

AUTHORS:

João Manuel P R Serrano ¹
 Shakib Shahidian ¹
 João Ferro Serrano ²
 Nuno Miguel C Leite ³

¹ Escola de Ciências e Tecnologia,
 Universidade de Évora, Portugal.

² Providence College, Cuning
 Square, Providence, USA.

³ Departamento de Ciências
 do Desporto, Exercício e Saúde,
 Universidade de Trás-os-Montes
 e Alto Douro, Portugal.

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ABSTRACT

Futsal is the most popular sport at the level of schools in Portugal. Its future development requires better knowledge of the incidence of injuries, as a means of adjusting the training and match processes. The aim of this study was to characterize match injury in young Portuguese futsal players based on: (a) an approach centred on the playing position, and (b) real-time monitoring of the 111 national inter-association tournament matches promoted by the Portuguese Football Federation in the 2017/2018 sports season. The results showed a higher match injury index (I_{MI} , injuries per 1000 h) in the women's tournament ($I_{MI} = 234.8$) than in the men's tournaments ($I_{MI}=156.8$ and $I_{MI}=119.3$, respectively under 18 years and under 16 years). Regarding the playing positions, winger and goalkeeper together accounted for 67.5% of the injuries. Our prospective study also showed that contusion (65.6%), of traumatic origin (69.1%), over the dominant (79.0%) foot (42.1%) and with time-loss (67.1%) represents the dominant pattern of match injuries, with greater prevalence in the final period of each part of the match (63.2%). These findings show the interest in further studies that can provide a better understanding of why there is a higher incidence of injuries in women's futsal and highlight the need for specific work on injury prevention, especially at the level of wingers and goalkeepers and in the management of the balanced participation of players throughout the match.

CORRESPONDING AUTHOR: João Manuel Pereira Ramalho Serrano, Escola de Ciências e Tecnologia,
 Universidade de Évora, Núcleo da Mitra, 7000 Évora, Portugal.
 telephone: +351 963824046. email: jmrs@uevora.pt

Prospective study on the incidence and pattern of injuries in young Portuguese futsal players: An approach centred on the playing position.

KEYWORDS:

Injury. Futsal. Match.
 Playing position. Gender.

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Estudo prospectivo sobre a incidência e o padrão de lesões de jogadores jovens de futsal Portugueses: Uma abordagem centrada na posição.

RESUMO

O futsal é a modalidade com maior número de praticantes ao nível do desporto escolar em Portugal. O seu desenvolvimento exige um melhor conhecimento sobre a incidência de lesões como forma de ajustar os processos de treino e de jogo. O objectivo deste estudo foi caracterizar as lesões ocorridas em jogos por jovens jogadores de futsal Portugueses tendo por base: (a) uma abordagem centrada na posição específica e (b) a partir da monitorização em tempo real de 111 jogos dos torneios nacionais inter-associações promovidos pela Federação Portuguesa de Futebol na época desportiva de 2017/2018. Os resultados mostraram um maior índice de incidência de lesões (I_{IJ} , lesões por 1000 h) no torneio feminino ($I_{IJ} = 234.8$) do que nos torneios masculinos ($I_{IJ}=156.8$ and $I_{IJ}=119.3$, respectivamente sub 18 anos e sub 16 anos). Relativamente à posição específica, os alas e os guarda-redes em conjunto representaram 67.5% das lesões. Este estudo também mostrou que a contusão (65.6%), de origem traumática (69.1%), sobre o pé (42.1%) dominante (79.0%) e com tempo de impedimento (67.1%) representa o padrão de lesões, com maior prevalência no período final de cada parte do jogo (63.2%). Estas conclusões mostram o interesse em desenvolver mais estudos que possam fornecer uma melhor compreensão sobre a maior incidência de lesões no futsal feminino e realçam a necessidade de realização de trabalho específico de prevenção de lesões, especialmente ao nível dos alas e guarda-redes, e na gestão da participação equilibrada dos jogadores ao longo do tempo de jogo.

PALAVRAS-CHAVE:

Lesão. Futsal. Jogo.
 Posição. Género.

INTRODUCTION

Futsal (indoor soccer) is a relatively recent sport which is specially developed in South America and South and East of Europe. The specific characteristics of this sport modality, where players make movements with sudden changes of direction, involving contact with the ball and with opponents, on very different floors, with very high levels of competitive demand and periods of overload of training and competition, contribute to the development of lesions (Cain, Nicholson, Adams, & Burns 2007). This sport seems to involve a high number of high-intensity phases in terms of proportion of match time, multiple-sprints and fast moments in tight spaces, repeated multiplanar movements such as sudden acceleration and deceleration, rapid changes of direction, tackling and kicking (Ruiz-Pérez et al., 2019), which may be taken into consideration when planning for injury prevention (Lopes, Oliveira, & Ribeiro, 2020).

References to research works in this sport are very limited, with frequent references only to epidemiological studies of injuries in soccer (Agel, Evans, Dick, Putukian, & Marshall, 2007; Dick, Putukian, Agel, Evans, & Marshall, 2007) and in other more popular indoor sports such as Basketball, Volleyball or Handball. Nevertheless, the rapid growth of futsal as a popular sport has led to an increased awareness of the injuries associated with it (Lopes, Simões, Costa, Oliveira, & Ribeiro, 2020). Some epidemiological studies in futsal (Junge & Dvorak, 2010) or comparative studies of injuries in futsal and soccer have emerged (Emery & Meeuwisse, 2006; Junge, Dvorak, Grauf-Baumann, & Peterson, 2004).

The methodology followed by studies on the incidence of sports injuries in different sports is usually descriptive and is based on surveys or interviews with athletes (Nicholl, Coleman, & Williams, 1991). Fuller et al. (2006), when describing the scope of sports injuries, refer to prospective type (monitoring and recording of occurrences in real-time) and retrospective type (which appeal to the athletes' memory in terms of occurrences during their sports career) studies. Dantas (2007), based on a prospective study, listed the following as general reasons for the incidence of injuries in futsal: deficient physical preparation, significant postural changes, reduced rates of flexibility, errors in the execution of sports skills and inadequate equipment, associated with injuries of traumatic origin during the competition. Elsner, Pavan, e Wisniewski (2007) carried out an exploratory and descriptive study, based on bibliographic review of scientific articles, and concluded that the factors that predispose futsal players to injuries are related to its nature as a team sport, which involves frequent contact with opponents, with fast, complex, accelerating and decelerating movements and refer to the interaction of extrinsic and intrinsic factors related to the player, considerations corroborated by Lago-Fuentes et al. (2020).

Aspects related to injury type, location, severity or mechanisms are usually common in sports injury studies (Fuller et al., 2006). Most studies indicate that the injuries in futsal are predominantly located in the lower limbs, which is due to the characteristics of this sport. For example, Junge and Dvorak (2010) and Kurata, Júnior, and Nowotny (2007) obtained values of 70 and 88.1%, respectively, for the percentage of injury incidence in the lower limbs during futsal practice. These values even assume a differentiating meaning for the modality when compared to the 54% obtained by Hootman, Dick, and Agel (2007) in the group of 15 collective sports, including soccer, or by Rechel, Yard, and Comstock (2008), specifically for the soccer. Regarding the anatomical region, Emery and Meeuwisse (2006) found that the ankle is the anatomical region most prone to injuries in futsal, while Serrano, Shahidian, Voser, and Leite, (2013), in a retrospective study found the preponderance of knee sprain.

Another parameter normally considered in studies on injuries, especially when comparing sports, is the index of injury incidence in a given exposure period, normally 1000 h (Fuller et al., 2006). The current literature estimates the rate of futsal injuries to be twice that of soccer (Lopes, Simões, et al., 2020b). Hoff and Martin (1986) found that the incidence of injuries was 4.5 times higher in futsal than in soccer in players under 16 years of age. Junge et al. (2004), whose comparative study on the incidence of injuries between soccer (having accompanied tournaments organized by FIFA and Olympic tournaments between 1998 and 2001) and futsal (based on the 2000 World Cup in Guatemala) revealed that the incidence of injuries in futsal matches was twice the incidence of injuries in soccer. To add to the diversity of conclusions presented by different research teams, Emery and Meeuwisse (2006) and Putukian, Knowles, Swere, and Castle (1996) did not register significant differences regarding the index of injury incidence involved in soccer and futsal.

These different conclusions are mostly due to the diversity of approaches, but also sometimes indicate controversial results. Future development of futsal requires better knowledge of the incidence of injuries as a means of adjusting the training and match processes, especially taking into account the specificity of the players' positions in the field (playing position). These different playing positions correspond to different physical, physiological, technical and tactical demands on the players (Naser, Ali, & Macadam, 2017), which can result in different susceptibility to injuries. Despite some published works on this theme in Portugal (Serrano et al., 2013), these refer to retrospective approach, which appeal to the players' memory and, therefore, subject to some level of imprecision (Fuller et al., 2006). Success in team sport, from the sport science and medicine staff perspective, is to use evidence-based knowledge in an effective manner to develop the decision-making process for injury risk reduction and athletes' performance optimization (Claudino et al., 2019).

In Portugal, the main moment for futsal talent identification takes place in the national inter-association tournaments organized annually by the Portuguese Football Federation. The aim of this study was to characterize the match injury pattern in young Portuguese futsal players based on: (a) an approach centred on the playing position, and (b) real-time monitoring of the 111 national inter-association tournament matches promoted by the Portuguese Football Federation in the 2017/2018 sports season (female under 18 years, “U-18 F” and male under 18 and under 16 years, “U-18 M” and “U-16 M”, respectively).

MATERIAL AND METHODS

SAMPLE

The sample was composed of 111 monitored matches, involving a total of 711 players from all districts in the country, in the 2017/2018 season: 23 matches (and 227 players) in the under 18 years female tournament (U-18 F), 44 matches (and 230 players) in the under 18 years male tournament (U-18 M) and 44 matches (and 254 players) in the under 16 years male tournament (U-16 M).

DATA COLLECTION

In each monitored match, a coach of the Portuguese Football Federation followed the occurrences of the match, recording all injuries. Both the injury definition and the procedure for recording player’s injuries were compliant with the international consensus statement for epidemiological studies of injuries in soccer (Fuller et al., 2006). Each record included the identification of the teams, the sweater number of the injured player, the team, the playing position, the dominant limb, the injury type, location (with the indication of the limb, when applicable), mechanism (traumatic or overuse), playing time elapsed in the match and potential severity.

Regarding the mechanism, traumatic injury refers to an injury resulting from a specific, identifiable event, while overuse injury is one caused by repeated micro-trauma without a single, identifiable responsible event (Lopes et al., 2020b).

Injuries were considered at any time, whether during the match or in the pre-match warm-up phase, and any physical complaint sustained by a player were recorded, irrespective of the need for “medical-attention” (i.e., an assessment of a player’s medical condition by a qualified medical practitioner) or “time-loss” (injury that results in a player being unable to participate fully in the current match) (Fuller et al., 2006; Lopes, Simões, et al., 2020). If the player returned to the match, it was considered a “medical-attention” (low potential severity), if he or she did not return it was considered a “time-loss” (high potential severity). At the end of each match, the coach who collected the data met with the medical staff of each team to validate the recorded information, based on your knowledge and experience with the application of scale international consensus statement for epidemiological studies of injuries.

As the number of some injury types and anatomical locations is small, it was necessary to combine individual type or location categories into main groupings, for analysis purposes. Three categories of injury types were considered (contusions, sprain -joint or ligament injury, and others) and four categories of injury locations (upper limbs, lower limbs – include thigh and knee, foot – include ankle, and others).

The futsal match lasts 40 effective min (with stopped clock), consisting of two 20 min parts, separated by a 15 min interval. In this study, the matches were divided into five periods in terms of injury registration: (a) pre-match (the warm-up and activation before the match); (b) 0-10 min; (c) 10-20 min; (d) 20-30 min; and (e) 30-40 min.

In the U-18 F tournament it was only possible to monitor 23 of the 36 matches played since, at the same time, several Portuguese Football Federation coaches participated in the “2018 UEFA Futsal Championship”.

The study protocol followed the guidelines stated in the Declaration of Helsinki and was approved by the Ethics Commission of the Research Centre for Human Health and Welfare of University of Évora, Portugal.

DATA PROCESSING

The collected data was loaded into an Excel spreadsheet. Regarding the specific positions of the players in the field (playing position), the following designations were considered: goalkeeper, defender, winger, pivot and universal. The universal position clustered together the players associated with more than one position (defender-winger or winger-pivot). These positions depend fundamentally on the offensive system of each team, with a predominance of the “1:3:1” system compared to the “1:4:0” and “1:2:2” systems. In the “1:3:1” system two wingers are used, which explains the greater number of wingers in the sample.

For easier visualization, graphs were prepared with the number of injuries in each category reported as percentages, for each playing position. One of the calculated parameters was the index of match injury (I_{MI}) referring to each tournament. This index is usually shown as the number of injuries per 1 000 h of practice or exposure. In this study, equations (1) and (2) were used, adapted from the proposals of Fuller et al. (2006).

$$t_{ME} = \frac{N_M \times N_P \times t_M}{60} \quad (1)$$

$$I_{MI} = \frac{N_I \times 1000}{t_{ME}} \quad (2)$$

t_{ME} - total player-match exposure time (in h), N_M is the number of matches played, N_P is number of players in the match (5 players for each team), t_M is the duration of the match in min (40), “60” is a factor to correction of unities (min to h), I_{MI} - index of match injury (injuries per 1000h of match exposure) and N_I - number total of injuries.

The collected data were used in a descriptive analysis, by frequencies and percentage, in the calculation of the indices of match injury incidence in the three tournaments and in the evaluation and description of the characteristic patterns of futsal injuries by playing position: type, location, laterality, mechanism, potential injury and period of the match.

RESULTS

Table 1 shows the total number of participants and injuries, for each tournament (U-18 F, U-18 M, and U-16 M) and for each playing position (goalkeeper, defender, winger, pivot and universal). As can be observed, the total number of players in the winger position (258) is superior to any of the other playing positions. This characteristic of the sample is related to the preponderance of coaches using the offensive “1: 3: 1” system, which includes two wingers. Figure 1 shows that the set of winger and goalkeeper playing positions represents 53.7% (36.4 and 17.3%, respectively) of the total players participating, however, the same set represents 67.5% (42.7 and 24.8%, respectively) of the total injuries observed, while defenders, pivots and universal players as a whole only represent the remaining 32.5% of the total injuries.

TABLE 1. Total number of players and injuries registered for each tournament and for each playing position

| PLAYING POSITION | U-18 F | | U-18 M | | U-16 M | | TOTAL | |
|------------------|---------|----------|---------|----------|---------|----------|---------|----------|
| | PLAYERS | INJURIES | PLAYERS | INJURIES | PLAYERS | INJURIES | PLAYERS | INJURIES |
| Goalkeeper | 38 | 7 | 41 | 12 | 44 | 10 | 123 | 29 |
| Defender | 33 | 8 | 34 | 2 | 35 | 4 | 102 | 14 |
| Winger | 84 | 15 | 87 | 21 | 87 | 14 | 258 | 50 |
| Pivot | 24 | 3 | 32 | 4 | 33 | 3 | 89 | 10 |
| Universal | 48 | 3 | 36 | 7 | 55 | 4 | 139 | 14 |
| TOTAL | 227 | 36 | 230 | 46 | 254 | 35 | 711 | 117 |

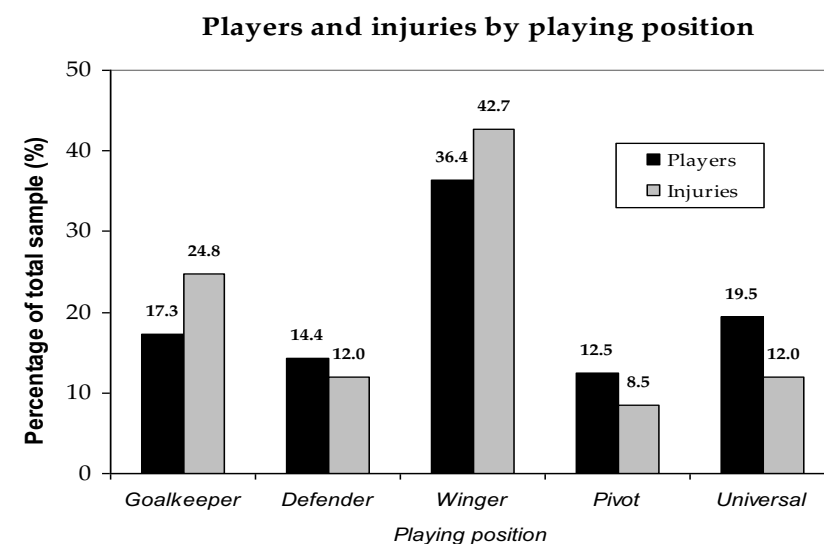


FIGURE 1. Players and injuries by playing position, in percentage of total sample

On the other hand, it is also important to highlight on table 1 that the total number of injuries in the U-18 F tournament (36) is similar to that registered in the U-16 M tournament (35), while the number of matches monitored is practically half (23 in the first and 44 in the second), which indicates a higher incidence of injuries in the female tournament (234.8 injuries/1000h), compared to male tournaments (156.8 and 119.3 injuries/1000h, respectively in the U-18 M and U-16 M tournament).

Table 2 shows, for each tournament and for each playing position, the number of injuries registered in each group under consideration: anatomical region (location), type, laterality, mechanism and potential injury severity. In these , it is possible to identify the following general patterns of match injury: (a) contusion is the main type of injury (average 65.6%), followed by sprain (average 30.0%) (FIGURE 2A); (b) foot (average 42.1%) and lower limbs (average 28.8%) are the principal locations of injuries (FIGURE 2B); (c) in regards to laterality, injuries occur mainly in the dominant limb (average 79%) (FIGURE 2C); (d) the main mechanism of injury is traumatic (average 69.1%) (FIGURE 3A); and (e) the majority of injuries involve time-loss (67.1%), thus indicate some potential injury severity (FIGURE 3B). However, and only for players in the pivot position, the prevalence goes to medical-attention (70.0%) which may indicate specificity of this playing position in terms of injury incidence.

TABLE 2. Number of injuries registered per anatomical region, type, laterality, mechanism and potential severity.

| PLAYING POSITION | INJ. LOC. | U-18 F | U-18 M | U-16 M | INJ. TYPE | U-18 F | U-18 M | U-16 M | INJ. LAT. | U-18 F | U-18 M | U-16 M | MEC. INJ. | U-18 F | U-18 M | U-16 M | POT. INJ. SEV. | U-18 F | U-18 M | U-16 M |
|------------------|-----------|--------|--------|--------|-----------|--------|--------|--------|-----------|--------|--------|--------|-----------|--------|--------|--------|----------------|--------|--------|--------|
| Lat. | UL | 0 | 1 | 2 | S | 0 | 6 | 1 | D | 2 | 7 | 6 | T | 5 | 7 | 4 | T.-loss | 6 | 8 | 9 |
| | LL | 1 | 5 | 4 | C | 7 | 4 | 8 | ND | 0 | 1 | 1 | O | 2 | 5 | 6 | Med.-at. | 1 | 4 | 1 |
| | F | 1 | 3 | 1 | O | 0 | 2 | 1 | Nap | 5 | 4 | 3 | - | - | - | - | - | - | - | - |
| | O | 5 | 3 | 3 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Defender | UL | 0 | 0 | 0 | S | 4 | 2 | 0 | D | 5 | 1 | 2 | T | 6 | 1 | 4 | T.-loss | 4 | 1 | 4 |
| | LL | 3 | 0 | 1 | C | 4 | 0 | 4 | ND | 3 | 0 | 0 | O | 2 | 1 | 0 | Med.-at. | 4 | 1 | 0 |
| | F | 5 | 1 | 1 | O | 0 | 0 | 0 | Nap | 0 | 1 | 2 | - | - | - | - | - | - | - | - |
| | O | 0 | 1 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Winger | UL | 0 | 0 | 0 | S | 4 | 4 | 2 | D | 8 | 9 | 8 | T | 13 | 15 | 13 | T.-loss | 11 | 15 | 12 |
| | LL | 5 | 8 | 4 | C | 11 | 16 | 12 | ND | 5 | 7 | 1 | O | 2 | 6 | 1 | Med.-at. | 4 | 6 | 2 |
| | F | 8 | 9 | 6 | O | 0 | 1 | 0 | Nap | 2 | 5 | 5 | - | - | - | - | - | - | - | - |
| | O | 2 | 4 | 4 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Pivot | UL | 0 | 0 | 0 | S | 0 | 2 | 0 | D | 2 | 3 | 1 | T | 2 | 3 | 3 | T.-loss | 1 | 1 | 1 |
| | LL | 1 | 1 | 2 | C | 2 | 2 | 3 | ND | 1 | 0 | 0 | O | 1 | 1 | 0 | Med.-at. | 2 | 3 | 2 |
| | F | 2 | 2 | 0 | O | 1 | 0 | 0 | Nap | 0 | 1 | 2 | - | - | - | - | - | - | - | - |
| | O | 0 | 1 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Univ. | UL | 0 | 0 | 0 | S | 3 | 1 | 2 | D | 3 | 2 | 2 | T | 1 | 4 | 2 | T.-loss | 2 | 7 | 3 |
| | LL | 1 | 0 | 0 | C | 0 | 6 | 2 | ND | 0 | 0 | 1 | O | 2 | 3 | 2 | Med.-at. | 1 | 0 | 1 |
| | F | 2 | 2 | 4 | O | 0 | 0 | 0 | Nap | 0 | 5 | 1 | - | - | - | - | - | - | - | - |
| | O | 0 | 5 | 0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| TOTAL | - | 36 | 46 | 35 | - | 36 | 46 | 35 | - | 36 | 46 | 35 | - | 36 | 46 | 35 | - | 36 | 46 | 35 |

Inj. Loc.- Injury location, Inj. Type- Injury type, Inj. Lat.- Injury laterality, Mec. Inj.- Mechanism of injury, Pot.Inj. Sev.- Potential injury severity, Univ.- Universal, UL- Upper limbs, LL- Lower limbs (include thigh and knee), F-Foot (include ankle), O- Others, S-Sprain (joint and ligament injury), C- Contusions, D- Dominant limb, ND- Non dominant limb, Nap.- Not-applicable, T- Traumatic, O- Overuse, T.-loss- Time-loss and Med.-at.- Medical-attention.

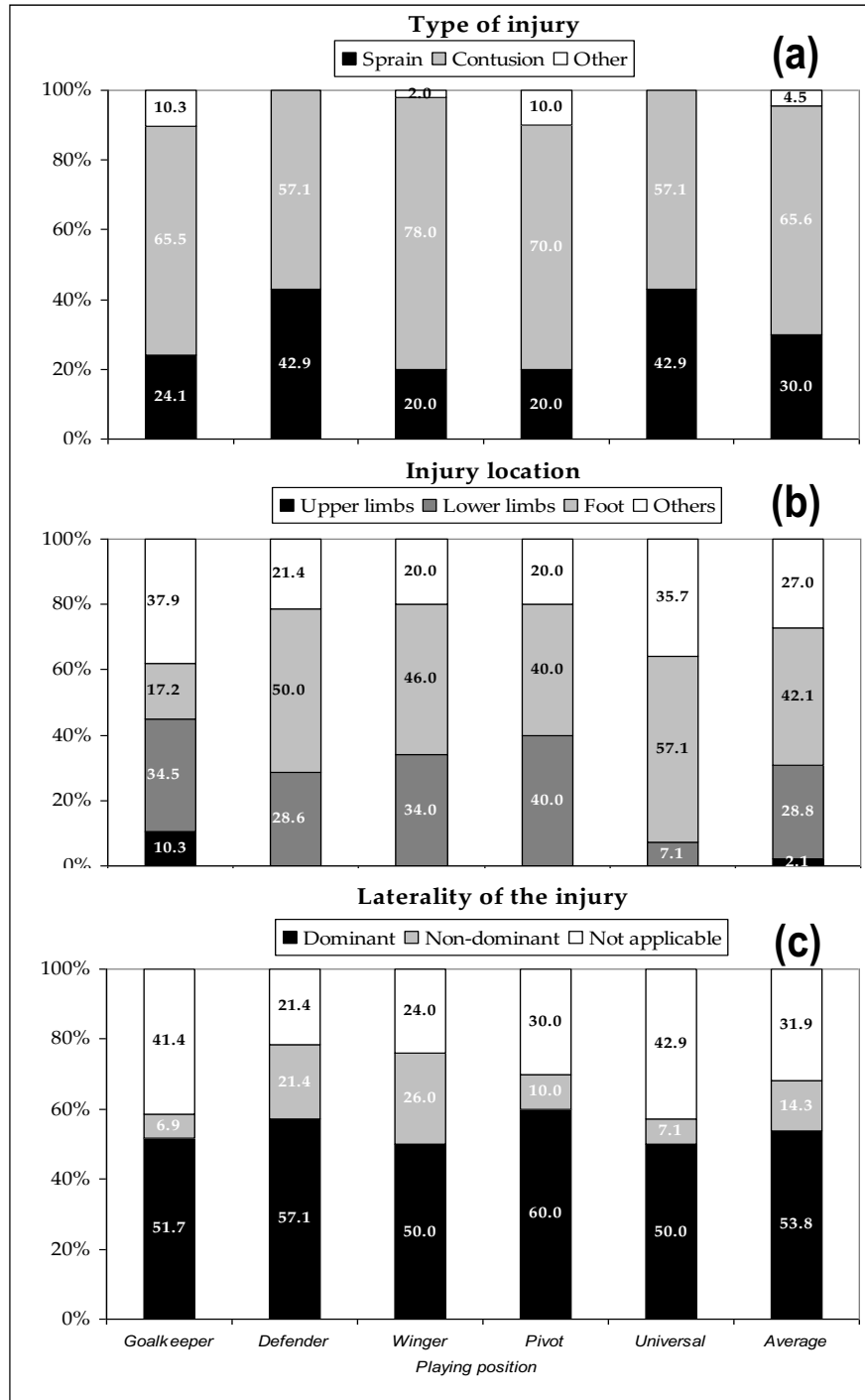


FIGURE 2. Pattern, by playing position, of type of injury (a), location (b) and laterality, in percentage of total sample

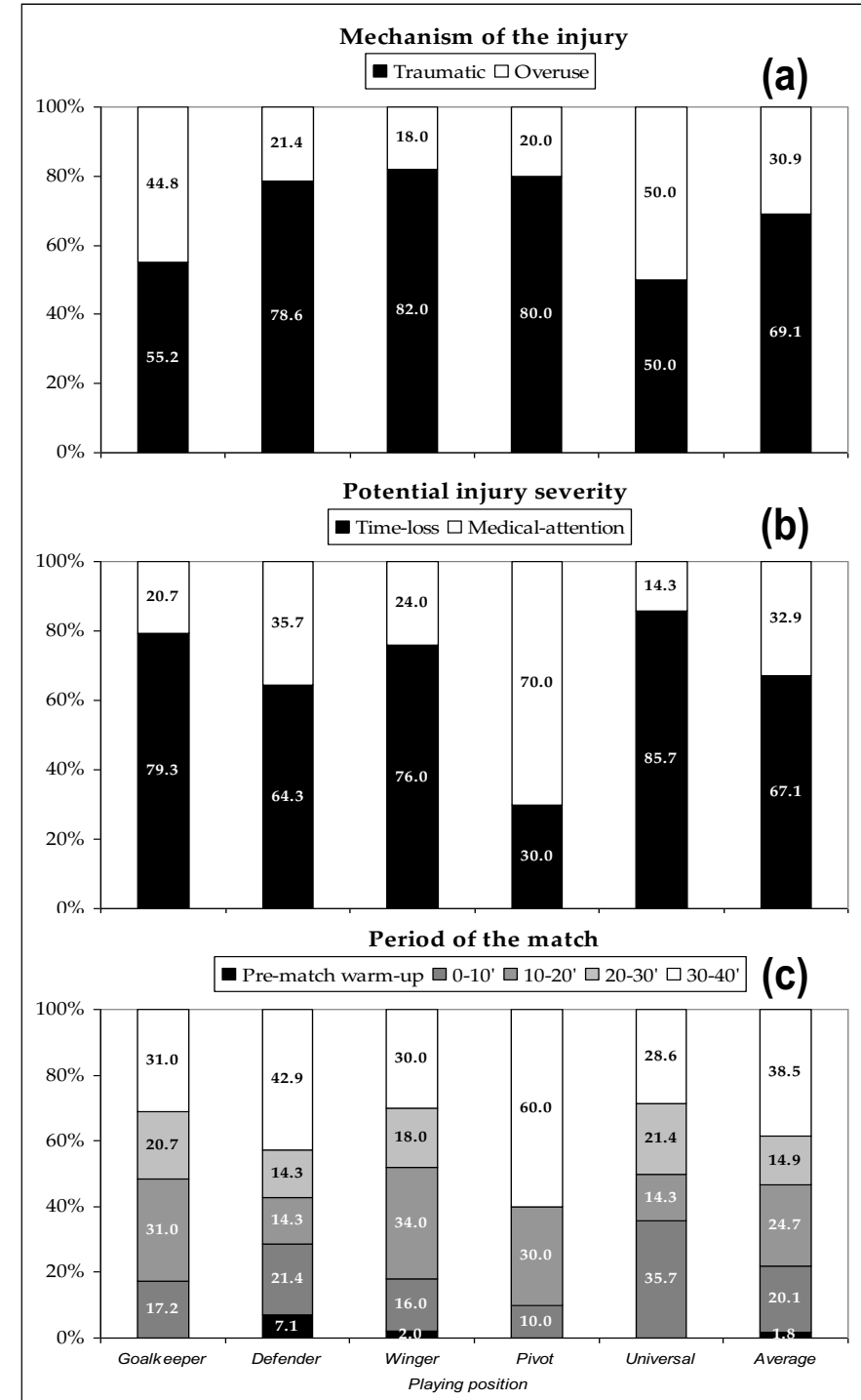


FIGURE 3. Pattern, by playing position, of mechanism of the injury (a), potential severity (b) and period of the occurrence in the match (c), in percentage of total sample

Table 3 shows, for each tournament and for each playing position, the number of injuries registered in each period of the match (pre-match, 0-10 min, 10-20 min, 20-30 min and 30-40 min). The majority of the injuries (63.2%) occur in the final period of each part of the match (38.5% in the last 10 min of the second part of the match and 24.7% in the last 10 min of first part of the match) (FIGURE 3c). It should also be noted that 60% of pivot injuries were recorded in the last 10 min of the match. This result seems to confirm that the pivot position has specific characteristics in terms of susceptibility and incidence of injuries.

TABLE 3. Number of injuries registered per each period of the match.

| | PERIOD OF THE MATCH | U-18 F | U-18 M | U-16 M | TOTAL |
|------------|---------------------|--------|--------|--------|-------|
| Goalkeeper | Pre-match warm-up | 0 | 0 | 0 | 0 |
| | 0-10 MIN | 0 | 3 | 2 | 5 |
| | 10-20 MIN | 3 | 2 | 4 | 9 |
| | 20-30 MIN | 1 | 4 | 1 | 6 |
| | 30-40 MIN | 3 | 3 | 3 | 9 |
| Defender | Pre-match warm-up | 1 | 0 | 0 | 1 |
| | 0-10 min | 0 | 1 | 2 | 3 |
| | 10-20 MIN | 1 | 1 | 0 | 2 |
| | 20-30 MIN | 0 | 0 | 2 | 2 |
| | 30-40 MIN | 6 | 0 | 0 | 6 |
| Winger | Pre-match warm-up | 1 | 0 | 0 | 1 |
| | 0-10 MIN | 3 | 1 | 4 | 8 |
| | 10-20 min | 4 | 7 | 6 | 17 |
| | 20-30 MIN | 3 | 5 | 1 | 9 |
| | 30-40 MIN | 4 | 8 | 3 | 15 |
| Pivot | Pre-match warm-up | 0 | 0 | 0 | 0 |
| | 0-10 MIN | 1 | 0 | 0 | 1 |
| | 10-20 MIN | 1 | 1 | 1 | 3 |
| | 20-30 min | 0 | 0 | 0 | 0 |
| | 30-40 MIN | 1 | 3 | 2 | 6 |
| Universal | Pre-match warm-up | 0 | 0 | 0 | 0 |
| | 0-10 MIN | 1 | 3 | 1 | 5 |
| | 10-20 MIN | 0 | 1 | 1 | 2 |
| | 20-30 MIN | 0 | 2 | 1 | 3 |
| | 30-40 min | 2 | 1 | 1 | 4 |
| TOTAL | | 36 | 46 | 35 | 117 |

DISCUSSION

The purpose of this study was to characterize the match injury pattern in young Portuguese futsal players. The study reveals the following aspects: (a) higher incidence in players in the winger position, followed by goalkeepers; (b) higher incidence in female tournament, and among male, higher incidence in U-18 than in U-16; (c) contusion was the principal type of injury, followed by sprain; (d) foot and lower limbs were the principal locations of injuries; (e) injuries occur mainly in the dominant limb; (f) the main mechanism of injury was traumatic; (g) except in the pivot playing position, the majority of injuries involved time-loss, which indicates some potential severity; and (h) the majority of the injuries occur in the last 10 min of each part of the match.

Despite futsal being one of the most popular sports in several countries, only a limited number of prospective epidemiological studies have been published investigating injuries sustained by futsal players, mainly during match play (Ruiz-Peréz et al., 2019). In particular, the greater or lesser predisposition for injuries due to the playing position has not been the subject of frequent study in futsal, with fewer references to this dimension of sports injuries. Nevertheless, Martínez-Riaza, Herrero-Gonzalez, Lopez-Alcorocho, Guillen-Garcia, and Fernandez-Jaen (2017) obtained a higher incidence (50.4%) in wingers, while Hamid, Jaafar, and Ali, (2014) recorded a higher incidence in the goalkeeper playing position, which are both in agreement with the results obtained in our study. Players in the winger position share some characteristics that predispose them to injuries: they play most of the time with the feet facing the lateral lines of the field, they are usually subject to requests involving sudden changes of direction, with sudden accelerations and brakes to try to win the hard duels with their opponents. On the other hand, the goalkeepers are subjected to shots at very short distances, are forced to make quick exits from the goal, often to slide on the ground which end in shocks with opponents, in addition to their increasing use as advanced goalkeepers.

On the contrary, the incidence of injuries by gender has attracted special attention in several sports and also in futsal. According to Nemcic, Sporis, and Fiorentini (2016) and Ruiz-Peréz et al. (2019), it is likely that the environmental, anatomical, hormonal, neuromuscular and biomechanical sex-related differences (among other factors) may contribute to sex-specific differences in injury incidence, with higher incidence in the female gender, which confirms the results of our study. Angoorani, Haratian, Mazaherinezhad, and Younespour (2014) also indicate that female players are significantly more prone to injuries than male players. Considering the nature of futsal which requires multiple sprints and frequent changes in the direction of movements, the physical fitness factors (particularly speed and agility) of the athletes should be much improved to make the players able to participate in the competitions and to decrease the risk of sports injuries. Therefore, it seems rational that the rate of injury among female futsal players with lower level of physical fitness would be greater than corresponding male futsal players (Angoorani et al., 2014).

The indices of match injury incidence observed in our study are similar to those obtained in others studies among top-level national and international championships, with high competitive level and, therefore, with higher risk of injuries. Junge et al. (2004) reported an average incidence rate of 191 per 1000 h of match exposure during the “Futsal World Championship 2000” in Guatemala. Ribeiro and Costa (2006) registered 208.6 injuries per 1000 h during the 15th Brazilian Futsal Championship Under 20 years. Junge and Dvorak (2010) studied the injury characteristics in top level international futsal tournaments (three consecutive futsal world cups) and reported an average incidence rate of 130.4 per 1000 h of match exposure. Given that matches, due to higher competitiveness and aggressiveness, have a higher risk of injury than training (Dantas, 2007; Gayardo, Matana, & Silva, 2012; Rechel et al., 2008), studies that simultaneously include match and training usually have lower average indices of injuries incidence. Hamid et al. (2014), for example, registered an incidence of 91.5 injuries per 1000 h.

In relation to the type, location, laterality, mechanism and potential severity of injury, the findings of the present study showed that contusion, of traumatic origin, over the dominant foot and with time-loss represents the prevalent pattern of futsal match injuries. Similar results were obtained in other studies. Angoorani et al. (2014), Lopes, Oliveira, et al. (2020) and Ruiz-Peréz et al. (2019) also confirmed that contusions are the most frequently diagnosed types of injury. Because futsal is a foot sport of contact, played predominantly with lower extremity, high rate of traumatic lower extremity injuries (ankle, knee, leg, hip and thigh) is unavoidable (Uluoz, 2016). The prevalence of traumatic injuries varies between 67% (Ruiz-Pérez et al., 2019) and 80% (Uluoz, 2016). The distinct characteristics of futsal such as the repetitive cycles of single-leg standing while dominating, drive, protecting and throw the ball from the opponents, may entail stress on the joints of the lower leg, predisposing the foot and ankle to injury (Lopes, Oliveira, et al., 2020). However, the question of the laterality of the injury is not consensual. Other studies find a correlation between injury and inverse lateral dominance, explained by the fact that the dominant limb is used most frequently when dribbling, whereas the non-dominant limb is used mostly for support and, therefore, more susceptible to injuries (Martinez-Riaza et al., 2017). Future studies should further extend our current knowledge in relation to the potential severity of futsal match injuries. Contrary to what our observation showed, Lopes, Oliveira, et al. (2020) refer that the available evidence suggests that most futsal injuries are not time-loss. In our study, only the players in the pivot playing position showed a lower incidence of injuries with potential severity (time-loss injuries), an aspect that justifies further studies regarding the specificity of this playing position.

Studies on injuries in soccer have contemplated the period of the match in which they occur. Pupo, Detanico, and Santos (2014), for example, concluded that the fatigue effect on performance is noticeable in the second half, as reflected by a drop in the work rate and a predisposition factor to injury during the last stages of a match, when the muscles’

capacity to generate force is reduced. However, in futsal there are no references to this specific parameter. One of the main reasons may be linked to the fact that this sport, unlike soccer, allows unlimited substitutions, and in most elite teams, players remain on the field for relatively short periods (in the order of 5 min or less), and frequently the four field players are replaced simultaneously. However, this substitution does not normally occur in the final phase of the matches and, sometimes, also in the final phase of the first part of the matches, depending especially on the evolution of the result of the match. This aspect, associated with the specific characteristics of this sport, such as dynamic intermittence of high-intensity (Gayardo et al., 2012; Hamid et al., 2014), with a high number the match. These findings suggest that training sessions and pre-match warm-up should mimic match demands in terms of work-load, intensity or duration, in order to replicate the holistic nature of the futsal match. This study also shows that playing position requires a specific approach, already recognized in technical-tactical terms, now confirmed in terms of susceptibility and injury prevention. The evolution and development of futsal offers the challenge and the opportunity of integrating the knowledge about the specificity of this sport in order to improve the coach’s decision making process.

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