Musculoskeletal problems in soccer players: current concepts

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Summary

Soccer is the most popular sport worldwide, with about 200 million players, both professionals and amateurs. Because of its popularity, it has been often proposed to be able to prevent or cure health problems around the world. Although participation in football leads to significant physical benefits such as improving well-being, extending life expectancy and reducing the likelihood of several major non-communicable diseases, the possibility to incur in soccer injuries must be considered. On average, an elite football player suffers from 1.5-7.6 injuries each 1,000 hours of training and 12-35 injuries each 1000 hours of match. Several risk factors for soccer injuries have been described. The most important of them are the level of play (the risk appears to be higher in professional than amateur players); the exercise load; and the standard of training. The injury prevention program "The 11", developed with the support of the *Federation Internationale de Football Association* (FIFA), aims to reduce the impact of intrinsic injury risk factors in soccer, and it has been validated in that sport. A successive modified version of "The 11" ("The 11+") has been also shown to be effective in preventing injuries in young female soccer players. The FIFA 11+ provided more than 40% of reduction of the risk of injury. Several factors can be related to the risk of injury during sport. Therefore different exercises or factors might have been responsible for efficacy of the FIFA 11+ to prevent injuries. Several improvements have been surely achieved in the last ten years, but further investigation is needed to improve the benefits of playing soccer on human health.

KEY WORDS: soccer; football; injuries; anterior cruciate ligament; muscle injuries; platelet rich plasma; players.

Introduction

Soccer is the most popular sport worldwide, with about 200 million players, both professionals and amateurs (1). Because of its popularity, it has been often proposed to be able to prevent or cure health problems around the world (2). Although participation in football leads to significant physical benefits such as improving well-being (3), extending life expectancy and reducing the likelihood of several major non-communicable diseases (2), the possibility to incur in soccer injuries must be considered (4-7). On average, an elite football player suffers from 1.5-7.6 injuries each 1,000 hours of training and 12-35 injuries each 1000 hours of match (8, 9). A pioneer study to prevent those injuries was performed by Ekstrand in 1983, focusing on the effectiveness of a multi-factorial training program to reduce injury incidence in male adult football players, including stretching exercises (10). The injury ratio, following this program, should be reduced by 75% (10).
Several risk factors for soccer injuries have been described. The most important of them are the level of play (the risk appears to be higher in professional than amateur players); the exercise load; and the standard of training (9). Several classification systems for soccer injuries have been developed (11). When a same type of injury re-affected the player, at the same sites, is considered recurrent (12-14). In terms of physical complaint, the injury can be defined as mild, if the loss of activity day is less then 1 week; moderate, if the rest period ranges between 1 and 4 weeks; and severe, if the loss of activity day is more than 4 weeks (15). Therefore, the injury severity is defined according to the number of days of activity lost by the player (12-14). An injury can occur during the match (match exposure), or during the training session (12-14).
Injuries can be classified by location, type, part of the body interested, and mechanism of injury, such as traumatic or overuse (14, 15).
The main locations of injuries are: head and neck (head, face, neck, cervical spine), upper limb (shoulder, clavicula, hand/fingers, elbow, wrist), trunk (pelvis/buttock, abdomen, lumbar spine, thorax and chest) and lower limb (hip, groin, thigh, knee, lower leg, ankle, foot and toes) (3).
The main types of injury are: traumatic, such as fracture, contusion or hematoma, laceration, muscle or tendon strain and joint or ligament sprains or overuse injuries (12-14).
Finally, injuries can be caused by different factors such as struck by another athlete, collision with a person/moving object, overuse, over-stretched, rapid acceleration or deceleration (21).
An overuse injury is caused by repeated microtrauma without a single, identifiable event responsible for the injury (12-14).
A traumatic injury refers to an injury resulting from a specific, identifiable event, and an overuse injury to one caused by repeated microtrauma without a single, identifiable event responsible for the injury (12-14). Finally, two different circumstances can lead to an injury: contact or non-contact with another player or object (21).
The aim of this paper is to provide a comprehensive overview on the types of injury, the mechanisms underlying their onset, and prevention strategies in the soccer.

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Aetiology of soccer injuries

An epidemiologic study on 350 soccer players was performed by Gabbe et al. to identify the main causes and mechanisms of injury in soccer (21). They reported that the main causes include struck by another person 28% [98, contact injuries], collision with a person or moving object 18.85% [66, contact injury], overuse 11.42% [40, non contact injuries], and over-stretched 9.42% [33, non contact injuries] (21).
Detailed results of this study are illustrated in Table 1. The authors showed that 50% of injuries were contact injuries, whereas the remaining were non contact injuries. Several authors found that the occurrence of non contact injuries was higher than the occurrence of contact injuries in adult male soccer players (20, 44, 48-61). Dvorak et al. reported 44.6% [54] contact versus 55.4% [67] non contact injuries (8); whereas Arnason reported 44.1% [34] contact versus 55.9% [43] non contact injuries (16).

Table 1 - Causes of injuries.

Cause of injury	No. of injuries
Struck by another person	98
Collision with a person/moving object	66
Overuse	40
Over-stretched	33
Rapid acceleration or deceleration	30
Aggravation of a previous injury	23
Awkward landing	17
Fall at ground level	11
Struck by an object	8
Twist or change of direction	7
Fail from height	6
Kicking	2
Running/sprinting	1
Collision with a fixed object	1
Unsure	7
Total	**350**

This finding has been confirmed by Hagglund et al., who performed a comparison between male and female players. In this study, contact injuries were 22.66% [192] in male and 9.20% [78] in female, while non contact injuries were 42.03% [356] in male and 26.09% [221] in female (17, 18). Overuse injuries mainly affected the tendon (5, 6). The most common tendinopathy arising in soccer players include patellar, Achilles, quadriceps and hamstring tendinopathy (19).

Location and types of soccer injuries

Lower limb is the most common injured site (67.7% of injuries), followed by the upper limb (13.4%). Detailed report of body's part involvement is reported in Table 2 (19).
Focusing on the lower limb, the most injured sites are tight, knee and lower leg. Similar results have been reported in literature in studies performed on male professional soccer players. Ekstrand et al. (20) reported 4,483 injuries in professional players aged 15 to 36 years.
In this population, the main location of injuries was the thigh 41.19% [1,064] followed by the knee 31.66% [818] and the ankle 24.19% [625]. Few injuries involved the head and neck region 2.98% [77] (20).

Table 2 - Location of injuries.

Part of the body	No. of responses
Head and neck (Head, face, neck, cervical spine)	39
Upper limb (shoulder, clavicula, hand/fingers, elbow, wrist)	47
Trunk (Pelvis/buttock, abdomen, lumbar spine, thorax and chest)	36
Lower limb (Hip, groin, thigh, knee, lower leg, ankle, foot and toes)	228
Total	350

Hägglund et al. reported 22.70% [252] injuries of the thigh, 17,29 [192] of the knee and 12.16% [135] of the ankle of 1,110 total injuries occurred in elite soccer players of the Danish and the Swedish top divisions (15).
Waldén et al. found 658 injuries in Swedish elite soccer players, in which 23.10% [152] were at the thigh, 19.90% [131] at the knee and 13.52% [89] at the ankle (1).
Although the most common sites of soccer injuries are the same in men and women, the incidence of injuries in men doubles that in women (17).
Several types of injuries can arise in participating in soccer, such as lesions of vascular structures (hematoma, contusion, swelling, cut and laceration), connective tissues (sprain, strain, dislocation and joint injuries) and bone tissue (fractures) (19). The most common types of injury are strains and sprains, affecting the connective tissue (21). Detailed report of several type of injuries is showed in Table 3.
On a total of 4,483 injuries, 61.87% [2,774] occurred in the connective tissue, 17.28% [775] in the vascular and 0.30% [160] are fractures (20).
Walden et al. reported 73,86% [506] connective tissue injuries, 15.95% [105] vascular injuries and 2.43% [16] fractures on a total of 658 injuries (1).
On the other hand, Hawkins et al. stated that the most common injuries affect the vascular tissue 73.09% [163], followed by connective 13.90% [31] and bone 13.00% [29] tissues (21, 22).

Table 3 - Mechanism and types of injuries.

Mechanism of injuries	Types of injuries	No. of injuries
Traumatic	Fracture	18
	Contusion/haematoma	79
	Laceration	20
	Muscle or tendon strain	95
	Joint or ligament sprains	79
Overuse		40
Other (not specified by the author)		110
Total (more than one nature of injury could be recorded per case)		350

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Severity of soccer injuries

Injury severity can be defined as the number of days, from the date of injury, required to the player's return to full participation in team training and availability for match selection. Severity of injury can be classified as follows: minimal, if day loss ranges from 1 to 3 days; mild, if day loss ranges from 4 to 7 days; moderate, if day loss ranges from 8 to 28 days; severe, if day loss is more than 28 days.
In literature, several authors reported that the most common injuries are minimal, mild and moderate (1, 9, 15, 17, 21, 23). The most common injuries in man are minimal and mild [200 vs 76 in women], whereas in woman are moderate [102 vs 143 in men] (17).

Epidemiology of soccer injuries

In several studies, a soccer player is defined as injured when unable to take part in games (16). On average, an elite football player suffers from 1.5-7.6 injuries each 1,000 hours of training and 12-35 injuries each 1,000 hours of match (8, 9).
Based on the available literature, lower limb injuries occur more frequently; the sites affected from both major and minor injuries at different levels are the tight, the knee or the ankle, hip and groin, lower leg and Achilles tendon and, in the other part of the body, lower back and sacrum, shoulder and clavicula, head and neck, sternum, hand, abdomen, elbow and cervical spine (4-7, 11).
Men usually injured two times more frequently than women. Such a consideration should be associated with a major incidence of noncontact ACL injury in women, largely studied in several trials focused on the potential prevention (17).
The most common injured site was the lower limb (67.7%), followed by the upper limb (13.4%); 10% of all soccer injuries occurred in the thorax, back, trunk, abdomen, groin and pelvis (19).
Many players complain of back pain, not limiting for participating to the game. However, it is important to pay attention to this kind of symptoms, as such a pain could be a sign of internal organs damage (19).

Prevention strategies of soccer injuries

Soccer injuries should be prevented. The best way to prevent those injuries is the physical preparation prior to play. The aim of physical training is, on one hand, to improve the physical function of a player, on the other hand, to protect him against injury, or re-injury (19). The ankle is the most commonly injured part of the body, particularly the lateral ankle ligaments (19).
The most common causes of injury are: running/walking (20%); landing (16%); field hazard (11%); collisions (12%); being kicked (11%); fouls (6%). Several prevention programs have been developed, including balance boards, neuromuscular training, peroneal strengthening, that are effective at preventing the second ankle sprain (19). Knee is the most common injured part of body after the ankle. Knee injuries include meniscal tears, medial collateral ligament sprains, anterior cruciate ligament sprains and articular cartilage defects (19).
These injuries can result from direct contact to the knee, most difficult to prevent, and noncontact activities. Different prevention programs are available. Their rationale consists in improving the balance and the control of the joint during the activity, through specific exercises. A good control of the body is a way to prevent injuries (19).
The anterior cruciate ligament (ACL) injuries are the most studied in terms of prevention strategies. Although at the elite level there is a higher incidence between male players, particularly during match, some evidences state that female run a higher risk for knee injury, particularly at the ACL (63, 64). Moreover, because of the increasing number of female participants in soccer (24), some prevention strategies have been investigated. Baber-Westin classified female risk factors in three main categories: anatomical, hormonal and neuromuscolar or biomechanical (25).
Also few studies have been conducted to determine the effect of genetics and environmental factors on noncontact ACL injuries, and no conclusion have been reached at present regarding these factors (6, 7, 25).
Anatomical risk factors include size of the ACL, Body Mass Index (BMI) and ligament laxity. Neuromuscular risk factors include movement and muscle activation such as knee adduction/abduction moments or muscle strength (25).
A survey reveals several trials on the prevention of noncontact ACL injuries particularly among women, because it seems that the incidence of knee injuries in female soccer players is 2-6 times higher than in men (25, 26).
Even though Chappet et al. were not able to identify the cause of higher incidence of noncontact ACL injuries in female; Barber-Westin et al. suppose the influence of higher risk factors such as a genetic predisposal, the anatomical structure (size and shape of the intercondylar notch or of the ACL), BMI and hormones (25).
Hagglund et al. presented a warm-up program to prevent acute knee injuries in adolescent female soccer players, as a positive habit not only for the athletes or their teams, but also for insurance companies and soccer clubs (17).
Although injuries of head result in a few incidence, they can have important effects on the health of soccer player. Moreover, the head is vulnerable because is unprotected. A common head impairment is a condition called mild traumatic brain injury (MTBI), a kind of concussion. The head injury arises from a contact with some other object such as another part of the adversary body (elbow, foot, head) or the ground.
Before 1970s and the introduction of a water-resistant ball, the old leather ball was a risk factor for head injury, because of the heaviness of the old ball. Of course a water-resistant ball is less heavy than the first one, and causes less damages when in touch with the head (19).
Using head protections, melt with commons sense, should be a prevention strategy to those injuries.
The aim of physical training is, on the one hand to improve the physical function of a player, and on the other hand to protect him against injury, or re-injury. Another way to improve the physical function of a player is the food and fluid intake, considered the fuel for soccer.
Running, jumping or dribbling such as walking and jogging require energy, coming from fats, proteins, vitamins and particularly carbohydrates, the most important bio-molecule for a soccer player. The body uses carbohydrates for the higher-intensity actions and fats for the lower-intensity actions, such as walking and jogging. Training is important to teach the body to use fat for higher intensities of work. When the limited amount of carbohydrates stored in the body as glycogen goes to an end, the player runs slower, makes shorter high intensity runs and makes poorer decisions. In this critical stage, injuries are most common.
Training helps to diminish fatigue and to deal with the loss of glycogen, so that the goal of training such as of nutrition is to become so fit that the opponents fatigue first and most.
Finally, proper nutrition is crucial for both the training and the game. There are different nutrition schedules to follow in the days prior to the match, in the day-game, during the game and after the game, to recover the glycogen lost. Also vitamins and supplement can be assumed to have a well-balanced diet.
Prevention strategies should be implemented for increase the safety of players. However, economic issues arise, linked to medical management and sponsors and media coverage, when an athlete is injured. Thus prevention strategies are also important in terms of economic aspects. Van Beiksterveldt et al. observed that the total costs of injuries is about £1.3 billion a year (27).

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In particular in the Netherlands, soccer causes the biggest number of injuries every year, with 679,000 injuries representing the 19% of all sports injuries. The indirect costs should be exploited to determine the severity of an injury (the more is severe, the more it will cost on medical treatment) (27). In this study, the healthcare costs included the expenses of visits to medical specialists, additional visits to other healthcare providers (general practitioners and physiotherapists), prescription medication, resources to improve recovery, hospitalisation, x-rays and other diagnostic procedures (27).

Therefore, the prevention of soccer injuries is expected to benefit the players and clubs involved, as well as the health insurance companies and society (27).

The injury prevention program "The 11", developed with the support of the Federation Internationale de Football Association (FIFA), aims to reduce the impact of intrinsic injury risk factors in soccer, and it has been validated in that sport (28, 29). A successive modified version of "The 11" ("The 11+") has been also shown to be effective in preventing injuries in young female soccer players (30). The FIFA 11+ provided more than 40% of reduction of the risk of injury (30). Several factors can be related to the risk of injury during sport. Therefore different exercises or factors might have been responsible for efficacy of the FIFA 11+ to prevent injuries. The program was found to be not effective in preventing the following injuries: ankle, leg anterior thigh, posterior thigh (hamstring), hip/groin, sprains, strains, fractures, anterior lower leg pain (periostitis). On the other hand, the program was effective in preventing knee injuries, lower extremity injuries, overall injuries, severe injuries, and overuse injuries, such as lower extremity tendon pain and low back pain. According to data about mechanism of injury in soccer (31, 32), basketball (33), handball (34), rugby, alpine skiing (35), the success of program could be related to running exercises with crescent difficulty to obtain a proper knee control and core stability during cutting and landing, exercises to improve dynamic and static balance, neuromuscular control and proprioception, particularly of the knee and the hip, and exercises increasing hamstring muscle strength to prevent injuries to the anterior cruciate ligament (31). For the first time, we conducted a cluster randomised controlled trial to examine the effect of the FIFA 11+ on rates of injuries also in elite male basketballers.

Conclusion

Soccer is the most popular sport worldwide and the participating in this sport can be associated with injuries. A comprehensive knowledge of types of injury and the mechanisms underlying their onset is required to develop effective prevention strategies in soccer. Several preventing strategies have been investigated, but only one study reports the costs related to those injuries and to prevention programs. Effective approaches to improve the physical function include: intensive session of training before the match and appropriate nutrition and fluid intake.

Several improvements have been surely achieved in the last ten years, but further investigation is needed to improve the benefits of playing soccer on human health by offsetting injuries, which can be considered as negative collateral effects.

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