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Injuries in elite lever soccer - A systematic review.

Bachelor's thesis in Human Movement Science
Supervisor: Øyvind Bucher Sandbakk
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Abstract

Soccer is one the largest sports worldwide, with around 130.000 elite athletes. Soccer is a contact sport with a lot of changes in direction and pace, which makes the players prone to injury. This systematic review has the goal of systemizing current knowledge related to the questions: What are the most common injuries among soccer players, when do the most common injuries occur, and how could they be prevented? 17 articles were included based on a search using EBSCOhost, searching SPORTdiscus and MEDLINE databases. The main findings of this systematic review were that most injuries occur in the lower extremities, in the thigh, knee, and lower leg. There is about seven times higher risk of getting injured during matches compared to training. To prevent these injuries, it may be beneficial to follow an injury prevention program or a warmup program like FIFA11+ and to increase the total number of training sessions during preseason.

Sammendrag

Fotball er en av de største idrettene i verden med omtrent 130.000 profesjonelle utøvere. Fotball er en kontaktsport med mye endringer i retning og hastighet, som gjør at spillerne er utsatt for skader. Denne systematiske gjennomgangen systematiserer nåværende informasjon knyttet til spørsmålene: hva er den mest vanlige skaden blant fotballspillere, når oppstår de vanligste skadene, og er det mulig å forebygge dem? 17 artikler ble inkludert, og hentet med et avansert søk på EBSCOhost, fra databasene SPORTdiscus og MEDLINE. Hovedfunnene i denne studien er at majoriteten av skader oppstår i underekstremiteten, mer spesifikt i lår, kneet og nedre fot. Det er omtrent 7 ganger større risiko for skade under kamp, sammenlignet med treninger. For å forebygge disse skadene kan det være hensiktsmessig å følge et skadeforebyggingsprogram eller et oppvarmings program som FIFA11+, og øke det totale antall treninger under perioden før sesongstart.

Introduction

Soccer is one of the largest competitive sports in the world, with around 130.000 elite level soccer players spread across the world (1). Elite level soccer is played on natural or artificial grass with two teams competing against one another. Each team consists of 10 outfield players, and one goalkeeper. The main objective of the game is to score goals and to stop the opponent from scoring. Soccer games have a duration of 90 minutes, divided into two halves of 45 minutes. In addition to the 90 minutes of play, extra time is also added based on effective playing time. This makes the game even longer and harder on the body. Elite soccer players cover a great distance in a game as they constantly change between walking, jogging and sprinting (2). This could induce neuromuscular fatigue which leads to a reduction in eccentric strength and alter explosive-type movements which results in a higher incidence of injury (3). Players are also exposed to potential injury situations such as tackling, being tackled and other contact situations with opposing players (4).

Due to the high intensity and the various potential injury situations, the risk of getting injured while playing soccer cannot be avoided. Therefore, elite level soccer clubs, coaches, and medical staff are responsible for securing the health and wellbeing of the elite level soccer players. This means having the needed knowledge of when, why, and how injuries occur, and how to minimize injury occurrence. With this knowledge, the club and staff can make sure the players perform at the desired level with as few days of action missed as possible. An injury is defined as damage to the body which makes the player unable to participate in practice or game for at least 1 day (5).

This systematic review has the goal of collecting knowledge on the questions: *What are the most common injuries among soccer players, when do the most common injuries occur, and how could they be prevented?* By answering this question and collecting knowledge, the review will help maneuver the spread and important information on the topic, and to assess the complicated question regarding injuries and injury prevention in elite level soccer.

All the findings in this study are based on 17 articles. All the articles investigate injuries or injury prevention among elite level soccer teams, spread around the world. This secures a homogenous but spread dataset on injuries and prevention data, containing data from, Sweden, Spain, Netherlands, the United States of America, Brazil, England and Germany among others.

Method

To understand how and when injuries occur, and how to prevent injuries, an advanced literature search using EBSCOhost searching SPORTdiscus and MEDLINE databases was used. In addition to the advanced search, Google Scholar was used to find 6 additional articles. The search words presented in Table 1 revealed 108 articles on the topic bringing the total up to 114 articles. After removing the duplicates there were 89 articles remaining. In the remaining 89 articles the title and abstract were read and analyzed. 54 studies were excluded, leaving 35 articles to be assessed for eligibility. A further 18 articles were then excluded based on the exclusion criteria found in the flowchart (Figure 1). 17 articles remained after the process and were used in this systematic review.

Some of the 17 articles were presented by themselves while others were used to collect data on what the most common injury is. All the data collected was first sorted using Excel, and then presented with mean and standard deviation from all the articles that included the desired data.

Since $85.8\% \pm 4.2\%$ (2,6–9) of injuries in soccer happen in the lower extremities, and as one of the main goals of this systematic review was to find the most common injuries among soccer players, upper extremities injuries were not included in this study.

The results regarding injury location were divided into three groups: ankle, calf, and foot as lower leg. Hip, groin, and thigh as thigh. Knee as knee. Injury type was divided into 4 groups, muscle and tendon, joint and ligament, overuse and contusion. Injury duration was divided into 4 groups, minimal (1-3 days), minor (4-7 days), moderate (8-28 days), and severe (28 or more days). The

days represent the number of days the player was absent from team practice or games with the period ending when a player is fully prepared to partake in all team practices and matches.

Some of the articles did not include the desired data. For these articles data was calculated by taking advantage of other data mentioned in the articles. By combining the results from all the subgroups categorized as lower leg and thigh it was possible to find the total number of injuries in the desired location. The formula “total injuries divided by total hours of action, multiplied by 1000” was used for calculating injuries per 1000 hours in match and practice situations.

The data was gathered between 12th of January 2024, and 14th of March 2024

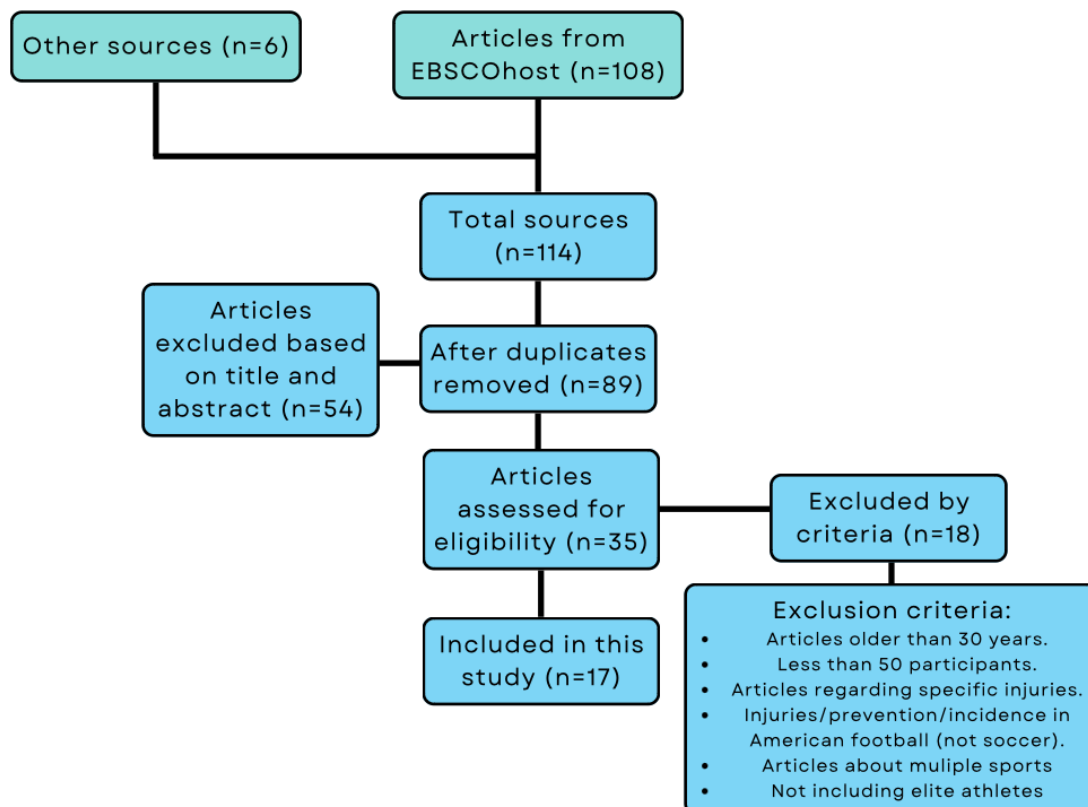


Figure 1: A flowchart describing the process of finding, excluding, and including articles for the systematic review.

Table 1: words used in the advanced search.

Women	Male	Soccer games	Injury	Football players
OR	OR	OR	OR	OR
Woman	Man	Soccer practice	Injuries	Soccer players
OR	OR	OR	OR	OR
Female	Men	Football games	Injury prevention	Soccer player
OR	OR	OR		OR
Females	Males	Football practice		Football player
		OR		OR
		Football match		Soccer athletes
		OR		OR
		Soccer match		Football athletes
				OR
				Elite soccer players
				OR
				Elite football players

Results

Injury location

Based on the findings in this systematic review the most common injury location is in the thigh region. See table 2 for more details (2,6–8).

Table 2: The result found on injury location from various articles reported in % of total injuries. All categories are reported with a mean and standard deviation.

Authors	Thigh	Knee	Lower Leg
Larruskain et al. (women)	30.0%	16.0%	29.0%
Larruskain et al. (men)	29.0%	11.0%	28.0%
Jacobson & Tegner.	26.0%	25.0%	31.0%
Stubbe et al.	33.6%	21.3%	28.0%
Forsythe et al.	34.6%	13.5%	28.4%
Mean	30.6%	17.4%	28.9%
Standard deviation	3.5%	5.7%	1.3%

López-Valenciano et al (3) conducted research on this topic but gave their results in injury per 1000 hours and not percentage. It was reported that injuries in the thigh region had an incidence of 1.25 per 1000 hours of action (0.9 given as thigh, 0.35 given as hip/groin). Knee injuries

happened 1.1 times per 1000 hours of action while lower leg injuries occurred 2 times per 1000 hours of action (1.1 given as ankle, 0.5 given as lower leg/Achilles and 0.4 given as foot/toe).

Injury type

Based on the findings in this systematic review the most common injury type is muscle and tendon. See table 3 for details (2,6,8–10)

Table 3: The result found on injury type from various articles reported in % of total injuries. All categories are reported with a mean and standard deviation.

Authors	Muscle and tendon	Joint and ligament	Overuse	Contusion
Larruskain et al. (women)	53.0%	36.0%	50.0%	5.0%
Larruskain et al. (men)	44.0%	26.0%	45.0%	18.0%
Gurau et al.	39.8%	21.1%	35.6%	17.9%
Jacobson & Tegner.	29.0%	24.0%	31.0%	8.0%
Stubbe et al.	36.4%	18.5%	7.7%	17.8%
Söderman et al.			34.0%	
Mean	40.4%	25.1%	33.9%	13.3%
Standard deviation	8.9%	6.7%	14.7%	6.3%

López-Valenciano et al (3) conducted research on injury type in professional women soccer and found that muscle and tendon injuries happen 1.8 times per 1000 hours of action, joint and ligament injuries happen 1.5 times per 1000 hours of action and contusion injuries happen 0.7 times per 1000 hours of action. Data for overuse injuries was not found in this study.

Injury duration

Based on the findings in this systematic review the most common injury duration is moderate (8-28 days). See table 4 for more details (6–8,10)

Table 4: The result found on injury duration from various articles reported in % of total injuries. All categories are reported with a mean and standard deviation.

Authors	1-3 days minimal	4-7 days mild	8-28 days moderate	28+ days severe
Larruskain et al. (women)	16.0%	22.0%	40.0%	23.0%
Larruskain et al. (men)	31.0%	29.0%	28.0%	11.0%
Gurau et al.	27.9%	24.5%	33.6%	13.3%
Jacobson & Tegner.	17.0%	22.0%	39.0%	22.0%
Stubbe et al.	17.5%	31.8%	34.3%	15.4%
Mean	21.9%	25.9%	35.0%	16.9%
Standard deviation	7.0%	4.4%	4.8%	5.3%

López-Valenciano et al (3) also studied the duration of injuries. Minimal injuries occurred 2.2 times per 1000 hours of action, mild injuries occurred 1.7 times per 1000 hours of action, moderate injuries occurred 2.1 times per 1000 hours of action and severe injuries occurred only 1.2 times per 1000 hours of action.

When do the injuries occur?

Based on the findings in this systematic review most injuries occur in match situations. See table 5 for more details (2,3,6–9,11)

Table 5: The result found on injury occurrence from various articles reported in injuries per 1000 hours. All categories are reported with a mean and standard deviation.

Authors	Injuries per 1000 hours	Match injuries per 1000 hours	Practice injuries per 1000 hours
Larruskain et al. (women)	5.5	22.6	3.4
Larruskain et al. (men)	7.7	29.9	4.8
Jacobson & Tegner.	4.6	13.9	2.7
Stubbe et al.	6.2	32.8	2.8
López-Valenciano et al.	6.1	19.2	3.5
Forsythe et al.	8.7	14.0	3.4
Ekstrand et al.	7.1		
Söderman et al.	6.8		
Mean	6.6	22.1	3.4
Standard deviation	1.3	8.0	0.7

Klein C et al (4) conducted a study where 345 match injuries in German professional male soccer were identified and investigated. The aim of the study was to find and describe typical injury patterns in the two highest divisions in German male soccer. The injuries investigated were moderate and severe acute match injuries. See details in Table 6.

The 9 injury patterns identified were: (1) Head-to-head injury. (2) Collision-and fall shoulder injury. (3) Sprinter’s thigh injury. (4) Perturbation-and-strain thigh injury. (5) Tackle knee injury. (6) Tackle-and-twist knee injury. (7) Non-contact knee injury. (8) Attacked ankle injury. (9) Collision-and twist ankle injury.

Table 6: Klein et al. Percentage of injuries during match.

Category	Percentage of Total injuries
<i>Moderate or severe match injuries</i>	345 (Total included in the study)
<i>Match play vs set play</i>	
Regular match play	77.4%
Set play	22.6%
<i>Common injuries by body part</i>	
Match play: thigh injuries	26.1%
Set play: Knee, ankle, and head injuries	20.4%
<i>Game specific behaviors and injury rates</i>	
Running	27.2%
Sprinting	23.2%
Lunging	10.7%
Jumping (taking off, mid-air, landing)	20.5% (1.4%, 10.1%, 9%)
<i>Contact vs non-contact situations</i>	
Contact with other players	49.3%
Non-contact situations	23.2%
Indirect contact situation	27.5%

Rahnama et al (12) investigated injuries and injury risk from 10 premier league games in the 1999/2000 season. The study reviewed nearly 18000 actions that either had an injury risk or

resulted in injury. The study found an overall injury incidence of 53 injuries per 1000 hours of playtime.

The findings on injuries and injury risk are that the first and last 15 minutes of each half contained the highest risk of injury, but the injuries occurred in the first 15 minutes of each half. In the goal area more mild injury potential occurred and, outside the goal area, an increase in moderate injury potential was found (12).

When it comes to when in a season the injuries occur, Jacobson & Tegner (6) found out that most injuries happen in March. In Sweden, March is the start of a new season and the end of pre-season. Traumatic injuries go up and down throughout the season with a spike almost every other month. Overuse injuries occur most in March and stay around 1 injury per 1000 hours through the whole season except a spike in the middle of the season (June). Larruskain et al (7) researched injuries in the Spanish first division and also reported a spike in injuries in the middle of the season (December)

Kuitunen et al (13) found that for elite players the injury risk is higher when playing on grass than on artificial grass. For both men and women, the injury incidence was lower when playing on artificial grass. Pelvis/thigh and knee injuries are lower among the athletes playing on artificial grass, compared to the athletes playing on grass.

Injury prevention

The FIFA 11+ program is a warmup program designed to reduce the rate of injuries in practices and matches. The teams that performed the program at least twice a week had 37% fewer injuries in practice, 29% fewer injuries in matches, and severe injuries had a reduction of almost 50%. (14).

Ekstrand et al (11) found that for every 10 additional preseason training sessions the match availability increased on average by 1.0 percentage point, and that teams with more preseason training experienced lower in-season injuries.

de Freitas et al (15) Investigated elite clubs in Brazil and found that all teams have at least one preventative training session a week throughout the season, while some clubs have multiple. Most teams have a fitness coach responsible for improving the strength, speed, and power of the athletes. The preventative training is eccentric, proprioceptive exercises and core strength, which are all found to help prevent injuries among elite soccer athletes.

Pérez-Gómez et al (16) studied injury prevention and its various methods. Injury prevention methods were divided into 4 groups, (1) strength training, (2) proprioceptive training, (3) multicomponent programs, and (4) warm-up programs. It was shown that all 4 methods of injury prevention had a positive effect on the occurrence of injuries making them happen less frequently. There were not found a positive effect on the severity of the injuries.

Discussion

The current study systematized current knowledge related to the most common injuries among soccer players, when they occur, and how they could be prevented. The main findings are as following: 1) The thigh region was the most prevalent injury location. 2) Most injuries happen to the muscle and tendon in the body. 3) The majority of injuries last between 8 and 28 days. 4) Injuries happen more frequently in match situations. 5) Injuries could be limited by good warm-up programs and the right training.

Injury location

The most common injury location in soccer is the thigh region with 30.6% of all injuries as shown in Table 2. Closely following the thigh region is lower leg with 28.9% of all injuries in elite level

soccer, and lastly the knee with 17.4% of all injuries. The knee could be the location with the highest injury occurrence as it is the only location that falls under the description knee. The lower leg is a combination of ankle, calf, and foot, meaning more injuries fall under the description of lower leg. The same applies to the thigh region as it is a combination of the hip, groin, and thigh.

The knee is also the injury location with the highest standard deviation leaving a possibility that it could be higher or lower than first expected. Data regarding injury location is not only based on one article but is a result of 4 different articles. The 4 different articles could vary in method and therefore report different results. As a result, a big range between the data presented could appear, leaving a big standard deviation which causes uncertainty when concluding what the most injury-prone location is. Based on the findings in this systematic review the thigh is the most injury-prone body part with a low standard deviation.

Injury type

In Table 3 it is found that the most common injury type is muscle and tendon injuries with a mean of 40.4% and a standard deviation of 8.9% but further investigation of the results shows that this may not be the case.

While investigating the most common injury type it was found that overuse injuries in the Netherlands are much lower compared to the other articles. Stubbe et al (8) reported that 7.7% of injuries in the Netherlands came from overuse, whereas the other articles included in Table 3 reported results ranging from 31% to 50%. This could be a result of a different method used for identifying overuse injuries by Stubbe et al (8). Because of the low percentage reported by Stubbe et al (8) the mean is lower and the standard deviation is higher in the category overuse injuries. Therefore, there is a possibility that overuse is the most prevalent injury type regardless of what the results in Table 3 show.

It could be challenging to find what injury type is most prevalent, because some injuries may be identified as overuse injuries in addition to any of the other categories. In the article written by Larruskain et al (7), the total percentage of injuries among women adds up to 144% showing that the possibility of some injuries overlapping or being reported in 2 categories is real. In comparison, the article written by Stubbe et al (8) gives a total percentage of 80,4% showing that overuse injuries may not overlap in this study.

Injury duration

The results from Table 4 show that the most common injury duration is moderate (8-28 days). Moderate injury duration shows a mean of 35% and a standard deviation of 4.8% (Table 4).

All the articles presented in Table 4 agree with the statement that moderate injury duration is the most prevalent, except for one. Larruskain et al (7) reported that minimal is the most prevalent injury duration for men, being responsible for 31% of all injuries while moderate is responsible for 28%. López-Valenciano et al (3) reported that minimal injury duration happens 2.2 times per 1000 hours of action while moderate injury duration happens 2.1 times per 1000 hours of action. This could be a result of differences in participants or seasons studied. The number of injuries and the duration of the injury could vary as injuries are unpredictable.

Despite the fact that Larruskain et al (7) and López-Valenciano et al (3) reported that minimal is the most common injury duration, there is such a great difference between moderate injury duration and the other categories in Table 4, that it is safe to assume that moderate injury duration is the most common.

When does injury occur?

This systematic review has found that per 1000 hours of practice 3.4 injuries occur. It was found that 23.1 injuries occur per 1000 hours of match play. The combined match and practice injuries

per 1000 hours add up to 6.6 injuries per 1000 hours of action (Table 5). As the numbers show, there is about seven times higher prevalence of injuries during matches than in practice. A reason for this could be that a player gets injured because of contact with an opposing player, or the surface of the football pitch (12,13).

The article written by Klein et al (4) researched how match injuries occur, the largest proportion of match injuries happened during contact with other players (49.3%, Table 6). Players tend to play at a higher intensity during matches and are exposed to a greater probability of contact with other players (2). This could explain why there are more match injuries than practice injuries.

Kuitunen et al (13) investigated the difference between artificial and natural grass on the pitch. In the study, it was found that fewer injuries occurred among elite athletes playing on artificial grass, meaning the surface impacts injuries. The difference could be that soccer teams practice on artificial grass and play on natural grass. This could cause injuries to players as the body is not used to the uneven surface on a natural grass pitch especially if the grass pitch is not in good condition.

Injury occurrence in a season was found by Jacobson & Tegner and Larruskain et al (6,7) to be more frequent in the start and middle of the season. As reported by Jacobson & Tegner (6) the injuries that happen when the season is about to commence are mostly overuse injuries. This could be a result of a hard and long pre-season, with many practices which may include high intensity drills, resulting in built up fatigue which can cause injuries. An explanation for the spike in the middle of the season could be that the players experience higher loads due to more games and practices in addition to a potential reduction in injury preventative training.

Injury prevention

After analyzing the results, it is shown that only 2 articles presented preventative training with a percentile of how effective they are. The two articles being FIFA 11+ (14) and Ekstrand et al (11).

FIFA 11+ (14) reported that teams who use the FIFA 11+ warmup program at least twice per week had a total of almost 50% reduction in severe injuries. Ekstrand et al (11) reported that for every 10 additional days of pre-season training, match availability went up by 1%. Both these articles show that preparation of the body ahead of a season or a game is important. Both these methods are reliant of the pre-season and the warmup program being done according to protocol as a slip in standard could result in lower effectiveness.

There could be a huge difference between the teams in an elite level soccer league. The highest ranked teams usually play domestic league matches in addition to domestic cups and international competitions. This results in a higher load per player, but it does not mean that they are more prone to injuries (6). A reason for this could be the economic state of the highest ranked teams as they have more money and therefore the ability to do more injury prevention training. Teams with more money usually also have staff to monitor and pay attention to biomarkers like creatine kinase (CK) to control load and prevent overuse injuries (17).

de Freitas et al (15) found that all clubs in the Brazilian top league have a physiotherapist or physical trainer with the knowledge to implement preventive training. Often these members of the staff design exercises with a scientific background. All the teams competing in the Brazilian top league have at least one preventative training session a week during the season, and some teams have two or more. Based on what is reported by Ekstrand et al (11) the teams that implement more pre-season training and continue the preventative training during the season have a lower frequency of injuries.

In pre-season, the fitness coaches or physiotherapist works on improving the strength, speed, and power of the athletes, at the same time working with preventative training to reduce the risk of injury and to be prepared for the increase in load when the season begins. The three most used methods of preventative training are eccentric, proprioceptive exercises, and core strength training. Neuromuscular improvement is a unanimous consensus in injury prevention programs, however, there is no strong evidence that this type of exercise is effective for soccer players. The

preventative work in Brazil prepares the athletes for the upcoming season and reduces the injury prevalence while in season (15). According to Pérez-Gómez et al (16) these types of exercises will have a positive effect on limiting injuries. It is not reported specifically how much it will help.

For all clubs worldwide, the recommendation is to increase the number of preseason training sessions and implement an IPP like the FIFA 11+ program. The benefits of using FIFA 11+ are that little equipment is required and can easily be modified to fit the needs of a team. Ekstrand et al (11) also found that more pre-season training sessions result in lower in-season injuries. This could help the team in terms of distributing the load on each player by having more players available for each match because of the fewer injuries experienced in the following season. In addition, this also reduces the cost related to players being injured. To get the best injury prevention possible, the team should hire a physiotherapist and a physical trainer to ensure high-quality preventative training and monitoring of the players. In addition, the club should show interest in preventative work and have the equipment required to monitor the load of the players.

Despite all the evidence showing that an injury could be prevented by using warm-up programs, a longer pre-season, or the many various training methods, it is impossible to fully stop injuries from happening. The most important part is to prepare the body for a game, or a training session as shown by Ekstrand et al (11) and FIFA (14). Because of the complexity of an injury and the many variables that follow, it is important to state that it is impossible to fully prevent injuries or stop them from happening. But rather limit the frequency and severity, using the methods above.

Conclusion

Through this systematic review, 17 articles have been screened to systemize the current knowledge related to the most common injuries among soccer players, when they occur, and how they could be prevented. The results show that the most common injury is located in the thigh, the most common type of injury is muscle and tendon while the most common injury duration is moderate (8-28 days). In the search for when the injuries occur, it has been found that most of the injuries happen in game situations and more specifically while in contact with other players. The

majority of injuries happen when playing on a natural grass surface. The right training, the FIFA 11+ warm-up program, longer pre-season, and having the economy to hire staff to surveil injuries among players have been proven effective in preventing injuries.

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