

Original Article (short paper)

Incidence of musculoskeletal injuries in professional soccer players from Aracaju/SE-Brazil.

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Abstract — Aims: To verify the incidence of injuries in professional soccer athletes in Aracaju-SE and to identify associated factors. **Methods:** This was an observational, prospective cohort study involving 39 healthy athletes, followed for seven months and evaluated on four occasions (start on preseason and two evaluations with three months of interval between each) through data collection sheet and orthopedic physical examination. **Results:** Participants were 20 athletes from Club Sportivo Sergipe and 19 from Associação Desportiva Confiança, with mean age of 26 years (CI 95%: 25.2-28 years), and mean career time of 9.6 years (CI 95%: 7.9-11.3 years). The 13 (2.4 / 1000 hours) diagnosed injuries occurred almost exclusively in the lower limbs and thigh muscle stretch was the most common injury. Injuries were mostly mild to moderate (69%). There was no significant association with any of the variables analyzed. **Conclusion:** Low incidence of injuries was observed in this study. Predominantly, lesions occurred on non-rainy days and were due to trauma. Lower limbs were the most affected location and thigh stretch was the most common injury.

Keywords (DeCS): athletic injuries (identificador DeCS: D001265), soccer (identificador DeCS: D012916), lower extremity (identificador DeCS: D35002), epidemiology (identificador DeCS: Q000453).

Introduction

Soccer, the most practiced sport, is also responsible for attracting the largest number of spectators in the world^{1,2}. Of a sport modality with such a capacity of public attraction and of potential income, it is expected exhibitions and disputes of high technical level, with athletes performance at its highest in the greater possible number of games².

Nevertheless, participation in extremely competitive sports is responsible for high physical demand for athletes³. During a match, players go through an average of 10 km divided into: running (40%), walking (25%), trotting (15%), speed (10%) and running back (10%)⁴. In addition, the sport is characterized by short, fast and non-continuous movements, such as acceleration, deceleration and abrupt changes of direction, in addition to intense physical contact⁵.

As a result, injuries incidence and associated costs tend to be high. It is estimated that soccer athletes are at risk of injury a thousand times greater than workers in industries considered to be at high risk⁶. In general, the global economic impact of football-related injuries exceeds \$ 30 billion². Therefore, in order to create injury prevention strategies, there is great interest in determining injuries risk factors^{7,8}.

Epidemiological studies are a useful tool in trying to define injuries risk factors and the athlete's risk profile⁷. In a classic study from 1992, van Mechelen, Hlobil, Kemper⁹ stated that these studies should be performed in four stages: 1) investigation of injury's epidemiological profile, identifying risk factors; 2)

attempt to define causes and mechanisms for the occurrence of injuries; 3) creation of prevention strategies and 4) assessment of the effectiveness of these strategies by repeating the first step.

More recently, experts from Union of European Football Associations (UEFA)¹ and The Brazilian Football Confederation (CBF)¹⁰ have attempted to solve a problem regarding the lack of homogeneity in epidemiological studies. The authors sought to standardize injury's definition and classifications, as well as to propose a model for the conduction of the studies. Studies¹¹ based on these models have shown a greater number of injuries affecting soccer athletes lower limbs musculature, with greater chance of occurrence in match rather than training days and in non-rainy days, for instance.

However, available data from scientific research in Brazil is still under the satisfactory level¹². The small amount of papers available is derivated from works with elite clubs, what represents a different scenario from that experienced by most Brazilian clubs^{10,13}. In this context, the lack of information from scientific articles represents a barrier to the creation and implementation of injury prevention strategies, the ultimate goal of epidemiological studies in sports^{4,7,14}.

Because it is unprecedented, the present study has the potential to generate data that can benefit more than twenty thousand athletes distributed in more than seven hundred professional soccer teams with a level of performance equivalent to that of the fourth division of the Brazilian championship or lower, which represents the majority of clubs in the country^{14,15}. Therefore, present study's goal is to determine the incidence of injuries

in male professional athletes from clubs in serie D national championship and its predisposing factors.

Methods

This was an observational prospective (cohort) study, planned according to the Declaration of Helsinki and Resolution No. 466/12 of the National Health Council and submitted to the Ethics and Research Committee of the Federal University of Sergipe (approbation number 544.973). The work was initiated after the release of this committee and data were collected after signature of informed consent from all participating athletes.

Male professional soccer players from the main clubs of the State of Sergipe, in Brazil’s northern coast, were selected: Associação Desportiva Confiança and Club Sportivo Sergipe. Both are located in the city of Aracaju, the state capital and had similar technical level, being in the same category within the national scenario, at the moment in which research was conducted. The teams began the pre-season process at the same time and during the 2014 season they would participate in the same championships: Northeast Cup (beginning of the year) and Sergipano Championship (until mid-year). In addition, they would be able to participate in the serie “D” of the Brazilian Championship, depending on the performance in the regional championship.

A total of 59 athletes, who could be observed for at least 08 weeks (minimum exposure time), were selected for this study. Twenty athletes with injuries already installed at the time of the first evaluation were excluded. Despite being considered a exclusion criteria, no injuries occurring outside the professional activity, in extra-club activities, were observed.

Sample

A proportion of lesions in the lower limbs of 25% was assumed to calculate the sample volume¹⁵. Considering a significance level of 5%, a precision of 14% was determined a sample size of 37 players.

Outcome

The outcome was the presence or absence of lesions (lesion vs. non-lesion). In this context, CBF¹⁰ and UEFA¹ models were used for general principles, study design, and injury definitions. Thus, an injury was defined as that which prevents player from active and complete participation in the following training session or game. The player was considered injured until return to training activities occurred and was available for playing (definition of injury duration).

Lesion intensity was defined and classified using absence time as the reference: minimal injury (up to three days of absence), mild (4 to 7 days), moderate (from 7 to 28 days) and severe (more than 28 days). Regarding the mechanism, the lesions were classified as traumatic, when resulting from an identifiable acute event, and atraumatic, when they were gradually established.

Types of variables

Physical, socio-demographic characteristics and aspects regarding soccer practice were collected through a sheet for semi-coded data collection and are summarized in figure 1.

Variables searched	
Quantitative	
Height and weight	Self-referred
Body mass index	Direct calculus
Thigh and calf circumference	Average of two measures
Categorical	
OBTAINING METHOD	
Playing position, dominance limb, ownership, comorbidities, addictions, past injuries, current complaints, injury mechanism, climatic condition at the time of injury, among others.	Data sheet

Figure 1. Variables searched and obtaining method

Regarding self-referred categorical variables (height, weight and career duration), it should be pointed out that previous studies in several countries, including Brazil, have validated this form of collection and have demonstrated the method accuracy¹⁶⁻¹⁸.

For circumference measurements, 150cm flexible and inelastic tapes were used and the athletes were positioned in dorsal decubitus. Thigh circumference was obtained at a point 10 cm proximal to the proximal border of the medial condyle of the femur and the circumference of the calf at a point 10 cm distal to the tibia anterior tuberosity. Two measurements were performed for each segment and the analysis was based on the mean value obtained^{19,20}.

Procedures

This was a longitudinal, prospective and observational study that was conducted throughout 2014 season of Sergipan soccer. During the follow-up period, athletes answered the mentioned questionnaire and underwent a comprehensive physical orthopedic examination, in four occasions: at the beginning of the season (beginning of the preseason - December / 2013), every 3 months and at the end of the season. On the first occasion, the data were collected through individual physical data sheets at the beginning or at the end of each training day, so that there was no interference with teams routine.

At this stage, athletes and coaches were instructed to record any injuries that would occur throughout the year. The teams had unrestricted telephone and email access to the responsible investigator and were advised to contact him as soon as they became aware of an injury. In this way, all injuries in the period were documented at the time of their occurrence and the involved athletes reexamined by this investigator, even at dates that did not correspond to scheduled interviews.

In the other opportunities, which occurred with approximate interval of 3 months, more succinct questionnaires were applied to identify lesions. In addition, players were reexamined whenever there was recurrence of orthopedic complaints.

All researchers were trained prior to questionnaires application. The data were collected with the presence of the researcher in charge at all times. After questionnaires completion, they were discharged whenever inconsistencies were detected and new ones were applied in the next interview with the same player.

Players physical examination was carried out exclusively by the responsible researcher. This examination was performed at the end of the first interview, still during preseason, and repeated whenever there were new orthopedic complaints in the subsequent interviews.

The study lasted approximately seven months. It started in December 2013 and ended in June 2014, at the end of the Sergipe 2014 football championship, which corresponds to a full season in Sergipe football.

Data analysis

The information collected was taken to the database for further statistical analysis. The database, as well as the tables and charts, were built in Microsoft Excel 2010.

Data descriptive analysis was performed using absolute and relative frequencies for categorical variables and through central tendency and variability measures for numerical variables. The differences between proportions were tested using the Pearson Chi-square test (with a significance level of 5%). For the analysis of mean comparisons between independent samples, Student's t-statistic test was used. Program R version 3.2.3 (R Core Team, 2015) was used for calculations²¹.

Regarding density of incidence calculation (number of injuries per 1000 hours of training or playing) was considered, since players had different times of exposure to the risk factors. The relative risk calculation was also carried out, which is characterized by the ratio between exposed and non exposed incidence.

Results

Fifty nine athletes were selected for the study. Of these, 20 athletes were excluded because they were already injured at the time of the initial evaluation. Thus, 39 athletes entered the study.

There were 20 players from Sergipe (51%) and 19 (49%) from Confiança. The average age of athletes was 26.6 years (95% CI: 25.2 to 28 years), with a mean career time of 9.6 years (95% CI: 7.9 to 11.3 years), mean age at which they started their careers of 17.3 years (IC95%: 16.7 to 17.9 years) and number of titles per player of 3, on average (95% CI: 2.4 to 3.9 years). The athletes' mean body mass index was 23.8 kg / m² (95% CI: 23.3 to 24.2 kg / m²). Most players considered himself black or mulatto (16/39, 41%).

Concerning previous medical history, four players (10%) reported previous orthopedic surgeries, three (8%) reported knee infiltrations and one third of athletes (13/39) reported social alcohol consumption.

Information regarding player distribution by position, dominance leg, team situation, presence or absence of knee complaints can be found in table 1.

Table 1. Distribution of Sergipe and Confiança 2014 football male athletes according to characteristics and conditions of performance.

	n	%
Player positions		
Attacker	9	23%
Goalkeeper	5	13%
Side	4	10%
Midfielder	9	23%
Box-to-box midfielder	10	26%
Defender	2	5%
Field condition*		

Good	15	38%
Bad	24	62%
Dominance leg		
Right	29	74%
Left	10	26%
Player situation		
First string	20	51%
Reserve bench	19	49%
Injury prevention program*		
Yes	34	87%
No	5	13%
Knee complains		
Yes	4	10%
No	35	90%
Total	39	100%

*According to the athlete's assessment.
n: sample (absolute frequency); %: Relative frequency

Thirteen injuries were diagnosed during the season, eight in Sergipe (3.5/1000h) and five in Confiança (2/1000h), with a total density of incidence of approximately 2.4 injuries per 1000 hours. Thigh muscle stretching was the main lesion (38%) observed. Seven injuries (54%) occurred during official games and the most common mechanism was trauma (11/13, 85%) (table 2).

Lesions intensity was mild to moderate in about 69% of the cases (figure 2). Of the 13 injured athletes, only one (8%) considered himself asymptomatic when returning to activities. Seven athletes reported return even without symptoms complete resolution (54%) and

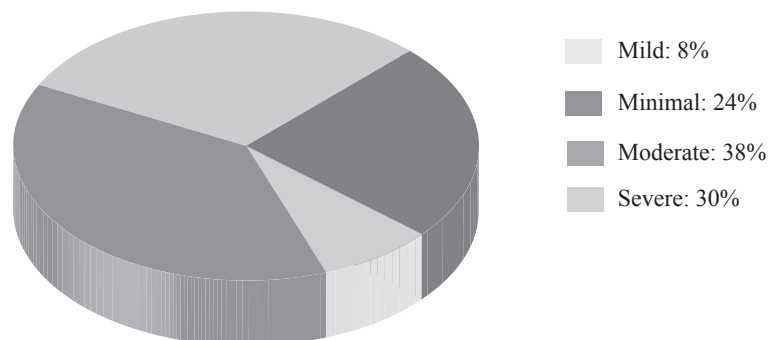


Figure 2. Severity of the lesions identified in male soccer athletes in the city of Aracaju - season 2014.

Table 2. Characteristics of lesions diagnosed in male soccer athletes in the city of Aracaju - season 2014.

	n	%
Moment of injury		
Match	6	46%
Training session	7	54%
Injury etiology		
Traumatic	11	85%
Non traumatic	2	15%
Trauma mechanism		
Direct	1	8%
Kick	2	15%
Contact	1	8%
Stretching	2	15%
Rotational	2	15%
Jump	2	15%
Hyperextension (hand/wrist)	1	8%
Non-traumatic injuries	2	15%
Weather condition		
Rain	2	15%
Without rain	11	85%
Lesion type (diagnosis)		
Thigh stretch	5	38%
Knee sprain	4	31%
ACL lesion	1	8%
Ankle sprain	1	8%
Fractures	2	15%
Total	13	100%

n: sample (absolute frequency); %: Relative frequency

five athletes (38%) were unable to return until the end of the season.

Regarding the variables studied, none of them presented a significant association (p value <0.05) with the analyzed outcome, as shown in Tables 3 and 4.

Table 3. Statistical evaluation of the association between each variable and the outcome. Sergipe, Brazil, 2014.

	Lesion	No lesion	Total	RR	IC _{95%}	X ²	p value
Sergipe	8	12	20	1.52	(0.60, 3.83)	0.821	0.365
Confiança	5	14	19				
Race							
White/hispanic	3	7	10	0.87	(0.30, 2.54)	0.067	0.795
Black	10	19	29				
Field condition							
Bad	10	14	24	2.08	(0.68, 6.37)	1.95	0.163
Good	3	12	15				
Dominance leg							
Right	10	19	29	1.15	(0.39, 3.36)	0.067	0.795
Left	3	7	10				
Team situation							
First-string	9	10	19	2.37	(0.87, 6.42)	3.284	0.07
Reserve bench	4	16	20				
Total	13	26	39				

RR: relative risk; 95% CI: confidence interval at 95%; X²: chi-square; p : level of statistical significance.

Table 4. Statistical evaluation of the association between each variable and the outcome. Sergipe, Brazil, 2014.

	Lesion	No lesion	Total	RR	IC _{95%}	X ²	p value
Injury prevention program							
No	2	3	5	1.24	(0.38, 4.02)	0.115	0.735
Yes	11	23	34				
Knee complain							
Yes	2	2	4	1.59	(0.53, 4.76)	0.557	0.455
No	11	24	35				
Knee infiltration							
Yes	1	2	3	1	(0.19, 5.29)	0	1

No	12	24	36				
Alcohol consumption							
Yes	5	8	13	1.25	(0.51, 3.07)	0.231	0.631
No	8	18	26				
Total	13	26	39				

RR: relative risk; 95% CI: confidence interval at 95%; X²: chi-square; p : level of statistical significance.

Discussion

The present prospective observational study identified a pattern of lesion occurrence similar to what has been reported in previous studies^{8,11,22-24}, which are: lesions happening especially in non-rainy days, with greater involvement of the lower limbs, thigh stretching as the most frequent lesion, and the majority of injuries happening as a consequence of a traumatic event.

According to Longo, Loppini, Cavagnino, Maffulli, Denaro²⁵, approximately 67% of the lesions occur in the lower limbs, followed by the upper limbs with approximately 13%²⁵. The lower limbs are the most affected body segment since it is where there is greater physical demand and a greater propensity to fatigue with reduction of neuromuscular control¹². More specifically, the thigh, knee and ankle are the most affected sites^{24,25}.

A study by Ekstrand, Myklebust, Holme, Engebretsen, Bahr²⁶ had similar results. A total of 2299 players from the top 51 teams in Europe were evaluated and the researchers found that muscle injury accounted for about 1/3 (31%) of the total number of injuries in the period under review. In addition, in this study, hamstrings were the main affected site (37%), followed by hip adductors (23%) and quadriceps (19%). It is worth mentioning that muscle injury is usually associated with an indirect mechanism of trauma due to sudden and vigorous contraction¹².

Regarding the climatic condition, the number of injuries is lower on rainy days than on sunny or cloudy days²⁴. The data shown in the present study are in agreement with this statement and this is probably due to the faster paced game play and with more contact between players on sunny days²².

In the present study, we also identified more injuries on training than on match days, what differs from data already published in the literature. Almeida, Scotta, Pimentel, Batista Júnior, Sampaio¹², assessing players from Clube do Remo in Belém-PA-Brazil, identified a higher occurrence of injuries in matches¹². Ekstrand, Häggglund, Waldén¹¹, went further and reported a sixfold incidence of injuries in match days rather than on training days¹¹. The difference between the present study and the data in the literature can not be explained by different loads of exposure to games and training between athletes from this and from other studies, since that calculated density of incidence for training and games was used to make comparisons.

Authors, in this study, had hypothesized that the incidence of lesions would be higher than that reported in other studies, especially when taking into account national data. The rationale was based on the fact that athletes in lower expression teams, with simpler training programs and physical structure, may be subject to a higher frequency of injuries and longer removal time^{10,15}.

However, results obtained here show a density of incidence much lower than 10 to 35 injuries per 1000 hours of practice, which is the estimated value in literature². In fact, it has been suggested by other authors²⁴ that players in football teams with higher performance levels tend to have more injuries and this is probably due to the differences in training load and the demands placed on clubs that participate in more expressive and competitive championships.

It is worth mentioning that a small number of injuries were identified, despite the fact that the present study took the model proposed by UEFA¹ and adopted by CBF¹⁰ into consideration. The recommendation from this models is that soccer epidemiological studies should be prospective and athletes should be followed for one season, at least. The authors in the present study believe that for small football teams that participate in short championships/short seasons and whose athletes remain for limited periods (because of temporary contracts), this recommendation should be extended for a minimum of two seasons.

In addition, it was not possible to establish a significant association between any of the variables and the outcome analyzed, although other authors have already demonstrated a greater number of injuries for older athletes^{2,27} and for those who plays as midfielders or attackers²⁶, for example. Even so, data resulting from this study were presented to the board and the medical department of the clubs in order that targeted prevention strategies could be adopted.

Conclusions

A low incidence of lesions was observed in the present study, with predominant involvement of the lower limbs of the athletes (thigh stretching being the most common lesion). There was no significant association between the variables studied and the outcome.

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