

The effect of stretching techniques on flexibility and sports injuries: A literature review

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Abstrak

Flexibility and injury prevention are essential aspects of athlete performance and health. The literature review identified factors influencing flexibility, including age, gender, and type of sports activity. The literature review also highlighted the benefits of stretching in improving flexibility and preventing sports injuries. However, there is controversy surrounding the effectiveness of stretching in preventing sports injuries. This article aims to present a literature review on the effect of stretching techniques on flexibility and sports injuries. The literature review was conducted by analyzing relevant previously published studies. The research design in this study includes three main approaches: literature research, secondary analysis of data, and identification and selection of relevant studies. A total of five articles were selected for review. This research method will provide a comprehensive understanding of the topic under investigation. The results from the literature review also highlighted the differences in research results regarding the effect of stretching on flexibility and injury. Some studies found a positive association between stretching and increased flexibility, while the results of other studies showed no significant association. This article analyzes the advantages and disadvantages of stretching techniques found in the literature. The implications of these findings can help coaches and athletes design efficacious and safe stretching programs. To conclude, stretching techniques are essential in improving flexibility and may affect preventing sports injuries. However, more research is needed to understand better the mechanisms of stretching techniques' effects on flexibility and sports injuries. Hopefully, this article can provide valuable insights for sports practitioners and researchers to understand better the role of stretching in sports and athlete health

Keywords: Stretching Techniques; Flexibility in Sports; Injuries in Sports; Benefits and Risks of Stretching.

INTRODUCTION

Research on the effect of stretching techniques on flexibility and sports injuries has been a topic of interest to many researchers. Flexibility is the ability of joints and muscles to move maximally with a wide range of motion. Meanwhile, sports injuries are a severe problem that can interfere with the performance and sustainability of athletes. To improve flexibility and prevent injuries, stretching techniques have become integral to sports training programs. Therefore, it is essential to look at a thorough literature review to understand the effect of stretching techniques on flexibility and sports injuries. When performed regularly and correctly, stretching can increase muscle flexibility, improve posture, and increase the range of motion required in various physical activities. Good flexibility is an essential factor in improving athlete performance in multiple sports (Bouguezzi et al., 2023). The success of athletes in achieving their best performance often depends on optimal body flexibility.

Therefore, understanding the effect of stretching techniques on flexibility is essential to improve the quality and performance of athletes.

In addition to improving flexibility, stretching can also play a role in preventing sports injuries, (Behm, Alizadeh, et al., 2023). Poor flexibility can be an indirect cause of injury (Primasoni, 2022). Sports injuries can be a severe obstacle to athletes in achieving their goals. Previous studies have shown that proper stretching exercises before and after sports can reduce injury risk. Correct stretching techniques can help relax muscles and increase elasticity, thus allowing the body to withstand extreme stresses and movements better. Therefore, a deep understanding of the effect of stretching techniques on injury is essential in designing effective and safe training programs for athletes.

The selection of appropriate stretching techniques is also essential in achieving optimal results, (Babault et al., 2021). There are various approaches to stretching, such as static stretching, dynamic stretching, PNF (Proprioceptive Neuromuscular Facilitation), and other methods. Each technique has its advantages and disadvantages. For example, static stretching generally maintains the stretch position for a few seconds, while dynamic stretching involves repetitive, active movements. The approach chosen should be by the exercise goals and individual characteristics. Therefore, an in-depth understanding of various stretching techniques is essential in designing the best exercise program to improve flexibility and prevent sports injuries.

In the literature, there is debate and controversy regarding the effectiveness of stretching in preventing injury. Some studies support the benefits of reducing injury risk, while others show conflicting results. Factors such as the type of sport, training intensity, and the individual concerned may influence the results of the studies. Therefore, conducting a comprehensive literature review is essential to look at the existing evidence and understand the controversy regarding the effectiveness of stretching in preventing injuries.

Through an in-depth literature review, this study aims to analyze the effect of stretching techniques on flexibility and sports injuries. By understanding the implications of previous research, this study can provide a better understanding of the importance of testing in sports training programs and help design programs that effectively improve flexibility and prevent injuries in athletes.

METHOD

Berisi jenis penelitian, waktu dan tempat penelitian, target/sasaran, subjek penelitian, prosedur, instrumen dan teknik analisis data serta hal-hal lain yang berkaitan dengan cara penelitiannya. target/sasaran, subjek penelitian, prosedur, data dan instrumen, dan teknik pengumpulan data, serta teknik analisis data serta hal-hal lain yang berkaitan dengan cara penelitiannya dapat ditulis dalam sub-subbab, dengan sub-subheading. Sub-subjudul tidak perlu diberi notasi atau numbering, namun ditulis dengan huruf kapital, Times New Roman 12 bold, rata kiri, dengan spasi atas dan bawah masing-masing 6pt.

Research Design

The research design in this study includes three main approaches: literature research, secondary analysis of data, and identification and selection of relevant studies. Literature research will explore various sources such as journal articles, books, and research reports to gather relevant information. Secondary data analysis will use existing data to gain new insights into the effect of stretching techniques on flexibility and injury. In addition, identifying and selecting relevant studies will assist in developing a solid research framework. This research method will provide a comprehensive understanding of the topic under investigation.

Table 1. Inclusion and exclusion criteria

Inclusion Criteria	Exclusion Criteria
Research published in peer-reviewed scientific journals	Sources that cannot be verified or are not scientific publications (for example, blogs, forums or personal websites)
Research relevant to the research topic	Studies that are not directly related to the research topic
Research published in an understandable language (English)	Research that is not available in an understandable language
Research published within a specific time period (last 5 years)	Research published before the specified time period
Research with a methodology that is in line with the research objectives	Research that uses irrelevant or inappropriate methodologies
Research that has a sample that covers a relevant sporting population	Research with irrelevant samples or not covering the appropriate sporting population
Research that provides data and findings relevant to the research topic	Research with data and findings that are not relevant to the research topic
Researchers who have full access to the full text	Research that is only available in abstract or summary form
Research that meets good standards of research quality and integrity	Research that does not meet quality standards or has significant methodological issues

Data Collection

The researcher will search for data sources such as journal articles, books, and research reports on the effect of stretching techniques on flexibility and sports injuries. The process involves searching with relevant keywords and selecting data that fit the study's inclusion criteria. Afterwards, data from the various sources were carefully extracted to ensure relevance and suitability to the study. This process ensures that the data used in the literature review is reliable and valid so that the analysis results can reflect the actual state of the research topic. A total of five articles were selected for review

Data Analysis

It is a critical stage in research to obtain valid and meaningful results. This process involves processing data from various sources, such as journal articles, books, and research reports related to flexibility and sports injuries. The data will be organized, extracted, and analyzed using appropriate analytical methods. The analysis results are then carefully interpreted to reveal findings relevant to the research objectives. In this stage, it is also necessary to apply appropriate statistical approaches to provide validity to the results obtained. With a structured and careful method of data analysis, this research can significantly contribute to understanding the effect of stretching techniques on flexibility and sports injuries.

RESULTS AND DISCUSSION

Results

Flexibility and injury in sports play a crucial role in athletes' performance and health maintenance. As the importance of stretching in improving flexibility and reducing injury risk increases, scientific research continues to evolve to provide greater insight. This paper details the key findings from related studies focusing on the relationship between stretching and flexibility.

In this discussion, we will look at research results that illustrate the positive impact of stretching on improving flexibility. Each approach has its own implications on athlete health outcomes, from static stretching exercises to dynamic and PNF methods. In addition, understanding the relationship between age, gender and sport type with flexibility levels is also an important focus.

By detailing the findings from various studies, we hope to provide a solid foundation for readers to understand the importance of integrating stretching exercises into exercise routines. This information is helpful for coaches, athletes, and researchers who continue to contribute to the development of sports

science. By digging deeper, we can build a solid knowledge base to improve the health and performance of athletes in the future. Based on the literature review stage carried out. five articles were obtained which will be analysed in more depth. the analysis was carried out based on data on article titles, journals where published, and research results written in the article. The following in-depth analysis of the five articles is shown in table 2.

Table 2. Related Research Results

Author and year	Article Title	Title of the journal	Results
(Nabira Izhar et al., 2023)	Effectiveness of Plantar Fascial Mobilization and Static Stretching on Hamstrings Flexibility among Overweight Individuals	The Healer Journal of Physiotherapy and Rehabilitation Sciences	The results showed that plantar fascial mobilization and static stretching were superior in improving hamstring flexibility.
(Bouguezzi et al., 2023)	Why Flexibility Deserves to Be Further Considered as a Standard Component of Physical Fitness: A Narrative Review of Existing Insights from Static Stretching Study Interventions	Youth	Flexibility deserves further consideration as a standard component of physical fitness. This is based on the finding that in addition to flexibility, long-term SS training induces positive effects on muscle strength, muscle power, and muscle hypertrophy, regardless of age and gender.
(Behm, Alizadeh, et al., 2023)	Potential Effects of Dynamic Stretching on Injury Incidence of Athletes: A Narrative Review of Risk Factors.	Sports medicine (Auckland, N.Z.)	The acute effects of dynamic stretching on thixotropic effects and psycho-physiological responses could benefit injury reduction.
(Witvrouw et al., n.d.)	Stretching and injury prevention: an obscure relationship.	Sports medicine (Auckland, N.Z.)	That increased flexibility of the muscle-tendon unit improves performance and reduces the number of injuries.
(Afonso et al., 2021)	Strength Training versus Stretching for Improving Range of Motion: A Systematic Review and Meta-Analysis.	Healthcare (Basel, Switzerland)	A total of eleven articles (n = 452 participants) were included in this study. Pooled data showed no difference between ST and stretching on ROM (ES = -0.22; 95% CI = -0.55 to 0.12; p = 0.206). Sub-group analysis based on the risk of bias, active vs. passive ROM, and movement-by-joint analysis showed no difference between protocols in ROM improvement.

Discussion

1. Definition of Flexibility and Sports Injuries

Flexibility in a sporting context can be defined as the ability of joints and muscles to move fully within a normal range of motion. Flexibility involves muscle flexibility, joint flexibility, and connective tissue flexibility. According to research (Ingraham), good flexibility can improve sports performance, minimize the risk of injury, and aid post-workout recovery. Sports injury is damage or disruption to body tissues due to physical activity or exercise. Sports injuries can include muscle, joint, ligament, and tendon injuries. Research conducted by (Chapon et al., 2022) in the journal *Frontiers in Sports and Active Living* shows that sports injuries can negatively impact athlete performance and require adequate treatment for optimal recovery.

There is a close relationship between the level of flexibility and the risk of sports injury. According to a study conducted by (Behm, Aragão-Santos, et al., 2023), increased flexibility can reduce the risk of injury, especially muscle and ligament injuries. Poor flexibility can lead to muscle tension, imbalances, and decreased joint stability, increasing the likelihood of injury. Flexibility has a vital role in sports performance and injury prevention. A regular flexibility training program can help prevent sports injuries. (Warneke et al., 2023), good flexibility can increase muscle strength, agility, and movement coordination and reduce muscle tension.

Several methods and tests can be used to evaluate the level of flexibility. One commonly used test is the Sit and Reach test, which measures the flexibility of the back and hamstring muscles. This test can provide objective information about the level of flexibility. In addition, other methods, such as goniometry (measurement of joint range of motion) and specialized tests for joint flexibility, can also be used for flexibility evaluation.

2. Factors Affecting Flexibility

1). Age and Gender

Age and gender factors can affect a person's level of flexibility. Studies show that with age, flexibility tends to decrease. Research by (Donti et al., 2022), found that the age group of 40 years and above had lower flexibility levels than younger age groups. In addition, there are differences in flexibility between men and women. (Yu et al., 2022), Women in similar age groups and fitness levels tend to have higher flexibility levels than men.

2). Sports Activity

Sports activities performed can have an impact on a person's level of flexibility. Certain sports, such as yoga or gymnastics, focus intensely on stretching and flexible movements. Research by (Luo & Huang, 2023), revealed that yoga practitioners have higher flexibility levels than individuals who do not do the sport. Sports that rely on full range of motion, such as gymnastics or ballet, can also contribute to increased flexibility.

3). Stretching Exercises

Stretching exercises are a commonly used method to improve flexibility. Research shows that regular stretching exercises can result in significant improvements in flexibility. In a study by (Alizadeh et al., 2023), stretching exercises performed regularly can increase body flexibility. Physical fitness level and body composition also affect a person's flexibility. Research shows that individuals with good physical fitness tend to have higher levels of flexibility. Individuals with high levels of cardiovascular fitness have better flexibility than those with low levels of fitness. In addition, body composition also affects flexibility. A study by (Conlin et al., 2021), showed that individuals with a low percentage of body fat tend to have higher levels of flexibility.

4). Anatomical and Structural Factors

In addition to these other factors, differences in anatomical and structural elements of the body can also affect an individual's level of flexibility. For example, muscle length and connective tissue elasticity can affect the body's ability to achieve flexible movements. Research by (Stecco et al., 2021) suggests that individuals with anatomical characteristics that favor muscle length tend to have higher levels of flexibility. However, it is essential to note that these anatomical and structural factors are individualized and may vary from individual to individual. Warming up before an exercise or sporting activity also influences flexibility levels. A proper warm-up can help increase body temperature and prepare muscles and connective tissues for more extensive movements. A study by (Warneke et al., 2022), found that a dynamic warm-up before stretching exercises significantly increased flexibility

compared to no introduction. Thus, a good introduction before sports activities can be an essential factor in improving flexibility and preventing injury.

3. Benefits of Stretching in Improving Flexibility

Good flexibility is an essential aspect of the sport, as it affects the range of motion (ROM) of joints and muscles and the athlete's ability to respond to external forces. Stretching exercises have been known to have significant benefits in improving flexibility. Stretching consistently and regularly can increase ROM, muscle and tendon elasticity, and improve posture. According to a study by (Turci et al., 2023), stretching exercises directed at significant muscles can increase flexibility by changing the length and elasticity of muscle fibers.

In addition, stretching performed before and after training can improve athletic performance. A study by (Lyu et al., 2020) found that dynamic stretching before sports activities can improve muscle contraction ability, accelerate neuromuscular responses, and increase thrust during explosive movements. This can give athletes a competitive advantage in achieving better sports results. In addition to performance benefits, stretching is essential in injury prevention. Research by (Nazir et al., 2022) shows that proper stretching exercises can improve flexibility, reduce muscle stiffness, and increase resistance to injury. By improving flexibility, stretching helps reduce strain on muscles and tendons, reducing the risk of injuries such as muscle strains or ligament tears.

Beyond the physical benefits, stretching also has positive psychological effects. According to research by (Higaki et al., 2021), passive static stretching can reduce muscle tension, promote relaxation, and give individuals peace. This can help reduce stress and improve general well-being. Stretching has essential benefits in improving body flexibility. In sports, stretching can improve ROM, muscle elasticity, and athletic performance and reduce the risk of injury. In addition to the physical benefits, stretching also has positive psychological effects. Therefore, regular and proper stretching exercises can be essential to a sports training program to achieve optimal body flexibility.

4. Stretching as Injury Prevention

Sports injuries refer to physical damage that occurs during sports or intense physical activities. These injuries can involve muscles, tendons, ligaments, or bones. According to research published in the British Journal of sports medicine, sports injuries are a common consequence of intense physical activity and often occur in athletes and physically active individuals, (Soligard et al., 2022). Various factors, including excessive movement, muscle tension, fatigue, and lack of flexibility, can cause sports injuries. Risk factors such as lack of adequate warm-up, poor posture, and lack of flexibility can increase the likelihood of sports injuries, (Thacker et al.).

Body flexibility plays an essential role in the prevention of sports injuries. Adequate levels of flexibility can help maintain joint stability, improve posture, and reduce excess stress on muscles and tendons. According to a study published in The Healer Journal of Physiotherapy and Rehabilitation Sciences, a lack of flexibility can increase the risk of muscle and ligament injuries, (Tahir, 2021). Regular stretching can provide significant benefits in the prevention of sports injuries. Stretching before and after physical activity can increase muscle strength and elasticity, improve blood circulation to muscles, and increase joint range of motion. A study published in the British Journal of sports medicine showed that regular stretching can help reduce the risk of muscle and tendon injuries, (Witvrouw et al.).

Various stretching techniques can be used for sports injury prevention, including dynamic, static, and PNF (Proprioceptive Neuromuscular Facilitation). Dynamic stretching involves active, rhythmic movements that engage the muscles and joints used during sports activities. Dynamic stretching effectively improves performance and reduces the risk of injury, (Behm, Alizadeh, et al., 2023). Although there are mixed opinions on the effectiveness of stretching in preventing sports injuries, most studies support the benefits of trying to reduce the risk of injury. However, it is essential to note that the effectiveness of stretching may vary depending on the individual, the type of sport, and the context. An article published in the International Journal of sports physical therapy concluded that stretching may provide benefits in injury prevention in some cases, (Behm, Aragão-Santos, et al., 2023).

5. Different Stretching Technique Approaches

In this literature review, several different approaches to stretching techniques that are often used in sports will be discussed. Firstly, static stretching is a technique that involves maintaining the stretch position for some time. Studies conducted by ((Zaidi et al., 2023), showed that passive static stretching can effectively improve muscle flexibility. In addition, active static stretching can also increase

flexibility and reduce muscle tension after sports activities. Furthermore, a dynamic stretching approach involves repetitive movements with a full range of motion. Research conducted by (Iwata et al., 2019) showed that dynamic stretching can improve the ability of muscles to extend their active range of motion. Examples of commonly used emotional stretching techniques are undulating stretching and rotating stretching.

In addition, another approach is PNF (Proprioceptive Neuromuscular Facilitation), which involves a combination of muscle contraction and relaxation controlled with the help of a partner or device. According to research conducted by (Lim, 2020), the PNF method can provide significant advantages in improving muscle flexibility compared to other stretching methods. The PNF method consists of several techniques, including the Contraction-Relaxation and Contraction-Relaxation-Antagonist methods.

Other stretching methods, such as active-isometric, bow ball, or assisted stretching, can be used. According to (Afshari et al., 2023), the active-isometric stretching technique can increase flexibility by utilizing isometric contraction of muscles before stretching movements. In the bow ball trying approach, a ball-shaped aid is used to extend the range of motion. Meanwhile, assisted stretching techniques involve assistance from a partner or tool to help develop muscle range of motion (Ameer Hussain et al., 2022). Each stretching technique approach has its advantages and disadvantages. Therefore, selecting an appropriate stretching technique should be tailored to the goals and needs of the individual or athlete. In addition, factors such as sport type, fitness level, and physical condition may also influence the choice of an effective stretching technique.

6. The controversy surrounding the Effectiveness of Stretching in Preventing Injuries

The effectiveness of stretching in preventing sports injuries is controversial in the literature. Studies have shown mixed results, reinforcing the debate over the benefits of stretching before exercise. A study published in the international journal of sports physical therapy found that static stretching before physical activity can improve flexibility and reduce the risk of injury, (Behm, Aragão-Santos, et al., 2023). However, some other studies show that stretching before exercise does not significantly prevent harm.

Controversy also arises from differences in the methodology and study design used. Some studies may have had small samples or used inconsistent measurement methods. A review published in the Journal of Functional Morphology and Kinesiology concluded that differences in stretching methods, such as duration and intensity, may lead to different results in existing studies, (Bryant et al., 2023). In addition, individual response to stretching is also a controversial factor. A study by (Bryant et al., 2023), showed a significant variation in individual responses to stretching. Some athletes may feel a performance improvement and prevent injury by trying, while others may not feel the same benefits.

Controversy also arises from the different sporting contexts and types of injuries studied. A study published in the Journal of Human Kinetics suggests that the benefits of stretching in preventing damage depend on the sport being performed. Dynamic stretching may provide more significant benefits in sports that involve repetitive movements, such as running. In contrast, static stretching may be more beneficial in sports that require high flexibility, such as gymnastics, (Zmijewski et al., 2020).

In looking at this controversy, gaining a more holistic understanding and considering multiple viewpoints is necessary. A more individualized approach in the application of stretching based on the needs of each athlete, given the varied responses of individuals. In conclusion, the controversy surrounding the effectiveness of preventing injury underscores the need for more in-depth research and consideration of context and individual response in applying stretching in sports.

1). Interpretation and Analysis of Study Results.

The results from the literature review indicate that stretching techniques have a positive relationship with improving flexibility in sports. Some studies reported that dynamic stretching was more effective in enhancing flexibility than static stretching (Lee et al., 2020). However, it is essential to consider the type of sport being performed, as proper stretching techniques may vary depending on the specific sporting activity.

2). Advantages and Disadvantages of Discovered Stretching Techniques

Some advantages of applying stretching techniques include increased range of motion, improved muscle circulation, and reduced risk of injury in athletes. The disadvantages of stretching before certain sports are that it can temporarily decrease muscle strength and sub-optimal sports performance.

3).Relevance of Findings to Research Objectives

The findings from this literature review consistently support our research objective to evaluate the effect of stretching techniques on flexibility and injury in a sporting context. Given these results, it can be concluded that stretching has an essential role in improving athletes' flexibility and helping to reduce the risk of sports-related injuries (Warneke et al., 2022).

4).Comparison with Other Research

The researcher's findings align with previous studies that suggest dynamic stretching is more effective than static stretching in improving flexibility. However, it should be noted that some studies also showed different results, and it is essential to consider the variation in the methodology used in these studies.

5).Implications and Significance

Knowledge of effective stretching techniques can positively impact athletes training and physical preparation. By integrating appropriate stretching into training programs, coaches and athletes can improve sports performance and reduce the risk of injury associated with high-intensity exercise (Andersen, n.d.). Implementing athletes' training programs is essential to ensure their health and success in competition.

6).Weaknesses and Limitations of the Literature Review

Although this literature review presents a wide range of relevant research, some limitations should be noted. Some studies have small sample sizes or varying research designs, which may affect the accuracy and generalizability of the findings. Furthermore, some studies may not have considered other variables affecting flexibility and injury risk, such as athletes' fitness levels and underlying medical conditions.

7).Suggestions for Future Research

To deepen the understanding of the effect of stretching techniques on flexibility and sports injuries, it is recommended that future studies include a larger sample group and pay attention to other potential factors that may affect the study results. In addition, conducting a more detailed intervention study may provide additional insight into the effectiveness of stretching techniques in a natural sports training environment.

CONCLUSION

This study has successfully explored the Effect of Stretching Techniques on Flexibility and Injuries in Sports through a literature review and analysis of related research results. The literature review identified that flexibility is essential in sports performance and injury prevention. Various factors such as age, gender, sports activities, and stretching exercises can affect a person's level of flexibility. The results of related studies show that stretching techniques can effectively improve flexibility, with dynamic stretching and PNF showing better results than static stretching. In addition, stretching has also been shown to contribute to preventing sports injuries, as it improves flexibility and muscle readiness. However, it is essential to remember that there is controversy surrounding the effectiveness of stretching in preventing injury. Some studies suggest that stretching before exercise can reduce strength and performance, so more research needs to be done to understand the true impact of stretching on sports injuries.

The implication of this study is the importance of including stretching exercises in sports training programs to improve flexibility and reduce the risk of injury. We recommend that sports practitioners, coaches, and athletes incorporate dynamic stretching and PNF techniques in warm-up and cool-down routines. Although these studies provide a better understanding of the effect of stretching techniques, there are some limitations to note. Sample sizes in some studies may be limited, and other factors, such as genetics and sport-specific activities, have yet to be fully considered. For future studies, we encourage researchers to involve more prominent and representative sample sizes and further identify the mechanisms underlying the effects of stretching on sports injuries. With a more comprehensive understanding, we can develop more effective and safe exercise approaches to improve flexibility and reduce the risk of sports injuries.

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