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# An analytical study of modern methods of preventing hamstring injuries in football.

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**Abstract:**
Hamstring muscle injuries are among the most common injuries in football. It has been proven that there are modern methods of prevention that reduce injuries through exercises and preventive programs. The purpose of this study was to investigate the effectiveness of modern methods in preventing hamstring injuries in football players. After analysis and discussion, the results showed that the most effective preventive methods, the NORDIC HAMSTRING exercise in first place, and the FIFA11+ program in second place, reduce injuries of the hamstring muscles at football players.
**KEY WORDS :** Injuries; Hamstring; Preventive Methods; Football.

**الملخص:**
تعد إصابات عضلات الفخذ الخلفية من أكثر الإصابات شيوعًا في رياضة كرة القدم. ثبت أن هناك طرق حديثة للوقاية تقلل من الاصابات عن طريق التمارين و البرامج الوقائية. كان الغرض من هذه الدراسة هو التحقيق في فعالية الطرق الحديثة في الوقاية من اصابات عضلات الفخذ الخلفية لدى لاعبي كرة القدم، وبعد التحليل و المناقشة اظهرت النتائج ان اكثر الطرق الوقائية فعالية تمرين NORDIC HAMSTRING في المرتبة الاولى وبرنامج FIFA11+ في المرتبة الثانية التي تقلل من اصابات عضلات الفخذ الخلفية لدى لاعبي كرة القدم.
**الكلمات المفتاحية:** إصابات؛ عضلات الفخذ الخلفية؛ طرق وقائية؛ كرة القدم.

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## 1-Introduction:

Football is considered one of the most popular sports in the world, with an estimated number of players playing this game at about 20 million people, both professional and amateur (Shamus, 2001) .

And due to its requirements and due to the large increase in the number of players playing this game, football is a contact sport, and the probability of injuries associated with it is relatively high. Football is considered one of the games in which players are most exposed to sports injuries, as (Gallucci, 2014) indicates that (50-60%) of all sports injuries in Europe occur in football.

(P Wong, 2005) indicates that 40% of injuries occur during contact with others, and 39% occur while running in football. And (Lasse Ishø et al ..., 2020) indicates that the most common muscle injuries in football are injuries of the hamstring muscles, at a rate of 37%.

Among the most common injuries in football are injuries of the hamstring muscles, as injury rates to these muscles related to training have increased significantly since 2001. The challenge has become for clubs to reduce training-related hamstring injury rates (Ekstrand & al, 2016). Therefore, sports injuries in general and muscular injuries in particular are among the main problems facing football players, as they lead to stopping training and competition for a period that may be long, which leads to the player being exposed to negative physical and psychological effects and repercussions that prevent the development of his achievement, and this is what motivates the workers In the field of sports medicine to work on knowing the types, causes, and how such injuries occur, and then how to prevent them (رويشدي، 1992) , and (Martens, 1977) states that preventing injury is the most important aspect of sports medicine, and that attention to prevention programs is sufficient to keep the player away from injuries on the sports field.

Injuries, constitute an important aspect of football, as they must be taken care of in order to play the game properly. Therefore, the research problem is focused on conducting an analytical study to find out modern methods for preventing injuries of the hamstring muscles in football among players. For example, in football, hamstring muscles injuries represent between 12 and 17% of all injuries that occur without contact (Goldman & Jones, 2011) , Since 2001, this type of injury has seen an increase of 4% every year, despite the available preventive methods (Ekstrand & al, 2016), and hamstring injuries require a rest period ranging from 4 to 140 days, depending on the type and degree of injury (Woods & al, 2004) Here lies the basic

research problem, and from it we pose the general problematic: Do modern methods contribute in preventing injuries of the hamstring muscles in football?

## 2- General objective of the study:

Preventing or reducing muscle injuries is considered a matter of utmost importance for football players because it will provide the workers in the sports field including coaches and their assistants, with practical knowledge concerning the development of preventive programs on scientific foundations derived from reality to reduce the most common injuries, such as injuries of the hamstring muscle, which is considered the subject of our study.

The objectives of the study centered on:

- Collecting and analyzing the results of previous studies from 2010 to the present time in 2023 in the sports domain that touched the topic of modern methods for preventing injuries of the hamstring muscles in football players.
- Knowing the most effective methods in preventing hamstring injuries at football players.

## 3- Procedural definition of the concepts mentioned in the research:

**- Muscle injury:** Muscle injury is damage of muscle tissue or the tendons associated with it. Muscle injury may occur in the form of tearing of muscle fibers affecting small blood vessels and capillaries, causing local bleeding (bruising) and pain associated with irritation of nerve endings at the site of the tear.

**- Hamstring muscles:** There are three muscles that occupy the back of the thigh. These muscles start from the bottom of the pelvis at the buttocks and end at the top of the leg bone. They work mainly to bend the knee joint, which are the biceps femoris muscle, the semitendinosus muscle, and the semimembranosus muscle. These muscles may suffer from a slight partial tear, a complete tear, or a muscle strain.

**- Prevention of muscular injuries:** is research into the physiological, anatomical, and biological changes and causes, both negative and positive, that occur in the tissues, condition of players, and their physical and psychological safety in all circumstances of their lives on and off the field, and giving directions on what should be avoided, and what should be done to maintain safety. Perhaps one of its most

important goals is issuing instructions to the coaches of various specialties, the medical team, and the physical preparators, which include exercises, strategies, and preventive programs to avoid players being away from the stadiums.

## 4- The methodological procedures used in the study:

**4-1 Method and tools:** To conduct our study from a practical perspective, we relied on the meta-analysis methodology for some of the previous studies most relevant to our problem that were concerned with the subject of our study, as well as published scientific articles and notes from 2010 to 2023. Within the framework of the research, we used search engines for scientific studies, such as the National Website for Scientific Research via the Internet SNDL, and reliable international websites such as: PUPMED - WEB OF SCIENCE - COCHRANE LIBRARY- SPORTDiscuss - SPORT MEDICCINE JOURNAL - WORLDCAT - GOOGLE SCHOOLER .

The search language for studies was in English, based on the following keywords: HAMSTRING INJURIES IN SOCCER – METHODS TO PREVENT HAMSTRING INJURIES – HAMSTRING INJURY.

Initially, 52 studies were reviewed, and after the selection and classification process, 16 articles were selected from these studies that were related to the objectives of our research on modern methods of preventing muscular injuries to the hamstring muscles in football. The following table represents the list of scientific studies selected for our post-analysis (Table 01).

| Study | Year | Title | Author |
|---|---|---|---|
| 01 | 2015 | The preventive effect of the nordic hamstring exercise on hamstring injuries in amateur soccer players: a randomized controlled trial . (PEDro: 5/10*) | Nick van der Horst et al… |
| 02 | 2022 | Hamstring Injury Prevention for Elite Soccer Players: A Real-World Prevention Program Showing the Effect of Players' Compliance on the | Chebbi et al... |

| | | | |
|---|---|---|---|
| | | Outcome. (PEDro: 6/10*) | |
| 03 | 2019 | Effect of Pre-training and Post-training Nordic Exercise on Hamstring Injury Prevention, Recurrence, and Severity in Soccer Players. (PEDro: 6/10*) | Ahmed EbrahiM et al… |
| 04 | 2017 | Hamstring injury prevention in soccer: Before or after training? (PEDro: 4/10*) | Lovell et al... |
| 05 | 2011 | Preventive effect of eccentric training on acute hamstring injuries in men's soccer. (PEDro: 6/10*) | Petersen et al… |
| 06 | 2013 | Soccer-Specific Warm-Up and Lower Extremity Injury Rates in Collegiate Male Soccer Players. (PEDro: 5/10*) | Dustin et al… |
| 07 | 2015 | Efficacy of the FIFA 11+ Injury Prevention Program in the Collegiate Male Soccer Player. (PEDro: 7/10*) | Holly Silvers et al …. |
| 08 | 2020 | Effects of Nordic Hamstring Exercise on Hamstring Injuries in High School Soccer Players. (PEDro: 7/10*) | Yuki et al… |
| 09 | 2017 | Adding a post-training FIFA 11+ exercise program to the pre-training FIFA 11+ injury prevention program reduces injury rates among male amateur soccer players. (PEDro: 7/10*) | Wesam Saleh et al… |
| 10 | 2017 | Implementation of an evidence-based injury prevention program in professional and semi-professional soccer. (PEDro: 5/10*) | Wesam Saleh et al … |
| 11 | 2018 | Clinical benefit of the FIFA 11 program for the prevention of hamstring and lateral ankle ligament injuries among amateur soccer players. (PEDro: 7/10*) | Rauf Nouni ET al… |
| 12 | 2013 | Reducing muscle injuries and reinjuries in one italian professional male soccer team. (PEDro: 05/10*) | Gianluca et al… |
| 13 | 2017 | The preventive effect of the bounding exercise programme on hamstring injuries in amateur soccer players: the design of a randomized controlled trial. . (PEDro: 4/10*) | Van de Hoef et al … |
| 14 | 2018 | Does a bounding exercise program prevent hamstring injuries in adult male soccer players? (PEDro: 4/10*) | Van de Hoef et al… |

| | | | |
|---|---|---|---|
| 15 | 2014 | Effects of implementing Nordic hamstring exercises for semi-professional soccer players in Akershus, Norway. (PEDro: 5/10*) | Sebelien et al… |
| 16 | 2019 | Efficacy of Adding Post-Training Nordic Exercises to Hamstring Injury Prevention Program in Soccer Players. (PEDro: 6/10*) | HEND ADEL et al… |

Table N° 1 : List of scientific studies selected for our meta-analysis

**4-2 The methodological procedures used in selecting studies :**

**- Selection by title:** In the first step of selecting studies we relied on the title. In this step, the study was selected by reading the title and comparing its variables with the variables of our study and the search keywords previously mentioned by simply reading the title. If the title is not complete enough to make a decision, we prefer to select the study for the next step and thus obtain more information before including it and selecting or excluding it from the review. Among the studies that were selected on the basis of the title is No: 01-02-03-04-06-08-11-13-14-16 .

**- Selection in terms of study summary:** The second step of selecting the study was done by reading the summary of the selected studies. We read all abstracts individually and review their content. If the studies meet these criteria, they are selected for the next step. If they do not meet the criteria 100%, they are completely excluded. However, if they do not meet the criteria by a small percentage or they are in doubt, they are selected for the next step as well. Among the studies that were selected in terms of abstract is No: 05-10-12-15.

**- Selection by reviewing the content of the study**: The third and final stage of study selection was performed by reading the entire study. In order to analyze them and extract what suits our research criteria, if they do not meet the conditions, they are excluded permanently. Among the studies that were selected on the basis of reading the study are No: 07-09.

**Desirable and appropriate selection criteria:**

- Search engines with quality and reliability in publishing studies were searched: SNDL-PUPMED – WEB OF SCIENCE – COCHRANE LIBRARY- SPORTDiscuss - SPORT MEDICCINE JOURNAL - WORLDCAT- GOOGLE SCHOOLER-PEDRO .
- Articles published during a limited time period between 2010 to 2023 were selected.
- The sample was selected according to the following levels: professionals - amateurs - semi-professionals - elite.

- **Gender:** Male only.
- **Search language:** English.
- **Age group**: 15 years and above.

**Excluded and inappropriate criteria:**

- All studies conducted before 2010.
- **Gender:** Women.
- Age group under 15 years.
- The study does not include: Futsal - American Football - It does not include Australian Football.
- The study does not include systematic reviews, meta-analysis studies, and descriptive analysis.

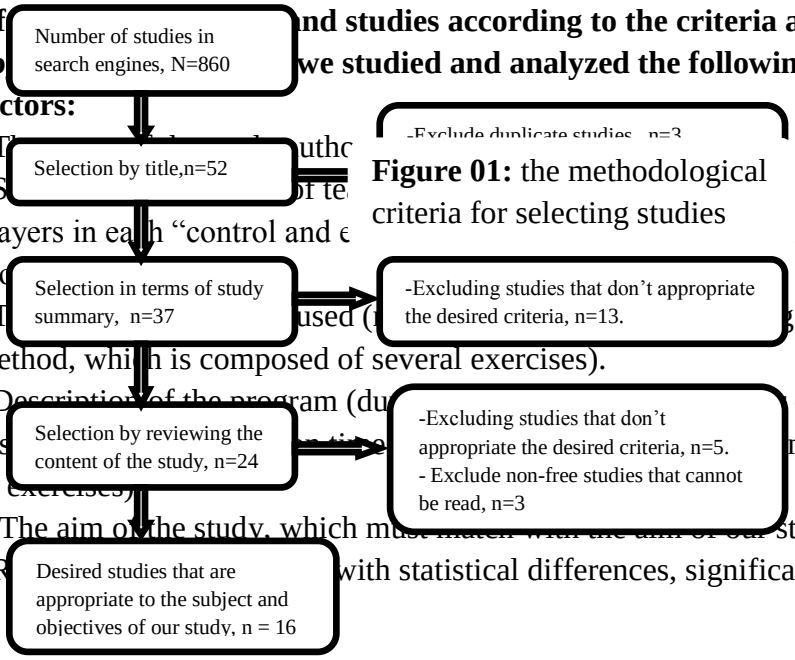


**Figure 01:** the methodological criteria for selecting studies

**Af** **nd studies according to the criteria and ob** **we studied and analyzed the following factors:**

- T uthc
- S f te of
players in ea h "control and e ge
gr
- T used ( the
method, whi h is composed of several exercises).
- D of
ses ntent
of exercises).
- The aim of the study, which must match with the aim of our study.
- R with statistical differences, significance

and reliability).

**Quality and reliability of studies:**

In this research, we relied on studies from the international sites mentioned above, such as the PEDro website, which evaluates studies. PEDro is designed to support the practice of evidence-based physical therapy. It provides quick access to the best research evaluating the effects of physical therapy methods. Only studies that use the most rigorous search methods are indexed: randomized controlled studies, systematic reviews, and evidence-based clinical practice guidelines. A unique feature of PEDro is that studies are independently assessed for quality using the PEDro scale. These quality ratings are used to quickly direct users to studies that are likely to be credible and contain sufficient information to guide professional practice (PEDro, 2022).

- The studies are evaluated on 10 according to some site items as shown in Table 1.

**Difficulties of study:**

- Non-free studies.
- Availability of many search engines, which increases search possibilities.
- Lack of references that addressed the subject of our study.

**Study population:** Our meta-analysis samples were made up of some football teams from different categories, and their total number was 4634 players, aged between 18 - 45 years. All participants were male, and their sports level varied between amateurs (08 teams), semi-professional teams (2 teams), professionals (04 teams), and elite teams (03 teams).

| Study | Age | Sample | Gender | Level |
|---|---|---|---|---|
| 01 | 19-24 years | 579 player | Male | Amateur |
| 02 | 21-38 years | One team | Male | Elite |
| 03 | 21-35 years | 34 player | Male | Pro |
| 04 | 18-37 years | 35 player | Male | Amateur |
| 05 | | 942 player | Male | Amateur |
| 06 | 18-25 years | 41 player | Male | Elite |
| 07 | | 1525 player | Male | Semi-Pro |
| 08 | | 259 player | Male | Amateur |
| 09 | 14-35 years | 344 player | Male | Amateur |

| | | | | |
|---|---|---|---|---|
| 10 | | 60 team | Male | Pro, Semi-Pro |
| 11 | 21-35 years | 86 player | Male | Amateur |
| 12 | | 36 player | Male | Elite |
| 13 | 18-45 years | 120 player | Male | Amateur |
| 14 | 18-45 years | 400 player | Male | Amateur |
| 15 | 18-39 years | 199 player | Male | Pro |
| 16 | 21-35 years | 34 player | Male | Pro |

Table N° 2 : the number of the sample according to age, number, gender, and level according to each study.

## 4-3 Presentation and Analysis of Results:

**The preventive methods used:**

All studies adopted preventive protocols, programs and exercises in addition to the exercises performed by football players. No study mentioned physical therapies such as massage, hydrotherapy, or laser therapy (or manual therapy techniques associated with prevention protocols).

A- The initial **FIFA 11** program was applied, which is a preventive warm-up program that appeared in **2006** by experts at **FIFA** to prevent muscle injuries. It was applied to **45** players in study **N° 11**, and it is a program that contains a group of exercises for a period of 10 to 15 minutes. For each post-training session in addition to the **Nordic hamstring** exercise, divided as follows:

- core and stability exercises.
- Balance exercises.
- Plyometrics exercises.
- Nordic hamstring exercise.

B- The **FIFA11+** program is a preventive warm-up program developed in **2009** by experts from the Football Medical Research Evaluation Center to prevent muscle injuries, divided into three parts for each session. The program is designed for players and referees with the goal of reducing lower extremity injuries. It was applied to 1010 players from the experimental groups in studies N° 06 - 07 - 09 - 10. The program contains three parts for 20 minutes after training, in addition to the NORDIC HAMSTRING exercise, divided as follows:

- First part: 6 low to medium intensity running exercises.
- Part Two: 6 NORDIC HAMSTRING muscle strengthening exercises
- plyometrics - and balance.
- Part Three: 3 high-intensity running exercises.

The players perform the FIFA 11+ warm-up program for 20 minutes

for the program as a whole, as Part 2 of the program is performed at the end of training, which are muscle strengthening exercises, in contrast to Part 1 and Part 3, "which are performed at the beginning of training, which are light running exercises at the beginning and fast running exercises at the end. These exercises are divided into three levels:

- First level: Beginners, the intensity of the exercises is low.
- The second level: Advanced exercises exceed the intensity of the first level.
- Third level: Professionals. The exercises are different from other levels.

C- A total of 1,076 athletes performed the NORDIC HAMSTRING exercise alone as a prevention strategy in studies N° 01-02-03-04-05-08-12-15-16. Some players went through this session before training, while some players went through sessions before and after training.

D- A total of 294 athletes implemented a plyometric BOUNDING EXERCICE program as a preventive strategy in Studies N° 13-14, divided into three parts:

- Part One: Eccentric contraction exercise.
- Part Two: Exercise for the phase between the concentric and eccentric contraction exercise.
- Part three: Concentric contraction exercise.

E- 47 soccer players performed basic stability and core exercises, as a strategy to prevent hamstring injuries in Studies N° 04-12.

F- 41 players carried out the **F_MARC11+** warm-up program. This football-specific program was developed by a group of experts in collaboration with the FIFA Medical Evaluation and Research Center (**F-MARC**) to require minimal equipment and implementation as part of normal training. It contains the same features and exercises as the **FIFA11+** program, which was implemented and tested on football players, in addition to containing the nordic hamstring exercise with other exercises.

| Study | The preventive method or strategy used |
|---|---|
| 01 | Nordic hamstring exercise. |
| 02 | Nordic hamstring exercise. |
| 03 | Nordic hamstring exercise. |
| 04 | Core and stability exercises + Nordic hamstring exercise. |
| 05 | Nordic hamstring exercise. |
| 06 | F-MARC11+ program containing Nordic hamstring exercise |

| | |
|---|---|
| 07 | F-MARC11+ program containing Nordic hamstring exercise |
| 08 | Nordic hamstring exercise. |
| 09 | FIFA11+ program containing Nordic hamstring exercise. |
| 10 | FIFA11+ program containing Nordic hamstring exercise. |
| 11 | FIFA11+ program containing Nordic hamstring exercise. |
| 12 | Nordic hamstring exercise + Core exercises. |
| 13 | Bounding plyometric exercise. |
| 14 | Bounding plyometric exercise. |
| 15 | Nordic hamstring exercise. |
| 16 | Nordic hamstring exercise. |

Table N° 3 : Shows the N° of study and the preventive methods used.

## 4-4 Discussion and interpretation of the results:

- Using a training program for the NORDIC HAMSTRING exercise is considered as the first most effective method in reducing and preventing injuries of the hamstring muscles at football players. Through our study, we found that the football players implementation of a 12-week training program containing the NORDIC HAMSTRING exercise leads to an increase in the hamstring muscles strength and reduces injury of the previously mentioned muscles, and this is evident from the study of (R.Lovell, 2017) , also (Al Attar et al.. , 2017) confirmed that the risk of injuries of the hamstring muscles can be reduced by up to 51% when the NORDIC HAMSTRING exercise is performed and adhered to.
- Incorporating the NORDIC HAMSTRING exercise into training on a regular basis contributes significantly to reducing injuries of the hamstring muscles at football players, as is evident from the study of (Sebelien , 2014).
- The inclusion of the previously mentioned exercise program before and after training, and with other preventive programs is very effective in preventing injuries of the hamstring muscles at football players, as shown by (HEND, 2019).
- The NORDIC HAMSTRING exercise reduces the amount of time lost for players away from training and playing by reducing injuries of the hamstring muscles (Yuki, 2020). Looking at our study, we find that this exercise was used in most studies (14 studies) (Table N°3).
- The Fifa11+ program is considered as the second most effective method in reducing and preventing the risk of

hamstring injuries at football players, especially when the FIFA11+ program is adhered to and the program must be implemented with all its components. In our analytical study, the use of the FIFA11+ program, which contains speed exercises and the NORDIC HAMSTRING exercise, was discussed as a method of preventing injuries of the hamstring muscles at football players, and this was explained in 4 studies (07, 09, 10, 11) (Table N° 3) , As confirmed by (Attar, 2016) that this program reduces lower extremity injuries by 39 to 44% and hamstring muscle injuries by 55%.

- The developed F-Marc11+ warm-up program is a preventive method against injuries of the hamstring muscles at football players, because it contains the NORDIC HAMSTRING exercise, which is effective in reducing and preventing injuries of the hamstring muscles, and this was explained in the study of (R.Grooms, 2013) (Study 06 from table N°3).
- Including the NORDIC HAMSTRING exercise with core and stability exercises is effective in preventing injuries of the hamstring muscles at football players, and this was shown in the two studies (04, 12) (Table N°3).
- The plyometric Bounding Exercise program is not considered as an effective method for preventing injuries of the hamstring muscles at football players, because there is no scientific evidence proving that this program reduces injuries of the hamstring muscles, and this was explained in the two studies (13, 14) (Table N°3). However, including it in the Fifa11+ program with speed exercises and the NORDIC HAMSTRING exercise helps in preventing injuries of the hamstring muscles.
- A program consisting of the NORDIC HAMSTRING exercise alone can be used to prevent injuries of the hamstring muscles, and it can also be used in combination with various other preventive methods (FIFA11+, F-marc11+, core and stability exercises).
- The NORDIC HAMSTRING exercise is considered the basic and the most effective method for preventing injuries of the hamstring muscles in football at various levels (professionals, elite, semi-professionals, amateurs). (The studies: 15,12,11,10,09,08,07,06,05,04,03,02,01 and 16) (Table N°3).

- All studies used preventive programs for a period of 10 to 14 weeks to achieve an ideal result in preventing and reducing injuries of the hamstring muscles at football players.

## Conclusion:

- There are a number of modern methods to prevent injuries of the hamstring muscles at football players, but the NORDIC HAMSTRING exercise is considered the most effective methods of prevention, especially when included with other programs.
- The NORDIC HAMSTRING exercise strengthens the harmstring muscles in addition to prevention.
- Including the NORDIC HAMSTRING exercise before and after training has effective results in reducing the risk of hamstring injuries at football players.
- The developed F-marc11+ warm-up program and the Fifa11+ program are modern methods for preventing injuries of the hamstring muscles at football players.
- The plyometric Bounding exercises program and the Core and stability exercises program are not considered a way to prevent injuries of the hamstring muscles at football players without the NORDIC HAMSTRING exercise.
- Hamstring muscle injuries are the most common muscle injuries in football.
- Good compliance and adherence to the components of all preventive programs must be done in order to increase the effectiveness of each method in preventing injuries of the hamstring muscles.
- The NORDIC HAMSTRING exercise is considered a most effective exercise than other exercises and programs in preventing injuries of the hamstring muscles at football players.

## Recommendations:

- It is necessary for coaches and players to pay attention to preventive methods to avoid muscle injuries during competitions and training sessions.
- Following scientific foundations and including preventive methods in physical preparation gives the football player good physical fitness that enables him to avoid various sports injuries and endure training loads.
- The necessity of informing football coaches of what is new in the field of physical preparation and sports training to avoid muscle injuries among their players.
- Encouraging joint studies between football and sports medicine, with the necessity of involving coaches in special courses so that they have a background and knowledge in the field of sports medicine.
- Generalizing the study to other muscle injuries and other collectif sports.

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