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REVIEW ARTICLE

EFFECT OF STRETCHING ON MOTOR SKILLS AND INJURY REDUCTION IN FEMALE FOOTBALL PLAYERS

WPŁYW ĆWICZEŃ ROZCIĄGAJĄCYCH NA ZDOLNOŚCI MOTORYCZNE I ZMNIEJSZENIE LICZBY URAZÓW SPORTOWYCH WŚRÓD PIŁKAREK NOŻNYCH

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ABSTRACT

Introduction

Due to the growing popularity of women's football and in view of the increasing information on the importance of the use of stretching exercises by athletes in various sports, including football, it is reasonable to review the data on the importance of stretching in the training process and the prevention of musculoskeletal injuries in women's football.

Aim

This systematic review investigates the quality of scientific evidence on the effect of stretching on motor skills and the impact of stretching on reducing the number of injuries in female football players.

Material and methods

PubMed and Web of Science databases were searched using keywords such as football, soccer, female, woman, stretching, stretch, injuries, injury, performance, strength, speed, coordination, flexibility, endurance, and agility. Methodological quality was assessed using the PEDro scale and Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies.

Results

Among 172 records, only six articles met the criteria and were included in the systematic review.

Conclusions

While stretching has been shown to have positive effects on motor skills, particularly balance and strength, its impact on injury prevention remains uncertain. Stretching should be considered as one element within a comprehensive training program. More research is needed to gain a better understanding of the role of stretching in women's football and its impact on injury prevention.

Keywords: football, women, stretching, injuries, motor skills

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STRESZCZENIE

Wprowadzenie

Z powodu rosnącej popularności piłki nożnej kobiet oraz wobec coraz częstszych informacji dotyczących znaczenia stosowania ćwiczeń rozciągających przez sportowców różnych dyscyplin, w tym także w piłce nożnej, uzasadnione jest zweryfikowanie danych na temat znaczenia rozciągania w procesie treningowych i profilaktyce uszkodzeń narządu ruchu w piłce nożnej kobiet.

Cel

W tym przeglądzie systematycznym przeanalizowano jakości dowodów naukowych na dotyczących wpływu ćwiczeń rozciągających na zdolności motoryczne oraz na zmniejszenie liczby urazów u kobiet w piłce nożnej.

Materiał i metody

Bazy danych: PubMed i Web of Science zostały przeszukane przy użyciu słów kluczowych takich jak piłka nożna, kobieta, rozciąganie, rozciągać, kontuzje, urazy, wydajność, siła, prędkość, koordynacja, elastyczność, wytrzymałość, zwinność. Jakość metodologiczna została oceniona za pomocą skali PEDro i narzędzia Oceny Jakości dla Badań Kohortowych i Badań Przekrojowych.

Wyniki

Spośród 172 rekordów tylko 6 artykułów spełniało kryteria i zostało włączonych do przeglądu systematycznego.

Wnioski

Chociaż wykazano, że stretching ma pozytywny wpływ na zdolności motoryczne, szczególnie na równowagę i siłę, jego wpływ na zapobieganie urazom sportowym pozostaje niepewny. Stretching powinien być traktowany jako jeden z elementów kompleksowego programu treningowego. Potrzeba więcej badań, by lepiej zrozumieć rolę rozciągania w piłce nożnej kobiet i jego wpływ na zapobieganie uszkodzeniom narządu ruchu.

Słowa kluczowe: piłka nożna, kobiety, rozciąganie, uszkodzenia, zdolności motoryczne

Introduction

For many years, stretching has been considered a significant factor in injury prevention and enhancing specific abilities. It is well-established that regular stretching positively impacts speed, power, and strength. Regular stretching leads to a 2% to 5% increase in force and power and improves 50-yard running speed by approximately 0.06 seconds (Shrier, 2005). While researchers acknowledge the variations in the types of stretching and their effects, there is no doubt that stretching has a beneficial impact on sports abilities (Bressel *et al.,* 2007; Bullis *et al.,* 2007; Amiri-Khorasani, 2015). Consequently, stretching is an essential component of any sport and is included in many injury preventions and strengthening programs. Football, in particular, has been extensively studied regarding the effects of stretching (Bressel *et al.,* 2007; Bullis *et al.,* 2007).

Football is undoubtedly the most popular team sport globally, with FIFA currently comprising 211 countries and 140 million players. This popularity and the associated substantial financial investments result in a considerable number of articles

dedicated to this sport. Numerous studies focus on injury prevention programs such as FIFA+ or comparative skills studies among specific player groups (Bizzini and Dvorak, 2015; Silvers-Granelli *et al.,* 2017; Bojkowski *et al.,* 2022). Despite the wealth of knowledge available, football experiences a higher incidence of injuries, especially in the lower limbs, compared to other sports (Wong and Hong, 2005). Accurately determining this parameter is challenging, but researchers estimate injury rates at 8.1/1000 hours of exposure for men and 4.6/1000 hours of exposure for women (Le Gall, Carling, and Reilly, 2008; López-Valenciano *et al.,* 2020). Studies indicate that injury incidence is higher in men, but there is no difference in the rate of moderate to severe injuries between men and women (Hägglund, Waldén, and Ekstrand, 2009). Despite the extensive research on football, there is a significant disparity in research attention between male and female football players. Despite women's football being one of the fastest-growing sports worldwide, it still does not receive the same attention as men's football (Crossley *et al.,* 2020). It should be noted that over 13 million women are playing football globally, highlighting the need for greater focus on women's football (FIFA, 2019). To the best of the authors' knowledge, no systematic reviews explicitly examine the effects of stretching on women playing football, encompassing improvements in motor skills and injury prevention. Consequently, the authors decided to conduct research in this area. The specific aims of this systematic review were as follows: A) To determine the influence of stretching on the development of motor skills among female football players. B) To investigate whether stretching reduces the number of injuries in female football.

Methods

Individual Studies

Studies were identified through a computerized literature search in two databases, PubMed and Web of Science, conducted on August 31, 2022. The search was performed using the PICO framework and the following keywords: football OR soccer AND female OR woman AND stretching OR stretch AND injuries OR injury OR performance OR strength OR speed OR coordination OR flexibility OR endurance OR agility. There were no restrictions on the publication year or language.

All search results were collected in Excel, including the publication titles and authors. Several inclusion and exclusion criteria were applied for this review. The most important criterion was that the studies had to involve women who played football. Articles unrelated to sports were excluded. The studies had to focus on stretching, motor skills, or injuries in football.

The title, abstract, and full text of the articles were assessed for eligibility based on the criteria. The final selection of articles was reviewed and approved by two independent authors.

Types of Studies

This systematic review included randomized controlled trials and cohort studies, while systematic reviews were excluded. Figure 1 presents a flow chart depicting the study selection process.

Validity

The methodological quality of the studies was assessed using the Pedro scale and the Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies (Waldén, Hägglund, and Ekstrand, 2015). Two independent authors conducted the methodological assessment.

The Pedro Scale is a validated scale widely used to assess the quality of scientific studies, including clinical research. It consists of 11 criteria; each assigned a score from 0 to 1 based on the fulfillment of the criteria. A higher final score indicates higher study quality. Scores below 4 indicate poor quality, 4–5 indicate fair quality, 6–8 indicate good quality, and 9–10 indicate excellent quality (Cashin and McAuley, 2020).

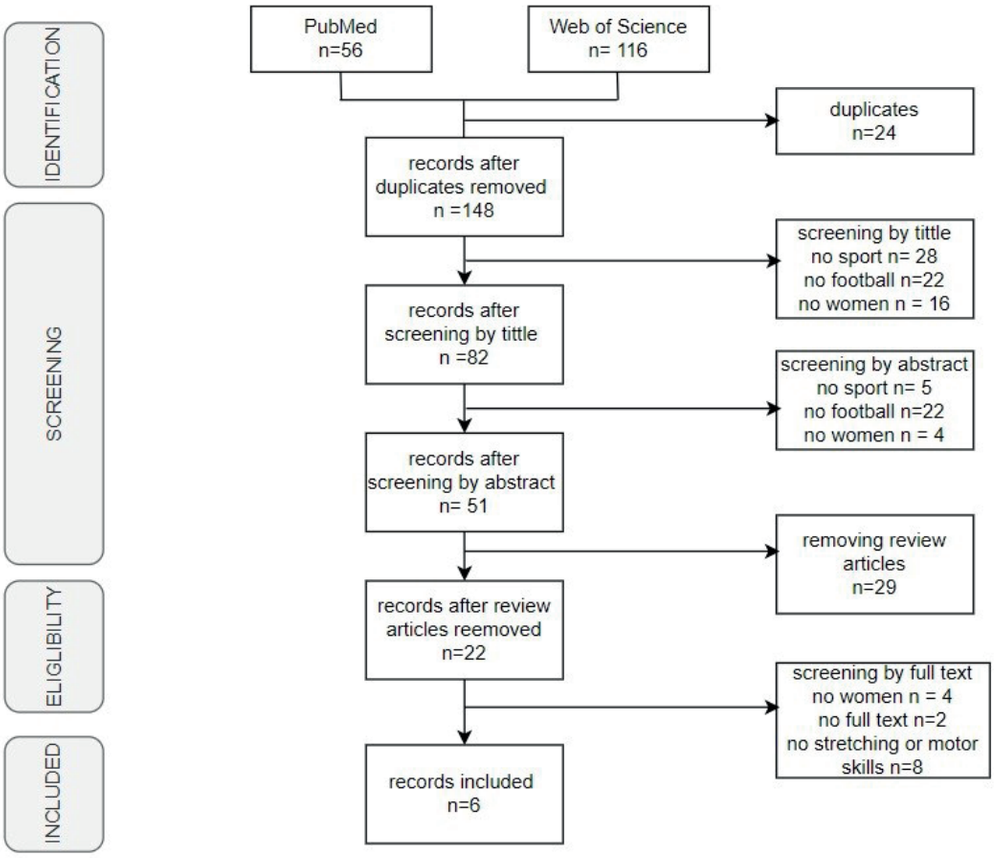

Figure 1 Flow chart of study selection

The Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies comprises 14 questions, each with response options of "yes," "no," or "not reported in this study." The quality rating can be classified as good, fair, or poor. A cohort study is considered poor if there are "yes" responses in 0–4 out of the 14 questions, fair if there are 5–10 "yes" responses, and good if there are 11–14 "yes" responses out of 14 questions (Bagias *et al.*, 2021).

Results

Among the initial 172 records identified, only six articles met the inclusion criteria and were included in the systematic review.

Two independent authors assessed the methodological quality of the included studies. There was no blinding of the authors of the studies. The results of the rating for the randomized controlled trials (RCTs) are described in Table 2, while the rating for the cohort study is presented in Table 1. Any disagreements between the authors were resolved through discussion and consultation with a third author. Four RCT studies were classified as good, and one was classified as fair. The cohort study was also classified as fair.

The study selection process is depicted in Figure 1. After removing duplicates, there were 148 records remaining. Ultimately, only six articles met the criteria and were included in the systematic review. The final selection of articles was performed independently by two authors who screened the full text of the articles and approved them.

Among the six articles that met the inclusion criteria, four articles focused on motor skills, while two articles addressed injuries in female football. Table 3 provides the characteristics of the included studies.

Emery and Meeuwisse conducted a study on the influence of neuromuscular training on injuries (Emery and Meeuwisse, 2010).

Table 1. Quality assessment for cohort study.

Effectiveness of a Neuromuscular and Proprioceptive Training Program in Preventing Anterior Cruciate Ligament Injuries in Female Athletes 2-Year Follow-up	**Yes**	**No**
1. Was the research question or objective in this paper clearly stated?	X	
2. Was the study population clearly specified and defined?	X	
3. Was the participation rate of eligible persons at least 50%?	X	
4. Were all the subjects selected or recruited from the same or similar populations (including the same time period)? Were inclusion and exclusion criteria for being in the study prespecified and applied uniformly to all participants?	X	
5. Was a sample size justification, power description, or variance and effect estimates provided?		X
6. For the analyses in this paper, were the exposure(s) of interest measured prior to the outcome(s) being measured?	X	
7. Was the timeframe sufficient so that one could reasonably expect to see an association between exposure and outcome if it existed?	X	
8. For exposures that can vary in amount or level, did the study examine different levels of the exposure as related to the outcome (e.g., categories of exposure, or exposure measured as continuous variable)?	NA	
9. Were the exposure measures (independent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?	X	
10. Was the exposure(s) assessed more than once over time?		X
11. Were the outcome measures (dependent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?	X	
12. Were the outcome assessors blinded to the exposure status of participants?		X
13. Was loss to follow-up after baseline 20% or less?	X	
14. Were key potential confounding variables measured and adjusted statistically for their impact on the relationship between exposure(s) and outcome(s)?	X	

The study included both girls and boys aged 13–18 years. A total of 60 teams were included, with 380 participants in the study group and 264 participants in the control group. The study was conducted over a one-year period during the 2006/2007 season. The teams were randomly assigned to either the study or control group, and they were unaware of the training details of the other groups involved in the study. Physiotherapists provided training programs to the coaches and players of the teams. The control group followed a warm-up routine consisting of 15 minutes of standard warm-up exercises, including aerobic exercises, static stretching, and dynamic stretching. The research group received an additional 5-minute program that included aerobic exercises and dynamic stretching. Moreover, the participants in the control group also received a 10-minute set of neuromuscular exercises (strength, agility, balance) and a 15-minute balance training program to be performed at home. Participants were provided with a diary to record their weekly exercises. The balance training was conducted using a 16-inch diameter wobble board called Fitter First. After one year, the researchers reported a total of 129 injuries, with 50 injuries in the study group and 79 injuries in the control group. An injury was defined as any harm that required medical attention or led to a player's absence from participation in the game. The injury rate was calculated as 2.08 per 1000 hours played in the study group and 3.35 per 1000 hours played in the control group. Additionally, in the study group, 46 players experienced one injury, and two players experienced two injuries. In the control group, 63 players suffered one injury, five players suffered two injuries, and two players suffered three injuries. The authors noted a 38% reduction in injuries in the study group compared to the control group. Gender was not identified as a significant determinant of injuries, although the authors observed a higher tendency for women to experience knee and ankle injuries. There was no observed correlation between

Table 2. Quality assessment for RCT.

	Acute effects of different stretching methods on static and dynamic balance in female football players	**Effects of a program of stretching in the development of muscular strength in women's soccer players**	**The effects of two stretching protocols on the reactive strenght index in female soccer and rugby players**	**The effectiveness of a neuromuscular prevention strategy to reduce injuries in youth soccer: a cluster-randomised controlled trial**	**The effects of different stretching techniques of the quadriceps muscles on agility performance in female collegiate soccer athletes: a pilot study**
eligibility criteria were specified	1	1	1	1	1
subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received)	1	1	1	1	1
allocation was concealed	0	0	0	1	0
the groups were similar at baseline regarding the most important prognostic indicators	0	0	0	0	0
there was blinding of all subjects	0	0	0	1	0
there was blinding of all therapists who administered the therapy	0	0	0	0	0
there was blinding of all assessors who measured at least one key outcome	0	0	0	0	0
measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups	1	1	1	1	0
all subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case, data for at least one key outcome was analysed by "intention to treat	1	1	1	1	1
the results of between-group statistical comparisons are reported for at least one key outcome	1	1	1	1	1
the study provides both point measures and measures of variability for at least one key outcome	1	1	1	1	1
Total score	6	6	6	8	5
Quality rating	Good	Good	Good	Good	Fair

Table 3. Characteristic of the studies.

Tittle	Authors	Study design	Patient	Intervention	Follow up	Outcome
The effectiveness of a neuromuscular prevention strategy to reduce injuries in youth soccer: a cluster-randomised controlled trial	Emery, Meeuwisse (2010)	RCT	male and female 13–18 years; players from 60 soccer teams training n = 380 control n = 364	The training group: specific neuromuscular training programm (dynamic stretching, eccentric strength, agility, jumping and balance) The control group: standardised warm-up (static and dynamic stretching and aerobic components)	1 year season 2006/2007	The injury rate in the training group was 2.08 injuries/1000 player-hours, and in the control group 3.35; nuromuscular training warm-up was is protective fall all of injuries
Effectiveness of a neuromuscular and proprioceptive training program in preventing anterior cruciate ligament injuries in female athletes – 2-year follow-up	Mandelbaum, Silvers,Watanabe, Knarr,Thomas, Griffin,Kirkendall, Garrett, (2000)	Cohort study	female soccer players year 14–18; In the 2000 season study group n = 1041 control group n = 1905; In the 2001 season, study group n = 844 control group n = 1913	Study group performed traditional warm-up and study group sports-specific training intervention before athletic activity over a 2-year period. Sport specific training included: education, stretching, strengthening, plyometrics, and sports-specific agility drills	2 years	In the 2000 soccer season, the incidence of injuries in the study group was 1.9/1000 players compared to the control group 16.8/1000 players; In year 2 (2001) The incidence in the study group was 4.74/1000 players and in the control group 18.3/1000 players There was 74% reduction in injuries due to preventing programme
The effects of two stretching protocols on reactive strenght index in female soccer and rugby players	Werstein, Lund, (2012)	RCT	15 soccer and rugby female players year 20.1–5.9	Subjects participated in three different training sessions Session 1: WO, session 2: warmup followed by SS, session 3 warm-up followed by DS. After each session subjects performed drop jump test. Each sesson was separated 1 week	3 weeks	Dynamics stretching was best for improving RSI
Acute effects of different stretching methods on static and dynamic balance in female football players	Amiri-Khorasani (2014)	RCT	24 female football players age = 22.08 ± 0.77 years	Subjects were divided in four groups and performed different warm-up protocols-static, dynamic, combined and no stretching-over four days; after that dynamic and static balance test were performed	10 days	Dynamic stretching resulted in improving static balance and dynamic and combined stretching improved dynamic balance
The effects of different stretching techniques of the quadriceps muscles on agility performance in female collegiate soccer athletes: a pilot study.	Wallmann, Gillisb Martinezc (2008)	RCT	12 femalle collegiate soccer players; age 18–25	Subjects performed 3 stretching protocols (static, contract-relax, no stretch) each on different day; after completing the warm-up subjects performed t-test one time	1 week	No significant difference was found among the different stretching techniques; stretching has no influence on agility performance
Effects of a program of stretching in the development of muscular strength in women's soccer players	Valdivia, Moreno, González, Pineda, Valencia, Gómez (2015)	RCT	16 female soccer players age 19.03 ± 2.7 years control n = 8 subjects n = 8	subjects performed flexibility training (proprioceptive neuromuscular facilitation (PNF) and passive static) during 30 days with moderated intesity; test were performed before and after programm	30 days	stretching impacts positively on the IGF

RCT – randomized controlled trail, WO- warm-up only, SS-static stretching, DS.- dynamic stretching, RSI- reactive strenght, IGF – general flexibility index

the study group and the severity of injuries. Previous injury occurrences were identified as a factor increasing the risk of future injuries (Emery and Meeuwisse, 2010). Both programs included stretching exercises, so they do not have a direct impact on reducing the risk of injuries. In addition, in the control program that did not result in a reduction in the incidence of injuries, the main component was stretching exercises. Nervous muscle training was effective in reducing the number of injuries, but in the context of our review, stretching has no significant impact on this program and thus on the occurrence of injuries.

Mandelbaum *et al.* (2005) aimed to investigate the influence of a sports-specific program on preventing ACL injuries in soccer league players aged 14–18 years in Southern California. The research group consisted of 1.041 female athletes in the first year (2000) and 844 competitors in the second year (2001), while the control group comprised 1.905 female athletes in the first year and 1.913 competitors in the second year. The research group teams voluntarily participated in the study after receiving an email, whereas the control group teams were the remaining teams participating in league games. Fifty-two teams signed up for the 2000 season, and 45 teams signed up for the 2001 season. All teams received educational materials presenting the warm-up program, and the coaches attended a meeting where the program was explained. The control group performed the standard warm-up, while the research group followed a 20-minute program consisting of education, stretching, strengthening, plyometrics, and sports-specific agility drills. Injuries were reported weekly to the coordinator, including details such as injury location, mechanism, and severity. For ACL injuries, players received an additional questionnaire, and the researchers confirmed the injury through interviews, medical examinations, and MRI results. Only non-contact ACL injuries were considered for the analysis. Exposure was defined as the total time the athletes were at risk of injury. In the year 2000, the research group had 37.276 exposures, while the control group had 68.580 exposures. Two cases of ACL injuries were reported in the research group, compared to 32 cases in the control group. The incidence of injuries in the research group was 1.9/1000 players, whereas in the control group, it was 16.8/1000 players. During the season, the total number of exposures in the research group was 30.384, and in the control group, it was 68.868. There were four ACL injuries in the research group and 35 ACL injuries in the control group. This translates to a 74% reduction in injuries compared to the control group. The incidence of ACL injuries in the control group was 4.74/1000 players, while in the research group, it was 18.3/1000 players. In the 2001 season, the number of teams in the study decreased from 52 to 45. The authors of the study acknowledged that various factors, including hormonal, anatomical, and environmental factors, may influence ACL injuries. However, they concluded that the neuromuscular program had a significant effect in reducing the incidence of severe ACL injuries. Although stretching was part of the prevention program, the authors found it challenging to determine stretching alone as the specific factor responsible for reducing ACL injuries. Therefore, while stretching may contribute to injury prevention, it is considered as a supplement to the overall exercise program rather than an individual exercise.

Werstein and Lund (2012) aimed to compare the effects of two types of force stretching on a group of female soccer and rugby players. The participants consisted of 15 Division I female athletes aged 20.1 to 25.9 years who had similar physical conditions. The research was conducted over a period of three weeks, with each training session taking place once a week at the same time and day. There were three protocols used in the study: 1) warm-up only (WO): The athletes performed a 10-minute warm-up session on an ergometer, 2) static stretching (SS): The athletes performed a 10-minute warm-up session on an ergometer, followed by static stretching on four muscle structures in the lower limb.

Each stretch was held for 30 seconds, with 10 seconds of rest between stretches, and repeated three times, and 3) dynamic stretching (DS): The athletes performed a 10-minute warm-up session on an ergometer, followed by dynamic stretching on the same muscle structures as in the static stretching protocol. Each stretch was performed 10 times, with 10-second breaks between stretches. The participants were instructed on how to warm up before the tests. After the warm-up, the athletes performed a drop jump from a 45 cm crate. Each participant performed two unrecorded tests and one recorded test, which was used to calculate the time of contact with the ground and the time of flight. Based on these measurements, the reactive strength index (RSI) was calculated. The results of the study indicated that dynamic stretching had a positive effect on increasing flight time and reducing ground contact time. Dynamic stretching also had a significant impact on improving the reactive strength index (RSI). On the other hand, static stretching, and non-stretching (warm-up only) did not show a significant impact on RSI. In the context of this review, the study's results support the notion that stretching, specifically dynamic stretching, has a beneficial effect on reactive strength (Werstein and Lund, 2012).

Amiri-Khorasani (2015) compared the effects of different stretching methods on static and dynamic balance in female soccer players. The participants consisted of 24 female soccer players with an average age of 22.08 ± 0.77 years who were all at a similar level of skill and performance. None of the participants had any serious injuries or balance problems. The participants were randomly divided into four groups after receiving a theoretical explanation of the warm-up protocols. The test protocols were combined with workouts and repeated for four consecutive days. Each group performed a 10-minute run followed by one of four protocols, depending on their assigned group: 1) no stretching: the athletes performed the run without any stretching exercises. 2) static stretching: the athletes performed static stretching exercises for 15 seconds on each of the following muscle groups: Gastrocnemius, hamstrings, hip extensors, hip flexors, quadriceps, and hip adductors, 3) dynamic stretching: the athletes performed dynamic stretching exercises on the same muscle groups, focusing on achieving maximum range of motion; the exercises were performed at three tempos: slow, moderate, and as fast as possible, and 4) mix of static and dynamic stretching: the athletes performed the same exercises as the static and dynamic stretching protocols, starting with static stretching; after the stretching protocols, the participants had a 2-minute rest period and then underwent a balance test. Dynamic balance was measured using the SEBT (Star Excursion Balance Test), where the participants stood on one leg and reached for the shoulders of a star-shaped pattern on the floor using the opposite leg. The distance reached was normalized by dividing it by the participant's leg length to standardize the maximum reach distance. A higher excursion distance indicated greater dynamic balance. Static balance was assessed using a one-legged stance test, where the participants had to stand on one leg without support, focus their eyes on an object in front of them, and maintain their balance for 30 seconds with their eyes closed. The results of the study showed that dynamic balance significantly improved after dynamic stretching compared to static stretching and the control group without stretching. Dynamic balance also improved after combined stretching compared to the control group. Static balance was significantly improved after dynamic stretching compared to static stretching and combined stretching. There was no significant difference in improving static balance between static stretching and combined stretching. In summary, the study's findings confirmed the positive impact of stretching on the improvement of both dynamic and static balance in female soccer players. Dynamic stretching was particularly effective in improving dynamic balance, while static stretching

showed significant improvement in static balance. Combined stretching also led to improvements in both dynamic and static balance (Amiri-Khorasani, 2015).

The study conducted by Wallmann, Gillis, and Martinez (2008) aimed to investigate the influence of different stretching techniques on agility performance in female soccer players. The study included 12 soccer players aged 18–25 years who had not suffered a severe lower limb injury within the past six months. Three types of stretching techniques were performed: static stretching, contact-relax stretching, and no stretching. After the stretching protocols, the subjects performed the T-test, which is commonly used to assess agility and speed in changing direction. The athletes were given instructions on how to perform the T-test and the stretching exercises. They were also advised not to engage in excessive physical activity before the tests. Data were collected over three consecutive days within a week. The participants were divided into three groups, and each group followed a different stretching protocol on different days: group 1: no stretching on Monday, static stretching on Wednesday, and contact-relax stretching on Friday group 2: contact-relax stretching on Monday, no stretching on Wednesday, and static stretching on Friday, group 3: static stretching on Monday, contact-relax stretching on Wednesday, and no stretching on Friday. Before the start of stretching, the athletes performed 5 minutes of jogging. Immediately after the stretching exercises, the participants performed the T-test. The static stretching protocol involved stretching the quadriceps muscle, with each leg being stretched three times for 30 seconds. The contact-relax protocol consisted of active contraction of the quadriceps muscle for 6 seconds followed by a 4-second interval, repeated three times for each lower limb. The stretching group rested for 3 minutes between protocols. The results of the study indicated that there was no improvement in the T-test performance after any of the stretching protocols. The researchers concluded that stretching had no significant effect on the agility of female soccer players. This study suggests that stretching does not have a significant impact on agility performance in female soccer players (Wallmann, Gillis and Martinez, 2008).

The study conducted by Del Río Valdivia *et al.* (2015) investigated the influence of a stretching program on strength in female soccer players. The study included 16 female soccer players with an average age of 19.03 ± 2.7 years from the University of Colima in Mexico. The research spanned a period of 30 days, during which the athletes trained four times a week from Monday to Thursday. The participants were randomly divided into two equal groups: Group A, which performed regular training followed by flexibility training, and Group B, which only performed regular training. Before the start of the study, all athletes underwent tests to assess general flexibility, muscle strength, and anthropometric measurements. The flexibility program for the research group lasted for five weeks and consisted of stretches lasting 1–6 seconds, muscle contraction for 6–10 seconds, and relaxation for 2–4 seconds. The stretching duration increased up to 10 seconds. Each week, the training time increased by 10 minutes due to an increase in the number of exercises from 2 to 5. The study group demonstrated significant improvements in flexibility, with the flexibility index changing from 91.01 ± 18.3 to 111.93 ± 23.5. In contrast, the control group showed minimal changes, with flexibility scores changing from 78.22 ± 29 to 79.03 ± 29.1. Changes in strength were assessed by measuring the circumference of the right thigh and calf on the same side. In the study group, thigh circumference increased from 48.04 ± 3.6 cm to 49.54 ± 3.4 cm, while the control group showed minimal changes from 47.56 ± 4.9 cm to 47.89 ± 5 cm. Calf circumference also increased in the study group from 33.83 ± 2.7 cm to 35.21 ± 2.4 cm, while the control group showed minimal changes from 33.83 ± 2 cm to 33.73 ± 2 cm. To directly measure strength, a 1RM (one-repetition maximum) test was

performed. The study group demonstrated a significant increase in lifted weights, from 48.13 ± 7.8 kg at baseline to 53.38 ± 8.2 kg at the end, indicating a 10.9% increase. In comparison, the control group showed a minimal increase, starting at 52.63 ± 8.6 kg and reaching 53.39 ± 9.1 kg, representing only a 1.4% increase. The study also assessed explosive power, which showed improvements in the study group from 34.13 ± 2.9 cm at baseline to 36.63 ± 1.7 cm, indicating a 7.3% increase. In contrast, the control group exhibited a decrease, starting at 38.25 ± 4.7 cm and dropping to 37.06 ± 3.4 cm, reflecting a 3% decrease in explosive power. Overall, the study confirmed that the stretching program had a positive effect on increasing strength and flexibility in female soccer players. The study group showed significant improvements in strength, flexibility, and explosive power compared to the control group. In the context of the review article, this study supports the notion that stretching has a strong positive effect on strength and flexibility in female soccer players (Del *et al.,* 2015).

Disscussion

In this review article, two key findings were observed regarding the impact of stretching on motor skills and injury prevention in female soccer players.

Firstly, stretching was found to have a positive effect on motor skills such as static and dynamic balance, as well as strength increase. The study by Amiri-Khorasani (2015) demonstrated that different stretching methods had a positive impact on static and dynamic balance in female soccer players. Another study by Del Río Valdivia *et al.* (2015) showed that flexibility training resulted in a 10.9% increase in maximum weight lifted compared to the group without flexibility training.

However, it should be noted that not all studies have reported consistent findings. Some studies have not found a significant impact of stretching on agility. On the other hand, there are articles indicating that warm-up programs involving stretching methods can improve reactive strength index (RSI) by reducing ground contact time during drop jump tests. Overall, while there may be some discrepancies, most authors agree that stretching has a positive impact on developing motor skills.

The second finding relates to the impact of stretching on injury prevention. The evidence is inconclusive, and there is no unequivocal confirmation that stretching alone reduces the risk of injury. Training programs aimed at reducing injuries in female soccer players typically include stretching as one element, but they are not solely composed of stretching. Therefore, it can be concluded that stretching alone is not sufficient to prevent injuries in female soccer players.

Furthermore, there is still a significant research gap in the area of women's football, and stretching specifically lacks comprehensive testing to unequivocally determine its decisive effect on subjects. The results of stretching can vary depending on factors such as the timing and duration of stretching. Based on the collected articles, it can be concluded that stretching alone is not a comprehensive solution for developing skills and preventing injuries in women playing football.

Conclusions

In summary, while stretching has been shown to have positive effects on motor skills, particularly balance and strength, its impact on injury prevention remains uncertain. Stretching should be considered as one element within a comprehensive training program. More research is needed to gain a better understanding of the role of stretching in women's football and its impact on injury prevention.

Limitations

To our knowledge, this systematic review is the first one that specifically focuses on female football players and examines the impact of stretching on their motor skills and risk of injuries. However, it is important to acknowledge that the review does have

certain limitations. One limitation is that the search for relevant studies was conducted only in two databases, PubMed and Web of Science. While these are reputable sources, it is possible that some relevant studies may have been missed by not searching additional databases or sources. This could potentially introduce a bias in the selection of studies included in the review. Another limitation is the small sample sizes of the studies included in the review. The limited number of participants in each study may affect the generalizability and statistical power of the findings. Larger sample sizes would provide more robust evidence and allow for more accurate conclusions. It is also worth noting that the quality and rigor of the included studies may vary. Some studies may have had methodological limitations or risk of bias, which could influence the reliability and validity of the results. Overall, while this systematic review provides valuable insights into the impact of stretching on motor skills and injury risk in female football players, it is important to consider these limitations when interpreting the findings. Future research with larger sample sizes and comprehensive search strategies would further enhance our understanding of the effects of stretching in this specific population.

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