

## Original Article

# Evaluation of foot and ankle injuries in professional soccer – prospective analyses of the Paulista Soccer Championship 2016

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## Abstract

**Objective:** To evaluate the profile of foot and ankle injuries in professional soccer.

**Methods:** Data were collected prospectively during the 2016 São Paulo Soccer Championship using two electronic forms: an initial form (10 variables) and a follow-up form (6 variables). The results were standardized and evaluated in SPSS 23.0.

**Results:** A total of 259 injuries were reported: 106 to the thigh (40.9%), 42 to the foot and ankle (16.2%), 39 to the knee (15.1%), 39 to the head or face (15.1%) and 33 in other locations (12.7%). Of the 42 foot and ankle injuries, 20 were lateral ankle sprains (47.6%), 5 were medial ankle sprains (11.9%), 3 were to the triceps surae (7.1%), 3 were leg contusions (7.1%), 3 were foot contusions (7.1%), 3 were myalgias (4.8%), in addition to 5 other types (11.9%). There was physical contact in 73.8% of the injuries ( $p < 0.001$ ), and six injuries (14.3%) were considered severe, i.e., involving a time loss of at least one month. Of the severe injuries, four were treated surgically (three by osteosynthesis and one by tenorrhaphy). The mean time loss due to injury was 19.7 days, and the overall incidence rate was 3.5 injuries per 1000 hours of exposure, with 2.1 ligament injuries per 1000 hours. X-rays and magnetic resonance imaging were the most requested tests in the follow-up of these patients.

**Conclusion:** Foot and ankle injuries were the second most frequent injury in Brazilian professional soccer, 73.8% of which resulted from physical contact ( $p < 0.001$ ). Lateral ankle sprains accounted for 47.6% of these injuries, which reaffirms their high prevalence and importance for sports medicine.

**Level of Evidence III; Prognostic Studies; Prospective Study.**

**Keywords:** Foot injuries; Soccer; Athletes.

## Introduction

Soccer is one of the most popular sports in the world<sup>(1)</sup>. It is estimated that the sport generates more than 30 billion dollars per year worldwide and is played by more than 240 million people<sup>(2)</sup>. Since it involves running, sprinting, jumping and quick changes of direction, soccer athletes are exposed to several types of injuries to the muscles and ligaments, as well as contusions and even fractures<sup>(1,3,4)</sup>. Studies have shown that soccer has a higher injury rate than other sports, including handball, volleyball, basketball, judo, and swimming<sup>(5,6)</sup>.

The injury rate in this sport can reach 70 per 1000 hours of exposure<sup>(3)</sup>. Recent data show that the leg is the main site of these injuries, which are mainly traumatic in origin<sup>(2,3,7,8)</sup>. Depending on the force of the trauma, these injuries can be serious, sidelining players for long periods, damaging both the player and the team<sup>(2,9)</sup>.

In Brazil, the exhaustive training regimen and frequency of matches appear to increase the players' exposure to injuries. Nevertheless, studies on the profile of these injuries are still scarce in the national literature<sup>(3,10-14)</sup>. To date, we have found

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no Brazilian studies on foot and ankle injuries in professional soccer, only rare articles assessing recreational and pre-professional levels, which have found that lateral ankle sprain is the most prevalent diagnosis<sup>(15-17)</sup>.

Thus, our group proposed to prospectively assess foot and ankle injuries in the 2016 Paulista Soccer Championship (leagues A1 and A2), with the primary objective of understanding and describing these injuries.

### Methods

This study was approved by the Institutional Review Board and registered on the Plataforma Brazil database under CAAE (Ethics Evaluation Submission Certificate) number: 20242919.1.0000.5505.

Data collection was carried out prospectively with a specially developed electronic form that was filled out by the team doctor after each game. Two questionnaires were applied at different points in the study. The initial form contained 10 items: basic data about the match, whether an injury occurred, the injured player’s date of birth, his position (goalkeeper, forward, etc.), the part of the match in which the injury occurred, injury topography, injury laterality, injury type, whether there was shock/trauma, and probable diagnosis. The second form, which followed up cases of injury, consisted of 6 items: complementary exams, whether surgery was required, the date of the player’s return, total time loss in days, injury severity, and final diagnosis.

The concept of injury conformed to the Injury Consensus Group statement in Fuller et al. (2006): “Any physical complaint sustained by a player that results from a football match or football training, irrespective of the need for medical attention or time loss from football activities”<sup>(18)</sup>.

All injuries reported in full through the two questionnaires were included. Questionnaires filled out incorrectly or incompletely were excluded. The results were standardized according to Brazilian Football Confederation consensus<sup>(19)</sup>. The injuries were classified into five severity categories based on time loss: mild (up to 3 days), minor (4 to 7 days), moderate (8 to 28 days), major (29 days to 8 weeks) and severe (over 8 weeks)<sup>(19)</sup>. The matches were divided into 3 parts: beginning (0-15 minutes), middle (16-30 minutes) and end (31-45 minutes + additions)<sup>(18)</sup>.

To assess the incidence (I) of foot and ankle injuries, we first calculated the total hours of exposure (Exp), resulting in the formula:  $Exp = Nm \times Np \times Dm / 60$  where Nm is the number of matches, Np is the number of players, and Dm is the duration of the match. Finally, we calculated the incidence (I) as:  $I = Nlfa \times 1000 / Exp$ , where Nlfa is the number of foot and ankle injuries and Exp the exposure (in hours). The final product of this calculation is given in injuries per 1000 hours of exposure.

Descriptive analyses of categorical and numerical variables were performed, and the significance of their differences was measured with the chi-square test in SPSS 23.0. P-values <0.05 were considered significant.

### Results

In a total of 353 matches (150 in the A1 league and 203 in the A2 league), 259 injuries were reported: 106 to the thigh (40.9%), 42 to the foot and ankle (16.2%), 39 to the knee (15.1%), 39 to the head or face (15.1%), and 33 to other locations (12.7%), which corresponds to a rate of 0.73 injuries per match. Of the 42 injuries to the foot and ankle, 20 were lateral ankle sprains (47.6%), 5 were medial ankle sprain (11.9%), 3 were to the triceps surae (7.1%), 3 were leg contusions (7.1%), 3 were foot contusions (7.1%), 2 were myalgias (4.8%), and 1 was a cramp (2.4%). Four injuries required surgical treatment (9.5%): 1 calcaneal tendon rupture, 1 tibia fracture, 1 unimalleolar fracture, and 1 midfoot fracture, while surgical treatment was indicated in only 6.9% of the injuries to other anatomical regions ( $p > 0.05$ ).

The mean age of athletes with foot and/or ankle injuries was 25.4 years, compared to 27.0 years for all other injury types ( $p > 0.05$ ). The mean time loss for athletes with foot and/or ankle injuries was 19.7 days, compared to 23.7 days for other injury types ( $p > 0.05$ ). The incidence rate for all foot and ankle injuries was 4.4/1000h exposure in the A1 league, 2.8/1000h in the A2 league and 3.5/1000h overall (8349 total hours of exposure) ( $p > 0.05$ ). The overall incidence rate for ligament injuries alone was 2.1/1000h. No significant differences were found regarding the other factors (position, laterality, etc.) ( $p > 0.05$ ) – see table 1.

**Table 1.** Comparison of ligament and non-ligament injuries

		Ligament lesion		p
		No	Yes	
Position	Goalkeeper	2	0	<b>0.30</b>
	Fullback	4	4	
	Defender	0	4	
	Defensive midfielder	3	4	
	Midfielder	4	6	
	Forward	4	7	
Side	Left	8	14	<b>0.57</b>
	Right	9	11	
League	A1	9	14	<b>0.85</b>
	A2	8	11	
Time of day	Morning	1	1	<b>0.89</b>
	Afternoon	7	12	
	Night	9	12	
Point in match	Beginning	3	3	<b>0.85</b>
	Middle	5	7	
	End	9	15	
Contact	Yes	11	20	<b>0.27</b>
	No	6	5	

Table 2 shows the differences between foot and ankle injuries and all other types. It should be pointed out that 73.8% of the foot and ankle injuries involved physical contact ( $p < 0.001$ ), while 92.5% of thigh injuries did not ( $p < 0.001$ ). Finally, table 3 summarizes the complementary exams requested during follow-up treatment.

## Discussion

After the thigh (40.9%), the foot/ankle was the second most affected region of the body in this study (16.2%). This is in line with data from other championships. A seven-season (2001-2008) study of the Union of European Football Associations found prevalences of 37% and 31% for thigh and foot/ankle injuries, respectively, while prevalences of 41.1% of and 21.1% thigh and foot/ankle disorders, respectively, were reported in the 2016 Brazilian Championship. However, such findings are inconsistent with other international championships, such as the 2002 World Cup, in which the injury prevalences were 39.8% and 24% in the foot/ankle and the thigh, respectively, as well as the 2011 Copa América, in which the injury prevalences were 34.9 % and 27% in the foot/ankle and the thigh, respectively<sup>(2,5,8,12,20)</sup>.

In the present study, traumatic events were frequent, occurring in 73.8% of foot and ankle injuries, which approaches the upper limit of the 58% to 86% range described in the literature<sup>(6-8,21-26)</sup>. The highest reported rate of traumatic events occurred during

the 1998-2001 FIFA competitions, which included the 1998 World Cup and the 2000 Olympic Games<sup>(7,9,19,20,23)</sup>. The similar injury profile between the FIFA championships and our findings suggests that the Brazilian competitions are just as hotly disputed<sup>(7,9,19)</sup>.

The overwhelming majority of thigh injuries, however, occurred without direct contact from other players. Trauma was mentioned in only 8 of the 106 thigh injuries ( $p < 0.001$ ), and the remaining 98 were due to muscle strains. Of all reported injuries in the sample, strains occurred in 39.8%, with a further 20.5% due to sprains and 16.6% to contusions. The remaining 23.1% involved dislocations, fractures and concussions. These proportions differ significantly in other countries; in Japan, for example, 32.2% of injuries are sprains, 27.0% contusions, and 18.4% strains<sup>(23)</sup>. They also differ from other major FIFA championships, where the frequency of contusions has reached 59%<sup>(7)</sup>. These regional differences in muscle strain prevalence suggest differences in the quality of physical training and corroborate the hypothesis that Brazilian competition is more physically demanding<sup>(1,13,19)</sup>. However, more studies are needed to substantiate this hypothesis, especially since we live in a tropical country and other factors, both intrinsic and extrinsic, can influence the occurrence of these injuries<sup>(1)</sup>.

Among the foot and ankle injuries, the most frequent type (47.6%) was lateral ankle sprain, followed by medial ankle sprain (11.9%), triceps surae (7.1%), and contusions of the leg (7.1%) and foot (7.1%). According to the literature, lateral ankle

**Table 2.** Comparison of foot and ankle injuries

Physical contact		Yes	No	p			
Other		96	121	<b>&lt;0.01</b>			
Foot and ankle		31	11				
League		A1	A2	p			
Other		102	115	0.357			
Foot and ankle		23	19				
Severity	Mild	Minor	Moderate	Major	Severe	p	
Other	57	45	76	24	15	0.217	
Foot and ankle	10	13	13	1	5		
Part of the day		Morning		Afternoon	Night	p	
Other		25		75	117	0.253	
Foot and ankle		2		19	21		
Part of the match		Beginning		Middle	End	p	
Other		54		69	94	0.192	
Foot and ankle		6		12	24		
Position	Goalkeeper	Fullback	Defender	Defensive midfielder	Midfielder	Forward	p
Other	12	36	37	38	35	59	0.755
Foot	2	8	4	7	10	11	

**Table 3.** Complementary examinations

None	15 (35.7%)
Magnetic resonance imaging	15 (35.7%)
X-ray	11 (26.2%)
Ultrasound	2 (4.7%)
Computed tomography	1 (2.4%)

sprains are one of the most common sports injuries (up to 30%), with an incidence ranging from 1.7-2.0/1000h<sup>(1,2,4,24,25,27)</sup>. They are a common injury even in sports played with the hand, such as basketball, volleyball and handball<sup>(2,6)</sup>. Our value of 2.1/1000h is consistent with these data<sup>(1,2,4,24,25,27)</sup>. In the most severe cases, sprains can produce syndesmosis injuries, however no such case was reported in our sample<sup>(25,27)</sup>. The mean time loss due to injury in our study was 19.7 days, which was less than that found in the literature (34-37 days)<sup>(20,25)</sup>.

Of the 20 lateral ankle sprains, none were treated with surgery, while in eight cases no imaging exam was performed. The main requested complementary exam was magnetic resonance imaging. This discrepancy in the way cases were handled and the differing criteria for requesting exams suggests

a heterogeneity among the teams regarding the treatment of ankle sprains and reflects a need for standardized care and follow-up by specialized professionals.

This study has certain limitations. The main challenge was to ensure that the data were recorded correctly and completely by the team doctors. Although we standardized the data, the diagnostic criteria were not uniform and this may have added some observational bias. Another obstacle was a lack of in-depth data on the evolution of each injury, including its classification, the exams performed, and the physical therapy rehabilitation protocols for each team, as well as data on training injuries. However, despite its limitations, this is the first Brazilian study on foot and ankle injuries in professional soccer, which opens the door for future research that will improve our understanding of these injuries and direct our efforts toward increasingly effective therapeutic interventions<sup>(28,29)</sup>.

## Conclusion

This study provides initial data on the profile of foot and ankle injuries in Brazilian professional soccer. Foot and ankle injuries were the second most frequent topography, and 73.8% of these injuries resulted from physical contact ( $p < 0.01$ ). A total of 47.6% of the foot and ankle injuries were lateral ankle sprains, which reaffirms their prevalence and importance, especially in professional soccer.

**Authors' contributions:** Each author contributed individually and significantly to the development of this article: DPK \*(<https://orcid.org/0000-0003-1858-2718>) conceived and planned the activities that led to the study, wrote the article, participated in the review process, approved the final version; ESM \*(<https://orcid.org/0000-0002-8572-7764>) conceived and planned the activities that led to the study, wrote the article, participated in the review process, approved the final version; NSBM \*(<https://orcid.org/0000-0003-1067-727X>) conceived and planned the activities that led to the study, wrote the article, participated in the review process, approved the final version; ERM \*(<https://orcid.org/0000-0002-8245-2945>) wrote the article, participated in the review process, approved the final version; GGA \*(<https://orcid.org/0000-0003-4371-5041>) wrote the article, participated in the review process, approved the final version. \*ORCID (Open Researcher and Contributor ID) 

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