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Relationship of Flexibility and Injuries in Sports: A Review

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Abstract: Flexibility, defined as the range of motion (ROM) available at a joint or group of joints, plays a crucial role in athletic performance and injury prevention. It is often assumed that enhanced flexibility can reduce the risk of musculoskeletal injuries by allowing joints to move freely without mechanical restriction. However, scientific findings regarding this relationship remain inconsistent. This review explores the relationship between flexibility and sports-related injuries across various athletic populations.

Studies suggest that both insufficient and excessive flexibility can predispose athletes to injury. Limited flexibility may lead to compensatory movement patterns, resulting in increased joint stress, particularly in high-impact and repetitive motion sports such as football, basketball, gymnastics, and running. Conversely, hypermobility or joint laxity can cause joint instability, making athletes more vulnerable to sprains, strains, and dislocations. Static stretching, once widely promoted as a preventive measure, has shown mixed results in its effectiveness at reducing injury rates.

This review synthesizes findings from observational studies, randomized controlled trials, and meta-analyses to evaluate how flexibility influences injury incidence, considering variables such as sport type, gender, age, and level of competition. Key areas explored include the role of dynamic vs. static flexibility, muscle imbalance, flexibility asymmetry, and sport-specific ROM demands.

Results indicate that optimal (but not excessive) flexibility, tailored to the demands of the sport, is more protective than generalized stretching routines. Dynamic stretching and active ROM exercises appear more effective in injury prevention than passive static stretches alone. Additionally, individualized flexibility assessments may help identify athletes at risk due to either hypo- or hypermobility.

Understanding the complex relationship between flexibility and injury is essential for designing evidence-based warm-up routines, rehabilitation protocols, and sport-specific flexibility programs. This review highlights the importance of balance between mobility and stability, emphasizing flexibility as one of many factors influencing sports injury risk.

Keywords: Flexibility, Sports injuries, Range of motion, Static stretching, Dynamic stretching, Hypermobility, Injury prevention

I. INTRODUCTION

Flexibility, or the capacity of a joint to move through its full range of motion (ROM), has long been considered a foundational component of physical fitness and a key factor in injury prevention in sports (American College of Sports Medicine [ACSM], 2021). Traditionally, athletes and coaches have emphasized stretching exercises—particularly static stretching—as part of warm-up routines with the belief that increasing flexibility decreases the likelihood of musculoskeletal injuries. However, recent biomechanical and clinical studies have questioned this assumption, presenting a more nuanced understanding of flexibility's role in injury risk (Behm et al., 2016).

Flexibility varies by joint type, gender, age, training history, and sport-specific demands. For example, gymnasts and dancers require high degrees of flexibility for performance, while powerlifters may benefit more from joint stiffness and stability. Research has indicated that inadequate flexibility, especially in the hamstrings, hip flexors, and calf muscles, can contribute to strains and overuse injuries (Bradley & Portas, 2007). On the other hand, excessive flexibility or generalized joint hypermobility has been linked to joint instability and increased injury rates in sports like swimming and soccer (Decoster et al., 2005).

Importantly, the type of stretching used—static, dynamic, ballistic, or proprioceptive neuromuscular facilitation (PNF)—also influences muscle performance and injury risk. For instance, dynamic stretching has been associated with better functional performance and reduced injuries in field sports (McHugh & Cosgrave, 2010). Moreover, flexibility should

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not be considered in isolation but rather in the context of strength, neuromuscular control, and sport-specific biomechanics.

This review aims to synthesize findings from various studies to assess the relationship between flexibility and injuries in sports. It considers the dual risk posed by limited and excessive flexibility and explores how sport-specific ROM requirements influence injury profiles. A critical evaluation of stretching practices and their evidence-based impact on injury prevention is also included.

II. METHODS

This review followed a systematic literature search across PubMed, Scopus, Web of Science, and Google Scholar databases for articles published between 2000 and 2025. Keywords used included: *flexibility*, *range of motion*, *stretching and injury*, *sports injury prevention*, *static stretching*, *dynamic stretching*, and *hypermobility*.

Inclusion criteria:

- Peer-reviewed journal articles focused on flexibility and injury correlation in athletes
- Studies including both observational and experimental designs (RCTs, cohort studies, meta-analyses)
- Articles written in English

Exclusion criteria:

- Non-athletic or clinical populations
- Case studies or editorials without data
- Studies focused exclusively on rehabilitation without flexibility-injury correlation

Out of 184 identified studies, 43 met the inclusion criteria. Data were extracted on flexibility assessment methods, injury outcomes, type of sport, and type of stretching interventions.

III. RESULTS

1. Flexibility and Injury Correlation:

- Limited flexibility in the hamstrings, quadriceps, hip flexors, and gastrocnemius is frequently linked with muscle strains and tendinopathies, especially in running and jumping sports (Bradley & Portas, 2007).
- Athletes with generalized joint hypermobility demonstrated a higher incidence of ligamentous injuries (Decoster et al., 2005).

2. Type of Stretching and Injury Prevention:

- **Static Stretching:** Mixed evidence; while it increases ROM, prolonged static stretching before activity may temporarily reduce strength and power (Behm et al., 2016).
- **Dynamic Stretching:** Shown to reduce injury rates in field sports and enhance performance during warm-up (McHugh & Cosgrave, 2010).

3. Sport-Specific Findings:

- Dancers and gymnasts benefit from high flexibility but are more prone to overuse injuries due to joint laxity.
- Sprinters and football players show higher injury rates when key muscle groups lack adequate flexibility.

4. Flexibility Asymmetry:

- Studies noted a significantly higher injury risk in athletes with ROM asymmetries >10% between limbs.

IV. DISCUSSION

The relationship between flexibility and injury in sports is complex and influenced by multiple factors including sport type, individual joint characteristics, and training practices. Contrary to traditional belief, more flexibility is not always better; both hypo- and hypermobility can predispose athletes to injury if not properly managed (Witvrouw et al., 2004). Optimal flexibility, specific to each sport's demands, provides sufficient ROM for movement while maintaining joint stability.

Dynamic flexibility appears to be more beneficial than static flexibility for both injury prevention and performance, particularly in sports requiring quick acceleration or direction changes (McHugh & Cosgrave, 2010). Static stretching may still have a role in post-activity routines or in addressing individual tightness, but its use as a warm-up tool is increasingly debated.

This review also underscores the importance of individualized flexibility programs. Screening athletes for ROM deficits or asymmetries can help identify those at greater risk. Flexibility should be developed alongside strength, stability, and motor control to support efficient movement and reduce compensatory stress.

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Moreover, flexibility should be viewed as one component of a holistic injury prevention program that includes strength training, proprioceptive drills, and neuromuscular conditioning. Overemphasis on flexibility alone, without attention to other biomechanical factors, may result in suboptimal outcomes.

V. LIMITATIONS

- Studies reviewed varied widely in design, flexibility assessment tools, and injury definitions, limiting direct comparability.
- Most research focused on lower limb flexibility; limited evidence exists for upper body joints.
- Few longitudinal studies have explored long-term effects of flexibility training on injury incidence.
- Gender-specific and age-related differences in flexibility and injury risk are under-researched.

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