INCIDENCE AND INJURY RISK FACTORS IN PORTUGUESE FUTSAL PLAYERS

ORIGINAL ARTICLE

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ABSTRACT

Introduction: The reduced number of studies published on the occurrence of injuries in futsal in Portugal motivated this study. Objective: This study aimed to identify potential causes of injuries in this sport, which can be a reference for the creation of specific protocols for injury prevention. Methods: The sample was composed of 411 Portuguese male and female futsal players, of diverse competitive levels. All the participants filled out a previously validated questionnaire, based on retrospective information. Statistical inference consisted of inferential analysis using the Kruskal-Wallis test and using the Mann-Whitney test for non parametric data (significance level of 5%). Results: The results confirm ankle sprain injuries as the injury with the highest incidence (48.8% of total) in futsal. Injuries with recovery period between 8 and 28 days were the most frequent (52.7% of total). This study did not show gender or the position of the player on the pitch to cause significant differences on the frequency of the injuries or on the type or anatomical region of the injury. However, there were significant differences between training and competition, with greater occurrence of sprains and contractures during training and higher incidence of muscle tears and fractures in competition, with a longer recovery period resulting from injuries suffered during competition. Moreover, there were significant differences for the mechanism of injury, with higher incidence of bone or joint injuries, sprains and fractures as a result of contact with opponents and higher incidence of muscle or ligament injuries without contact with opponents. The results did not show any significant differences in the laterality of injuries. Conclusion: The results highlight the importance of specific programmes for ankle sprain injury prevention, especially in early stages, regardless of the position of the player on the pitch, mainly in situations of contact with opponents.

Keywords: injury, futsal, prevention, retrospective study.

INTRODUCTION

According to the research group on prevention of Sports Injuries in the European Committee[1], the concept of sports injury derives from the participation in sports with at least one of the following consequences: to need clinical guidance and/or treatment; to reflect on the social and economic life; and/or to lead to total or partial loss of the sports activities.

Futsal is a relatively recent modality which derived from the Indoor soccer and which presents great development, mainly in the South American countries, with special focus in Brazil and in the countries in South and East Europe, mainly Spain, Portugal, Italy, Russia and Ukraine. Therefore, reference to investigations in this modality is not frequent in the Anglo-Saxon literature[2]. Recently, some epidemiological studies about futsal[3] or comparative studies of futsal and soccer injuries[4,5] have been reported.

The specific characteristics of futsal, where players perform dislocations of intermittent rhythm, with sudden direction changes, involving contact with the ball and opponents, practiced in relatively reduced spaces and on surface many times at poor conditions, with very high levels of competitive demand and periods of training and competition overload, enable the onset of injuries[6]. This modality has suffered a very remarkable evolution in the last decade, especially due its increasing physical, tactical, technical and psychological demands, which make the players' work close to their thresholds and more prone to injuries[7].

The main interest in the studies about injuries lies on the possibility to understand its origin and attempt to design programs which minimize the risk of its onset. It is essential to know the injury incidence, risk factors as well as mechanisms in order to fight its causes[1]. According to Gianotti *et al.*[8], it is crucial that the information provided in the coach training gives the deserved attention to this issue. However, the advances verified in sports medicine provide better acknowledgement about the effort physiology, make protocols specific to any athlete available and make the sport managers involved aware of the associated risk situations[9].

The methodology followed in the studies with the aim to obtain information about the incidence of sports injuries in the different modalities is usually descriptive and based on the performance of questionnaires or interviews with the athletes[10]. Fuller *et al.*[11] make reference to two kinds of study in the sports injuries scenario: prospective (monitoring or following and record of occurrence) and retrospective (which refer to the athletes' memory concerning the onset of injuries during their sports life), highlighting the preference for the former, since, unlike the latter, those are not prone to inaccuracy associated with sports memory of the athletes.

Fuller *et al.*[11] called attention to the variability of definitions and methodologies used in the studies performed and published on the incidence of Soccer injuries, making the comparative approach of the results complex. In that perspective, they defined a set of concepts and methodologies which should guide the studies for publishing in international journals on the problems of the incidence of injuries in Soccer and which can be easily adapted to Futsal and served as grounding to the outlining of this study.

Potential causes of injuries

The analysis of the current investigations on the field of sport injuries shows massive attention to issues, such as posture alterations in athletes, as risk factors. Investigations like the ones by Cain *et al.*[6] or Ribeiro *et al.*[12] are examples of this perspective, which relies on a biomechanical analysis, namely posture balance, or foot morphology (Foot Posture Index, FPI-6) and plantar pressure for detection of instability sources and especially of ankle and foot injuries. These are prospective investigations aiming prevention and guidance of the sports practice through adequation of the training methodology to the athletes' specificities. Ribeiro *et al.*[12] justify the importance of this field due to the early age the athletes begin the sports practice. Dantas[13] numbered as general reasons for the incidence of injuries in futsal deficient physical preparation, significant posture alterations, reduced flexibility indices, errors in performance of sports gestures, inadequate equipment, for injuries, besides trauma origin during competition. Elsner *et al.*[14] conducted an exploratory study present in the bibliographic review of scientific articles and concluded that the reasons which make players of this modality prone to injuries are related to the fact it is a team sport which involves frequent contact with the opponents, besides presenting fast, complex and of acceleration and deceleration movements, and refers to interaction of extrinsic and intrinsic factors related to the players.

Type and site of injuries

Generality of the studies indicates that the injuries in futsal are predominately located on the lower limbs, a fact which is justified in the characteristics of the modality itself. For instance, Junge and Dvorak[3], Kurata *et al.*[7] abd Raymundo *et al.*[15] obtained values of 70%, 88.1% and 88.2%, respectively, for the percentage of injury incidence on lower limbs during futsal practice. These values take a differentiator meaning for the modality when compared with the 54% obtained by Hootman *et al.*[16] in the set of 15 team sports, among which, soccer.

Van Hespen *et al.*[17] reported higher incidence of ankle sprains (38% out of the total) and injuries of the knee ligaments (38% out of the total) in futsal. Ribeiro *et al.*[12] also verified in this sport higher incidence of ankle (45% out of the total) and knee injuries (19% out of the total), which corroborates the extensive list of bibliographical references in this way of thinking[4,5,7,13,14,18].

Kurata *et al.*[7] verified as the most frequent pathologies contusion and sprains (26.5% each), muscle injuries (17.6%) and ligament injuries (14.7%). Cohen *et al.*[19] verified the following incidence of injuries, in decreasing order of importance: muscular (39.0%), contusions (24.0%), sprains (18.0%), tendinitis (13.5%), fractures or bruises (5.5%). According to Dantas[13], ligament injuries were more frequent (55.6%) than muscle injuries (44.4%). Lindenfeld *et al.*[18] reported sprains and muscular contusions as the most frequent injuries. Baroni *et al.*[2] focused their studies mainly on the injury considered to be the most frequent in futsal: the ankle sprain, having concluded that 75.4% of the players have had this injury during their careers, 63.3% on both ankles and 24.5% on the dominant limb only and 12.2% had it only on the non-dominant limb.

The reduced number of published studies on injuries in futsal in Portugal and the awareness about the need to invest in investigation in this field justified the performance of this work. In a retrospective study, we tried to contribute to the identification of potential causes of injury in this sports modality under increasing expansion on international level, which are able to contribute as reference to the development to specific protocols for injury prevention.

METHODS

Sample

Data collected in a questionnaire on sports life of futsal players in the long run were used in this study. The sample was composed of 411 affiliated players who practiced futsal in Portugal (284 male and 127 female). Out of these, 24 players (15 male and nine female) represented the Portugal futsal national team in 2009-2010; 270 of these players (169 male and 101 female) represented the district futsal teams which were in the end of the sports formation period (aged 20 or 21 years in the male sex and 18 or 19 years in the female) and which participated in inter-association national championships in 2009-2010; the remaining 117 players (100 males and 17 females) were senior practitioners of the modality in different leagues of the national championship. Table 1 illustrates the sample concerning age and initiation age in futsal.

Table 1. Sample characterization concerning initiation age in futsal.

Team	Age (years)				Initiation age in futsal (years)			
	< 19	19-21	22-29	≥ 30	6-10	11-14	15-18	≥ 19
National teams (n = 24)	–	8.3%	75.0%	16.7%	20.8%	50.0%	29.2%	–
District teams (n = 270)	43.3%	56.7%	–	–	11.9%	41.9%	41.5%	4.8%
Other teams (n = 117)	6.8%	19.7%	54.7%	18.8%	17.9%	21.4%	24.8%	35.9%

Data collection

In each team one element for contact (coach/selector) to whom the procedures about data collection would be explained was selected, an aspect recommended by Fuller *et al.*[11].

The data collection protocol consisted of the following phases:

a) The questionnaires for data collection of the national teams were personally handed out to the Portugal futsal selector during the stages for international competitions and they were also personally collected from the respective team's captain;

b) The questionnaires for the futsal district players were personally handed out to the district selectors during the inter-association national championships and were also personally collected at the end of these events;

c) The questionnaires for the players of the senior teams were personally handed out to the respective coach and collected from him two weeks after they had been handed out.

The questionnaire was divided in two parts. On the first part, the following data were recorded: team, gender, age, age of beginning in futsal, position on the pitch, dominant foot. On the second part the data concerning the three main injuries found during the sports career in futsal were recorded: type of injury, anatomic site of the body involved, situation in which it has occurred (training or game), injury mechanism (with or without contact with opponents) and injury severity (evaluated by the resulting time out from the sport activity).

Consistency of the retrospective data

Since the questionnaire depended on the retrospective memory of the players and due to the complexity and depth of the expected information, evaluation of the consistency or temporal stability of the retrospective data was carried out using methodology similar to other investigation teams[20,21]. In this study, six months from the first filling out, 39 players were asked (9.5% of the sample) to redo the same questionnaire (re-test questioning) and they were asked to record only the injuries appeared until the moment of the filling out

of the first questionnaire. The concordance between the answers obtained in the two moments of evaluation was evaluated through the Pearson correlation coefficient.

Data treatment

The answers collected in the study were recorded on a spreadsheet in the Excel program for data descriptive analysis.

Tables 2 and 3 presented the answers classes considered for each variable, respectively, in the first and second parts of the questionnaire.

It is worth mentioning the notes about the answer classes: a) only the six first main types of injuries and the four main anatomic sites of their onset were considered (based on the body areas presented by Orchard[22]); the remaining ones, in either case, for presenting reduced incidence and following the recommendations by Fuller *et al.*[11] were grouped in "other injuries/other anatomic sites"; b) injury severity was defined by the number of days between the day at which the injury appeared (day "zero", not counted) and the day at which the player returns to training or competition being at his full ability, and the injury severity classes suggested by Fuller *et al.*[11] being used; c) additionally, statements by these authors concerning the main interest in considering whether the injury occurred during training or game as well as which mechanism involved was present were followed (with or without contact with opponents).

Regarding the evaluation of injury incidence in the training or game situations, only the injuries with explicit information about this were considered; therefore, the answers "both situations" were not considered. The same fact occurred in the characterization of the injury mechanism, where the answers "does not apply" were not considered.

Besides the descriptive analysis through the frequency of occurrences expressed in percentage, the statistical treatment consisted in the inferential direct comparison among all the groups through the Kruskal-Wallis test and between groups tow by two through inferential analysis, using the Mann-Whitney test for non-parametric data. Statistical differences were tested using a significance level of 5%. All data were analyzed with the statistical package SPSS for Windows, version 16.0 (SPSS Inc., Chicago, IL).

The study was approved by the Ethics Committee of the University of Évora.

Table 2. Classes considered for each variable of the first part of the questionnaire.

Teams	Gender	Age	Age of initiation in Futsal	Position on the pitch	Dominant foot
National teams; District teams; Senior teams;	- Male; - Female;	- < 19 years old; - 19-21 years old; - 22-29 years old; - ≥ 30 years old;	- 6-10 yrs old; - 11-14 yrs old; - 15-18 yrs old; - ≥ 19 yrs old;	- Goal keeper; - Defender; - Winger; - Pivot; - Universal;	-Left; -Right; -Ambidextrous;

Table 3. Classes considered for each variable of the second part of the questionnaire.

Injuries	Type of injury*	Anatomical site*	Side*	Severity*	Situation*	Mechanism*
-Without injuries; -One injury; -Two injuries; -Three ou more injuries;	-Sprains; -Fractures; -Rupture; -Groin strains; -Strains; -Contractures; -Other;	-Foot; -Knee; -Leg; -Hand; -Other;	-Does not apply; -Left; -Right;	-Light or minimal (0-3 days); -Reduced (4-7 days); -Moderate (8-28 days); -Severe (> 28 days);	-Training; -Game; -Both;	-With contact; -Without contact; -Both;

*Data concerning each injury reported by the players.

RESULTS

Consistency of the retrospective data

The temporal stability of the answers through the calculation of the Pearson correlation coefficient between the answers obtained in the two moments of data collection for 9.5% of the sample (n = 39) presented significant correlations for all the considered items. The correlation coefficients obtained were as follows: 0.835 ($p < 0.05$) for the "Number of injuries"; 0.799 ($p < 0.05$) for the "Type of injuries"; 0.952 ($p < 0.01$) for the "Anatomic site of the injury"; 0.967 ($p < 0.01$) for the "Time out period of the injury"; 0.963 ($p < 0.001$) for the "Situation at which the injury occurred" (Training/Competition) and 0.960 ($p < 0.001$) for the "Injury mechanism" (with or without contact with opponents). These results indicate fairly acceptable temporal consistency.

Descriptive analysis of the results

It was tried to evaluate the competitive level, gender, the position of the player on the pitch, the training or game situation and the injury mechanism (with or without contact) on the number or incidence, type, anatomic site and severity of the injuries in futsal in this study. Moreover, it was tried to evaluate the relation between the dominant foot of the players and laterality of injuries.

In a succinct and introductory analysis, it can be stated that out of the 411 players who answered the questionnaire, 98 did not present injuries which had been considered relevant in their futsal career, and 512 injuries were recorded in the collection of the 313 remaining players. Among these, sprains were the most reported injury (250 records; 48.8% out of the total); followed by muscular ruptures (76 records; 14.8% out of the total), fractures (43 records; 8.4% out of the total); strains (34 records; 6.6% out of the total); contractures (25 records; 4.9% out of the total) and groin strains (nine records; 1.8% out of the total). Since the remaining injuries presented remarkably reduced onset, they were grouped in "other injuries" and, all of them summed up represented 14.6% out of the total. This prevalence of tibiotarsal sprains was demonstrated by many authors[2,5,13]. In our study, 187 players (45% out of the total and 60% of the players who have suffered injuries in futsal) indicated to have had these injuries during their sport career.

Concerning the anatomic site of highest incidence of injuries, the tibiotarsal joint presented 259 records (50.6% out of the total), followed by the leg with 94 records (18.3% out of the total), the knee joint with 68 records (13.3% out of the total) and the foot with 32 records (6.2%). Since the remaining anatomic sites presented extremely reduced onset, they were grouped in "other regions" and represented 11.5% out of the total. These results are in accordance with the general bibliographic references[3-5,7,12,13,18].

Concerning severity, 270 injuries (52.7%) presented time-out period between eight and 28 days (moderate severity), 160 injuries (31.3% out of the total) presented time-out period over 28 days (serious severity), 54 injuries (10.5% out of the total) presented time-out period between four and seven days (reduced severity) and only 28 injuries (5.5% out of the total) presented time-out period equal or below three days (light or minimal severity). These values corroborate the statements by Dantas[13] concerning the highest incidence of injuries of moderate severity in futsal (55.6%) and the results by Van Hespen *et al.*[17] who recorded 27.0% of the injuries in futsal with time-out period over four weeks. However, Dantas[13] recorded 37% of injuries of light or reduced severity and only 7.4% of severe ones. This difference for our results is justified by two objective reasons: on one hand, in the questionnaire of our retrospective study

the players were asked to refer to the three main injuries in futsal, a fact they naturally associate with the injuries which presented the highest impact in their modality career, normally those which caused longer time-out periods; on the other hand, since it is a retrospective study about the long-run sports trajectory, the players more easily remember the most severe injuries, aspects which when connected, contribute to the underestimation of lighter injuries when compared with the higher prevalence of moderate or light injuries presented in studies of recording in person in tournaments or championships. For instance, Ribeiro and Costa[1] verified that the injuries severity in futsal is predominantly low (80% needed time-out equal or shorter than one day).

Tables 4 to 7 summarize the statistical analysis results with presentation of descriptive statistics (values in percentage) and inferential statistics respectively for injury incidence ("Number of injuries"; table 4), "Type of injury" (table 5), "Anatomic site of the injury" (table 6) and severity ("Time-out period", in days; table 7) concerning competitive level ("Team"), "Gender", "Position on the pitch, "Training/game situation" and "Injury mechanism" (with or without contact with opponents).

Table 4. Descriptive and inferential statistics of the variable "Number of injuries".

Variables	Number of injuries				X^2
	0	1	2	3+	
Team					
National teams (n = 24)	-	41.7%	33.3%	25.0%	26.975
District teams (n = 270)	28.5%	43.7%	18.1%	9.6%	(p = 0.000)
Other teams (n = 117)	17.9%	34.2%	25.6%	22.2%	
Gender					
Male (n = 284)	26.4%	39.4%	20.1%	14.1%	3.524
Female (n = 127)	18.1%	44.1%	23.6%	14.2%	(p = 0.318)
Position					
Goalkeeper (n = 70)	22.9%	48.6%	17.1%	11.4%	11.679
Defender (n = 62)	17.7%	40.3%	24.2%	17.7%	(p = 0.472)
Winger (n = 140)	30.7%	36.8%	19.3%	13.2%	
Pivot (n = 49)	14.3%	51.0%	18.4%	16.3%	
Universal (n = 116)	25.0%	36.2%	25.0%	13.8%	
T/G situation					
Training (n = 236)	-	30.9%	34.3%	34.7%	0.967
Game (n = 243)	-	35.0%	33.3%	31.7%	(p = 0.617)
Injury mechanism					
With contact (n = 219)	-	32.9%	36.1%	31.1%	1.392
Without contact (n = 277)	-	33.6%	31.4%	35.0%	(p = 0.499)

DISCUSSION

Competitive level (team)

Concerning the competitive level, significantly higher incidence of injury in the players of the national teams and in the other teams was verified when compared with the district teams ($X^2 = 26.975$; p = 0.000). This result reflects longer period of sports activity in the modality (older age and higher early age in futsal initiation; see table 1) of these two groups, and consequently, in the longer exposure and risk of occurrence of injuries period. These results also corroborate Lindenfeld *et al.*[18] statements who verified higher incidence of injuries in futsal players older than 25 years than players aged between 19 and 24 years.

Concerning the type of injury, significant differences have been identified among the players from the national teams and the remaining ones, with lower incidence of sprains and higher incidence of fractures, muscular ruptures and groin sprains in the players from the national teams ($X^2 = 28.031$; p = 0.005). The lower

Table 5. Descriptive and inferential statistics of the variable "Type of injury".

Variables	Type of injury							X^2
	Sprains	Fractures	Ruptures	Groin strains	Strains	Contractures	Other	
Team								
National teams (n = 45)	26.7%	17.8%	22.2%	6.7%	4.4%	4.4%	17.8%	28.031
District teams (n = 290)	52.8%	6.2%	13.8%	1.0%	7.2%	6.6%	12.4%	(p = 0.005)
Other teams (n = 177)	48.0%	9.6%	14.7%	1.7%	6.2%	2.3%	17.5%	
Gender								
Male (n = 347)	47.0%	9.2%	15.3%	2.0%	7.5%	4.3%	14.7%	4.045
Female (n = 165)	52.7%	6.7%	13.9%	1.2%	4.8%	6.1%	14.5%	(p = 0.671)
Position								
Goalkeeper (n = 82)	32.9%	11.0%	14.6%	-	7.3%	6.1%	28.0%	33.234
Defender (n = 87)	56.3%	9.2%	13.8%	2.3%	3.4%	3.4%	11.5%	(p = 0.099)
Winger (n = 131)	55.7%	6.1%	13.0%	1.5%	9.9%	3.8%	9.9%	
Pivot (n = 65)	38.5%	10.8%	21.5%	3.1%	6.2%	4.6%	15.4%	
Universal (n = 147)	51.7%	7.5%	14.3%	2.0%	5.4%	6.1%	12.9%	
T/G situation								
Training (n = 236)	53.4%	7.2%	12.7%	1.3%	6.8%	7.2%	11.4%	13.723
Game (n = 243)	47.3%	10.3%	17.7%	-	5.8%	2.9%	16.0%	(p = 0.033)
Injury mechanism								
With contact (n = 219)	55.3%	11.9%	10.5%	-	3.2%	2.3%	16.9%	30.484
Without contact (n = 277)	46.6%	6.1%	18.8%	0.7%	9.7%	7.2%	10.8%	(p = 0.000)

Table 6. Descriptive and inferential statistics of the variable "Anatomical site of the injury".

Variables	Anatomical site of the injury					X^2
	Foot	Knee	Leg	Hand	Other	
Team						
National teams (n = 45)	15.6%	35.6%	8.9%	17.8%	22.2%	10.544
District teams (n = 290)	12.4%	54.1%	5.5%	19.0%	9.0%	(p = 0.229)
Other teams (n = 177)	13.6%	49.2%	6.8%	17.5%	13.0%	
Gender						
Male (n = 347)	14.7%	49.3%	5.8%	19.0%	11.2%	3.354
Female (n = 165)	9.7%	53.9%	7.3%	17.0%	12.1%	(p = 0.500)
Position						
Goalkeeper (n = 82)	12.2%	30.5%	22.0%	14.6%	20.7%	58.240
Defender (n = 87)	10.3%	57.5%	5.7%	17.2%	9.2%	(p = 0.000)
Winger (n = 131)	14.5%	55.0%	2.3%	19.8%	8.4%	
Pivot (n = 65)	16.9%	52.3%	3.1%	16.9%	10.8%	
Universal (n = 147)	12.2%	53.7%	2.7%	20.4%	10.9%	
T/G situation						
Training (n = 236)	9.7%	54.2%	6.4%	20.8%	8.9%	7.282
Game (n = 243)	14.8%	49.0%	6.6%	17.3%	12.3%	(p = 0.506)
Injury mechanism						
With contact (n = 219)	13.2%	60.3%	6.8%	10.0%	9.6%	22.035
Without injury (n = 277)	12.6%	45.5%	6.1%	25.6%	10.1%	(p = 0.005)

reference in this group of players to sprains may imply that this injury did not result in relevant severity when compared with other injuries. The characteristics of the injuries of higher incidence in this group (fractures, muscular ruptures and groin strains) denote on one side the level of competitiveness which these players are submitted to, on the other side, the overload which may occur due to over concentrated competition calendars, with decrease of the recovery periods caused by appointments, either in the clubs or in the national teams. These reasons may also justify the higher injury severity found in the players from the national teams, presenting significant differences in the time-out period compared with the remaining players ($X^2 = 16.889$; p = 0.010).

Table 7. Descriptive and inferential statistics of the variable "Time-out period".

Variable	Time-out period (days)				X^2
	0-3	4-7	8-28	>28	
Teams					
National teams (n = 45)	8,9%	4,4%	42,2%	44,4%	16,889
District teams (n = 290)	4,5%	12,8%	57,6%	25,2%	(p = 0,010)
Other teams (n = 177)	6,2%	8,5%	47,5%	37,9%	
Gender					
Male (n = 347)	3,7%	9,5%	49,6%	37,2%	21,085
Female (n = 165)	9,1%	12,7%	59,4%	18,8%	(p = 0,000)
Position					
Goalkeeper (n = 82)	2,4%	14,6%	50,0%	32,9%	13,403
Defender (n = 87)	3,4%	8,0%	58,6%	29,9%	(p = 0,340)
Winger (n = 131)	3,8%	10,7%	55,0%	30,5%	
Pivot (n = 65)	6,2%	13,8%	43,1%	36,9%	
Universal (n = 147)	9,5%	8,2%	53,1%	29,3%	
T/G situation					
Training (n = 236)	7,2%	14,4%	56,4%	22,0%	18,122
Game (n = 243)	4,1%	7,8%	49,8%	38,3%	(p = 0,000)
Injury mechanism					
With contact (n = 219)	5,9%	10,0%	48,9%	35,2%	4,855
Without contact (n = 277)	5,4%	11,6%	56,7%	26,4%	(p = 0,183)

Men's *versus* women's

No significant differences have been recorded in the number, type and anatomic site of the injuries in this variable, and significant differences have only been recorded in the time-out period resulting from the injuries, with injury incidence of greater severity in the male players ($X^2 = 21.085$; $p = 0.000$). The fact the men's and women's competition calendars present very diverse structures may have contributed to these results. While the men's championship takes place on national level throughout the sports season, reaching its peak with games for the champion or games to decide on the change to the minor league, with high competitive level along the entire season, associated with many times long trips, the women's championship id played from September to April at district level, usually with relatively reduced competitive level and only in May and part of June the national Cup is played among the winning teams of the district championships.

Regarding the incidence of injuries, these results corroborate the statements by Lindenfeld *et al.*[18] and Putukian *et al.*[23] who did not find significant differences in the incidence of injuries between male and female futsal practitioners. However, according to Lindenfeld *et al.*[18], the male practitioners presented incidence of ankle ligament injuries significantly higher than the female practitioners, while the opposite fact was observed concerning the knee ligaments. Rechel *et al.*[24] verified in a sample which involved young practitioners of soccer integrated in physical education classes in the school year of 2005/2006, higher incidence of injuries among girls.

These results justify the performance of further studies which are able to clarify the issue of the influence of gender in higher or lower incidence of injuries in futsal practice.

Player position on the pitch

Some studies, especially the ones related with soccer, present significant differences in the incidence of sports injuries due to the players' position on the pitch. For instance, Cohen *et al.*[19] concluded that the pivots and the defenders presented the highest incidence of injuries, a fact which was justified by the specificity of these positions on the pitch, requiring constant change of direction and acceleration and deceleration.

This work did not reveal significant differences between positions in futsal at the injuries level of incidence, type or severity. The injuries/player ratio oscillated in 1.15 in the "wingers"; 1.17 in the "goalkeepers"; 1.27 in the "universals"; 1.33 in the "pivots" and 1.40 in the "defenders". The current futsal let us understand that the absence of significant differences between positions is due to the fact the game systems require that the players move around all the positions of the pitch and with increasing participation of the goalkeeper in all the game phases, be it defensive, offensive and in transitions[25]. The statements by Lindenfeld *et al.*[18] or by Hoff and Martin[26] are in agreement with the results of this study since they have not found any correlation which could associate the positions of the futsal players on the pitch with injury risk. Baroni *et al.*[2] justified this fact with the universality of the players functions, regardless of their position on the pitch, except for the goalkeeper, concluding hence that the incidence of injuries in futsal is not related with the position on the pitch due to the dynamics of the game, which requires all kinds of movements and technical abilities from all the players.

However, this study revealed significant differences in the anatomic site of the injuries at the "goalkeeper" level, with lower incidence of injuries on the knee and higher incidence of injuries on the leg and in "other regions" of the body ($X^2 = 58.240$; $p = 0.000$). Curiously, tendency to lower incidence of injuries on the hand site is verified on the "goalkeeper" level, which justifies the performance of complementary studies which are able to clarify this unpredictable issue, since this is the only player who can touch the ball with his/her hands within the penalty area.

Training *versus* game

The results of this study did not reveal significant differences concerning the incidence of injuries in the training or game situations. Dantas *et al.*[13], on the contrary, verified higher incidence of injuries in competition (55.6%) related with the training situation (44.4%), a tendency corroborated by Rechel *et al.*[24]. Situations of higher competitiveness normally associated with the game are simultaneously of higher risk, an aspect proved and described by Yard *et al.*[27]. These differences may be more or less clear due to the training methodology. We believe that the current training methodology, with predominance of full training, has the aim to make training as similar as possible to competition, since the differences tend to disappear.

Nevertheless, this study revealed significant differences between the training and game situations concerning the type of injury ($X^2 = 13.723$; $p = 0.033$) and its severity ($X^2 = 18.122$; $p = 0.000$). Higher incidence of sprains and contractures in training situations and higher incidence of muscular ruptures and fractures in games was found. On the other hand, the time-out period resulting from the injury presented tendency to be longer in injuries in game situations. The joint of these two variables is justified since fractures and muscular ruptures are situations with association of recovery periods longer than sprains, especially muscular contractures. The highest level of competitive demand in the game may justify the occurrence of more serious injuries in this context.

The "training/game situation" variable did not produce significant differences at the anatomic site level of the injury occurrence.

Injury mechanism

The results of this study did not reveal significant differences in the incidence of injuries by the injury mechanism. This issue justifies complementary studies since many diverse citations can

be found. While Ribeiro and Costa[1] and Dantas[13], in prospective studies on futsal recorded higher incidence of injuries by direct physical contact with opponents (about 2/3) compared with the ones which resulted from indirect mechanisms (that is, without contact, about 1/3), a confirmed tendency either by Junge and Dvorak[3] in the follow-up of three futsal world championships or by Hoff and Martin[26], in a sample with young players during futsal and soccer practice. Kurata *et al.*[7], on the other hand, recorded higher incidence of injuries without contact (67.7%) concerning injuries resulted from contact with opponents (32.3%) in futsal.

Concerning the injury severity due to its mechanism, significant differences have not been recorded, a fact which supports the need for further studies in response to what Ribeiro and Costa[1], Dantas[1)] and Putukian *et al.*[23] reported in futsal as higher severity in injuries without contact.

Nonetheless, the results of this investigation revealed significant differences concerning the type ($X^2 = 30.484$; $p = 0.000$) and anatomic site of the injury ($X^2 = 22.035$; $p = 0.005$). Higher incidence of articular or bone injuries (sprains and fractures) as a result of contact with opponents and higher incidence of muscular or ligament injuries (ruptures, strains and contractures) without contact with opponents was found. Great incidence of injuries in futsal is confirmed at the lower limbs level (between 60-70% of the injuries), which agrees with the papers by Kurata *et al.*[7] and Raymundo *et al.*[15].

The association of the two variables ("training/game situation" and "injury mechanism") may be favorable in justifying the onset of injuries in futsal. It is expected that in training situations, even with instructions from the coach to dedicate the same effort to the required during competition, the players in the ball dispute avoid direct contact with the players from the same team, for some moments in the situations with opponents, which may result in lower incidence of injuries by contact during training. Such aspect was demonstrated by Hootman *et al.*[16] in the analysis with 15 team sports played in the United States between 1988 and 2004. The Pearson correlation coefficient of the association of the "training/game situation" and "injury mechanism" variables concerning our investigation led to significant correlation coefficients of 0.61 with the "number of injuries", 0.70 with "injury types", 0.85 with "anatomic site of the injury" and 0.92 with "severity" of the injury.

Table 8. Descriptive and inferential statistics of the variable "Injury laterality".

Injury laterality	Dominant foot		X^2
	Left	Right	
Global analysis			
Injuries left side (n = 201)	19.4%	80.6%	0.845
Injuries right side (n = 219)	16.0%	84.0%	(p = 0.358)
Analysis per team			
National teams			
Injuries left side (n = 20)	35.0%	65.0%	0.156
Injuries right side (n = 14)	28.6%	71.4%	(p = 0.693)
District teams			
Injuries left side (n = 118)	13.6%	86.4%	3.117
Injuries right side (n = 120)	6.7%	93.3%	(p = 0.077)
Other teams			
Injuries left side (n = 63)	25.4%	74.6%	0.051
Injuries right side (n = 85)	27.1%	72.9%	(p = 0.820)
Analysis per gender			
Male			
Injuries left side (n = 141)	22.7%	77.3%	0.252
Injuries right side (n = 148)	20.3%	79.7%	(p = 0.616)
Female			
Injuries left side (n = 60)	11.7%	88.3%	0.836
Injuries right side (n = 71)	7.0%	93.0%	(p = 0.361)
Analysis per position			
Goalkeeper			
Injuries left side (n = 32)	12.5%	87.5%	3.750
Injuries right side (n = 28)	-	100.0%	(p = 0.053)
Defender			
Injuries left side (n = 32)	37.5%	62.5%	1.796
Injuries right side (n = 43)	23.3%	76.7%	(p = 0.180)
Winger			
Injuries left side (n = 53)	20.8%	79.2%	0.021
Injuries right side (n = 61)	19.7%	80.3%	(p = 0.886)
Pivot			
Injuries left side (n = 21)	-	100.0%	0.739
Injuries right side (n = 29)	3.4%	96.6%	(p = 0.390)
Universal			
Injuries left side (n = 63)	19.0%	81.0%	0.051
Injuries right side (n = 58)	20.7%	79.3%	(p = 0.821)

Relationship between the player's dominant foot and laterality of the injury

In order to evaluate the correlation between the dominant foot of the player and the side of the body where the injury occurs, a new database was built only with the players who reported having a dominant foot and among these, only the sports injuries associated with laterality (right or left hand, right or left foot, right or left knee, right or left leg). The results of the statistical analysis (descriptive and inferential) are presented in table 8.

The results did not evidence significant differences in the laterality of the injuries, regardless of the dominant foot of the players or for any of the considered variables (ream, gender and position on the pitch). The analysis for each type of injury did not reveal significant differences either in the correlation between laterality of injury and dominant foot (sprains: $X^2 = 2.442$; $p = 0.655$; fractures: $X^2 = 0.449$; $p = 0.978$; ruptures: $X^2 = 1.018$; $p = 0.907$; strains: $X^2 = 2.408$; $p = 0.661$; contractures: $X^2 = 1.213$; $p = 0.545$). Concerning this issue, for example, Baroni *et al.*[2] selected the injury considered the most present in futsal: ankle sprains, and determined its higher incidence on the ankle of the dominant limb, despite the expectation for the opposite fact, since the dominant limb presents motor coordination more developed than the non-dominant limb and, according to Lentell *et al.*[28], the proprioceptive deficit increases the risk of this injury onset. However, Baroni *et al.*[2] justified the results obtained based on the fact the dominant limb is more used in the attack while the non-dominant takes over the role of supporting. The systematic repetition of this activity during training and games, creates, according to these authors, a "specialization" pattern of these limbs in the roles of attacking and supporting, respectively, which makes the dominant limb less efficient than the non-dominant one when support is needed, which precisely corresponds to the mechanism of the majority of ankle sprains. This is a sufficiently interesting reason to justify the insistence on having the young players bilateral practice while in contact with the ball, in the specific training/learning processes as prevention to these types of injury[2]. Higher incidence of ankle sprains on the dominant limb is confirmed by Ekstrand and Gillquist[29] in soccer players.

In our study, the 222 reports of the tibiotarsal joint sprains did not reveal significant correlation (r = -0.009) between injury laterality and dominant foot of the player. The laterality issue is another aspect with which the athletes may present less retrospective confidence and may have also conditioned the obtained results

in the dominant foot/laterality correlation and which justifies the performance of prospective studies able to clarify this situation.

Another possible extension to this study may approach the collection of prospective data which involve players in championships from other countries, whose different characteristics will be able to offer better representativeness and which will simultaneously be able to clarify some issues which this study raised, such as: the gender and injury mechanism influence (with or without contact) in higher or lower incidence of injuries in futsal practice; the correlation between dominant foot and injury laterality; the completely unexpected tendency lower incidence of injuries on the hand site for the "goalkeeper"; the recording of the game (or training) time passed from the moment of the injury, to facilitate the interpretation of this phenomenon in more complex studies concerned with general factors for injury risk, especially fatigue.

The main limitation of this work has to do with the use of the collected data which rely on the players' retrospective memory, many times referring to periods very distant in their sports career. Although the responses' consistency had been guaranteed, there is always some concern about this type of information. A viable alternative to confirm the results published here and considering the digital and database development over the last years, would be the performance of future studies based on official records of the clubs or preferably, the implementation of a permanent scientific observatory for follow-up of the incidence of injuries in the different sports modalities, an essential instrument to the training methodological guidance and injury prevention.

The contribution to the understanding of the sports injuries associated with futsal is a key-aspect for the development of programs and strategies which aim to decrease their incidence, to which the coaches and teachers in general have saved a crucial role, justifying hence greater concern with this issue towards the entities responsible for the program contents of the courses for coaches/trainers. Regarding this topic, Steffen *et al.*[9] refer three strategies to be sued in the prevention of sports injuries: (1) the use of suitable equipment; (2) adaptation to the rules of the game and (3) development of specific exercise programs for reduction of risk of injury. For instance, they mention the importance of the performance of neuromuscular prevention training which incorporates plyometric work in order to reduce the risk of injury incidence on the knee, as well as the suggestion of the use of functional braces on the tibiotarsal joint of players who have suffered sprains on this joint, as an alternative to reduce the risk of recurrent incidence. The concern about offering guidance to athletes in rehabilitation for sports injuries is exposed by Hägglund *et al.*[30] who defined a program for soccer players. According to Steffen *et al.*[9], the success in the implementation of training programs for prevention for injuries should be associated with a consistent basic strategy, especially applied to children and adolescents, and should for instance, include exercises of up to 20 minutes of duration, preferably in the beginning of the pre-season sessions.

CONCLUSION

The results highlight the importance of specific programmes for ankle sprain injury prevention, especially in early stages, regardless of the position of the player on the pitch, mainly in situations of contact with opponents.

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