



# An Analysis of the Evidence Base Relating to the Role of Warm-Up and Stretching in Reduction of Injury Risk in Athletes

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## Abstract

Pre-participation warm up and stretching - in various forms - is widely employed by athletes before both training and competition. Various potential benefits of warming up and stretching are proposed, including a reduction in the risk of injury. Our aim is to summarize the available literature, identify appropriate information resources, and to produce a reasoned evaluation of the available evidence. We concluded that every athlete, coach, or conditioning trainer must incorporate a warm-up protocol along with a stretching routine in an athlete's training regimen.

## Introduction

Athletes, coaches, trainers, physiotherapists, and physicians recommend warm-up, stretching and cool down exercises in an effort to both prevent injury and enhance performance [1]. Warm-up increases blood flow to muscles, speed of nerve impulses, oxygen and energy substrate delivery, and oxygen release from hemoglobin and myoglobin [2]. It decreases both the activation energy for cellular reactions and muscle viscosity [2]. Warm-up is designed to increase muscle/tendon suppleness, increase body temperature, and enhance free, coordinated movement [3]. Warm-up techniques are classified in 3 major categories: (a) passive warm-up-increases temperature by some external means; (b) general warm-up - increases temperature by nonspecific body movements; and (c) specific warm-up - increases temperature using similar body parts that will be used in the subsequent, more strenuous activity [4,5]. Over the years, warm up protocols consisting of the above-mentioned categories along with various structures (e.g. varied intensity, duration and recovery) have been used [6].

Muscular injury is one of the major problems facing today's athletes, both recreational and professional, with injuries to skeletal muscle representing more than 30% of the injuries seen

in sports medicine clinics [7]. There has been research done in the past both for and against the need for warm-up and stretching before sporting activity, and its role in injury prevention.

## Evidence for Warm-Up

Studies have shown that the benefits of warm-up potentially reduce the risks of strain injury to the muscle [8]. Several programs that combine warm-up, strength training, balance training, stretching, controlled rehabilitation, information about the importance of disciplined play and the increased risk of injury, and correction and supervision by doctor(s) and physiotherapist(s) have demonstrated effectiveness in the prevention of knee and ankle injuries [9-11]. It has also been established that during pre-season screening and rehabilitation following hamstring muscle injury, clinicians should consider the influence of hamstring strength, flexibility, warm-up, and fatigue on muscle performance [12]. A study using biomechanical support to assess the athletic practice of warming up prior to an exercise task to reduce the incidence of injury, inferred that physiologic warming is of benefit in preventing muscular injury by increasing the length and elasticity of the muscle-tendon unit [13].

## Evidence Against Warm-Up

On the flip side, certain authors have said there is no evidence of muscle strain or injury resulting from performance without warm-up [14]. One study concluded that warm-up does not prevent Delayed Onset Muscle Soreness resulting from exhausting exercise [15]. Certain authors suggested that passive warm-up performed before eccentric exercise may be more beneficial than active warm-up or no warm-up in attenuating swelling, but do not support the use of warm-up to prevent, attenuate, or resolve more quickly the strength loss, loss of motion, or soreness resulting from eccentric muscle damage [16].

## Warm Up and Stretching

Preparation for athletic activity often includes both stretching and warm-up, making it difficult to assess their independent effects on injury prevention [17]. Research conveys that certain techniques and protocols have shown a positive outcome on deterring injuries. Warm-up and stretching protocol should be implemented prior to physical activity, with the routine allowing stretching to occur within 15 minutes immediately prior to the activity, in order to receive the most benefit [7]. Stretch reduces passive tension, and benefits from lower tension are reduced sensations of stiffness and soreness, thus presenting a new proposal for passive stretches as a warm-up strategy [18]. Studies showed that only ankle dorsiflexion was influenced by warming up [19], whereas hip and knee flexibility increased with stretching [20]. Warm-up and stretching are essential to preventing muscle injuries by increasing the elasticity of muscles and smoothing muscular contractions, however improper or excessive stretching and warming up can predispose to muscle injury [2]. In contrast to other studies, some authors found the combination of warm-up, stretching and massage to reduce some negative effects of eccentric exercise, but the results were inconsistent [21]. However, one author dismissed stretching saying that because most injuries occur during eccentric contractions within the normal range of joint motion, it is not clear how increasing the range of motion through stretching will decrease injury risk [22].

## Summary of Evidence

There is not sufficient evidence to strictly endorse or discontinue warm-up before sporting activity, however there is adequate evidence suggesting its role in prevention of certain muscle injuries. Even the studies that disregard the role of warm-up, do not mention any significant demerit or increased risk of injury if an athlete were to undergo a supervised and correct warm-up protocol, and hence every athlete, coach, or conditioning trainer must incorporate it in an athlete's training routine. An ideal warm-up session should include raising body parameters, activating muscles, mobilising joints, as well as preparing an athlete for the activity they perform in their particular sport. Incorporating stretching along with warm-up could be beneficial. In setting up a safe stretching program, one

should (A) precede stretching exercises with a mild warm-up; (B) use static stretching; (C) stretch before and after a workout; (D) begin with mild and proceed to moderate exercises; (E) alternate exercises for muscle groups; (F) stretch gently and slowly until tightness, not pain, is felt; and (G) hold the position for 30 to 60 seconds [23]. A correct attitude and mind set towards warm-up is also essential. A study showed subjects with a more favourable attitude toward warm-ups performed significantly better, while those subjects with a less favourable attitude did not improve significantly when warm-ups were given [24].

## Conclusion

Injury prevention (and reducing the risk of injury) is one of the most important aspects in sports medicine today. Therefore, wider promotion of injury prevention resources, combined with research into the effectiveness of these resources and how players can be encouraged to adopt appropriate injury prevention strategies, is recommended [25]. Better research is needed to determine the role of warm-up and stretching in sport, and its impact on injury prevention.

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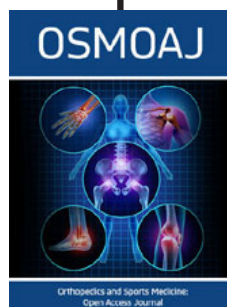


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