific evidence to suggest that such routines can improve exercise performance, reduce delayed-onset muscular soreness, or prevent injuries. Also, it remains to be confirmed whether stretching on a regular basis away from the exercise environment is effective in improving some types of exercise performance or reducing injury risk. Stretching just before exercise may cause temporary strength deficits. Epidemiologic data indicate that the risk of injury to muscles, tendons, and ligaments is more closely linked to poor aerobic fitness of the athlete than to insufficient flexibility.
If the scientific evidence does not support the value of pre-exercise stretching, why do sports medicine texts, medical experts, physiologists, athletic trainers, personal trainers, and coaches continue to recommend this practice? Although science is the most objective way to discover truth, it’s not the only way. Many experts in health care and athletics have had positive clinical and practical experiences with stretching, and there are thousands of anecdotal reports of injuries having occurred on the rare occasions when previously injury-free athletes neglected to stretch before exercise. Also, there are valid criticisms of the scientific data.

Studies of stretching have examined varied types, durations, and frequencies of stretching; limited populations of athletes; and only a few sports. For example, much of the negative data about stretching concerned athletes in distance running, a sport in which running economy seems to be better with less, not more, flexibility. While stretching may not be useful for endurance runners, would the same assumption apply to hurdlers, gymnasts or dancers, who all traditionally place a premium on flexibility? Finally, to conduct a flawless study on the effect of stretching on injury risk would be extremely difficult, if not impossible.

Because stretching does appear to achieve the goal of increased flexibility around joints, perhaps the apparent failure of stretching to prevent injury occurs because the timing of stretching before exercise is incorrect or the application of stretching for all athletes is unnecessary. Maybe athletes should be assessed individually to better understand how to utilize their preparation time before exercise. Inflexible athletes might be encouraged to incorporate some stretching into an overall warm-up routine, whereas other individuals who already have an excellent range of motion would focus on integrating strength, jumping, or other activities into their warm-up.

Most coaches, athletic trainers, and sports medicine experts seem to automatically assume that when an athlete pulls a muscle, the athlete needs improved flexibility to prevent future injuries. But research indicates that it would be more important for these athletes to improve their levels of fitness. Certainly the correlation of poor aerobic fitness with greater injury risk seems much stronger than that seen with poor flexibility.

In studies on the effects of stretching, factors that tend to reduce injury risk include eccentric strengthening, warming-up, and aerobic conditioning. Only when studies adequately control for these variables will the specific contribution of stretching to injury prevention become clear. Larger randomized controlled trials that incorporate men and women, multiple sports, and adequate length of follow-up would help clarify the role of stretching. Additional studies should examine the ideal timing of stretching as well as standardizing its quality and duration. Until stronger science emerges, sports medicine practitioners and coaches should offer cautious advice to athletes. A practical approach could be to emphasize aerobic fitness and warming-up while allowing the individual athlete to make the choice of whether or not they wish to incorporate stretching into this regimen.
SUMMARY AND TIPS

So, should you stretch before exercise? Unfortunately, there is no simple answer. There is no solid evidence that stretching, especially just before you exercise, has any benefits. Yet, there is no solid evidence that stretching does any harm. Plus, there is a medical and coaching tradition of pre-exercise stretching that should not be ignored.

One factor that clearly does reduce your risk of injury is to maintain a good level of cardiovascular (aerobic) fitness throughout training, during the offseason, and when you are recovering from injury. The most valuable warm-up practice includes activities such as easy running, swimming, cycling, jumping, and sports specific drills. This type of warming up will have you ready to play or practice with less risk of a muscle pull or other injury.

It’s your decision. Certainly, if you participate in a sport that places a premium on flexibility, for example, gymnastics, hurdles, diving, and dance, you need to have excellent range-of-motion. If you have marginal flexibility, consider incorporating stretching into the warm-up routine. If you already have excellent flexibility, you might better utilize your pre-exercise time by increasing aerobic and/or sport-specific activities in your warm-up.

If you participate in a sport that requires jumping, lifting, throwing, or other types of explosive power, be aware that stretching just before exercise can cause a temporary reduction in strength and should probably be avoided before competition.

Stretching Tips

• If you choose to stretch, warm your muscles first by aerobic activities such as jogging, swimming, cycling, and calisthenics. Warm muscles are easier to stretch and less prone to tear. Many experts recommend stretching after your workout, not before.

• Slow stretches held for 15—30 seconds and repeated up to 3 times for each muscle group offer as much benefit as other regimens. If a partner assists you with stretching, be cautious that the partner does not push too hard, leading to a stretching-related injury. Avoid ballistic or bouncing stretches.

• Since scientific studies do not show clear benefits from stretching, try different warm-up routines to determine which routine seems to make you most ready to participate in practices and competitions.

• Before returning to strenuous training or competition after injuries, consult with an athletic trainer, personal trainer, sports medicine physician, or knowledgeable coach to ensure you have adequate strength in the previously injured limb(s). It’s especially important to be strong in the eccentric phase of movements (for example, lowering a barbell, stepping down stairs, jumping down from heights, lowering yourself from a chin-up). Also, you should have satisfactory levels of core (trunk/abdominal muscles) strength, balance and agility. These factors clearly reduce the risk of becoming re-injured.