Shoulder injuries in Brazilian professional football players: epidemiological analysis of 3828 games


Sports Traumatology Center, Discipline of Sports Medicine and Physical Activity, Department of Orthopedics and Traumatology, Federal University of São Paulo, R. Estado de Israel, 713 - Vila Clementino, São Paulo, SP 04022-002, Brazil

Brazilian Football Confederation, Avenida Luis Carlos Prestes, 130 - Barra da Tijuca, Rio de Janeiro, RJ 22775-055, Brazil

ARTICLE INFO

Keywords:
Football
Epidemiological study
Glenohumeral dislocation
Acromioclavicular dislocation
Shoulder injury
Sports
Soccer

ABSTRACT

Objectives: Football is a globally played sport that poses potential risks for musculoskeletal injuries. Upper-limb injuries have a lower incidence rate than lower-limb injuries but can still cause absenteeism and performance impairment in football players. This descriptive epidemiological study aimed to evaluate and compare the epidemiological data on shoulder injuries among professional football players in two major Brazilian football championships.

Methods: Data were collected throughout the championships, and club physicians medically evaluated each player during official games using two online forms. The collected information included the player's age and position, injury diagnosis, laterality, location on the field where the injury occurred, playing time, imaging examinations performed, need for surgical treatment, time to return to play (TRP), and recurrence of the injury. The incidence of injuries was evaluated using the Federation Internationale de Football Association (FIFA) incidence formula.

Results: A total of 107 shoulder injuries were recorded (4.3% of all injuries), with a FIFA incidence of 0.847. Glenohumeral dislocations (GHDs) and acromioclavicular dislocations (ACDs) accounted for 37.38% and 35.51% of all shoulder injuries, respectively. Goalkeepers and defenders presented, respectively, a 2.15 and 1.57 times increased risk of suffering shoulder injuries, while attackers presented a 0.63 times decreased risk. Injury recurrence was observed in 14.95% of cases, with GHDs and ACDs showing recurrence rates of 35.00% and 5.26%, respectively. Goalkeepers and defenders presented, respectively, a 2.15 and 1.57 times increased risk of suffering shoulder injuries, while attackers presented a 0.63 times decreased risk. Injury recurrence was observed in 14.95% of cases, with GHDs and ACDs showing recurrence rates of 35.00% and 5.26%, respectively. Surgery was performed in 9.35% of cases, with GHDs representing 50% of all surgeries. The average TRP was 22.37 days, with severe and major injuries accounting for 11.21% and 10.28% of all injuries, respectively. Goalkeepers had the highest average TRP of 36.15 days. Recurring injuries had a higher average TRP of 33.44 days compared to nonrecurring injuries, which had an average TRP of 20.43 days. Surgically treated injuries had the highest average TRP of 112.5 days.

Conclusion: Shoulder injuries in the professional football scenario are of great concern due to the high recurrence rate and need for surgical treatment, which will lead to a long TRP. These findings emphasize the need to implement prevention protocols and effective treatments to reduce the consequences of such injuries, which are usually underestimated in this sport.

Level of evidence: III.

© 2024 Published by Elsevier Inc. on behalf of International Society of Arthroscopy, Knee Surgery and Orthopedic Sports Medicine. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).
INTRODUCTION

Football is a globally played sport that poses potential risks for musculoskeletal injuries [1]. Although upper-limb injuries have a lower incidence rate than lower-limb injuries, they can still cause absenteeism and performance impairment in football players [2]. In recent years, upper limb injuries have attracted increasing attention, especially after the introduction of the Federation Internationale de Football Association (FIFA) 11+ protocol for injury prevention, which emphasises the prevention of lower limb injuries and has reduced the incidence of injuries in this area by up to 70% [3].

Shoulder injuries represent approximately 8–13% of all football-related injuries [4]. Goalkeepers are most commonly affected by these injuries due to the intense use of their upper limbs to reach and stop the ball, perform dives towards the ground, switch limbs during jumps, and take falls. Collectively, these actions increase their chances of experiencing shoulder injuries [5]. Studies conducted on the American University League have calculated that goalkeepers’ risk of injury is 4.6 times higher than that of outfield players [6].

A protocol for preventing upper limb injuries was developed in 2016 to reduce injuries in goalkeepers. The FIFA 11+S was implemented and successfully reduced these injuries by 70%, effectively protecting goalkeepers during sports practice [2]. However, few studies have evaluated whether the introduction of this preventive regime causes greater changes in the factors involved in shoulder injuries in athletes.

Epidemiological studies on shoulder injuries in football, especially among elite players, are scarce. Hence, this study aimed to evaluate epidemiological data on shoulder injuries in professional football players from the Brazilian Football Championship (BFC) and the Paulista Football Championship (PFC).

METHODS

This prospective epidemiological study evaluated shoulder injuries in two divisions of two major professional football championships in Brazil—the BFC and PFC—during 2016 to 2019. This study was registered and approved by the Research Ethics Committee of Federal University of São Paulo (registration number 56723616.3.0000.5505).

Club physicians were contacted before the championships to participate in the study. They were provided instructions on collecting data and completing digital forms correctly using two online platforms: Transfertmarkt (Transfertmarkt GmbH & Co. KG, Germany) and SurveyMonkey (Momentive.ai, USA).

Data were collected throughout the championships, with club physicians recording each player’s medical evaluations during official games. Two forms were used: the first was filled out immediately after each match, and the second after the athlete’s return to sports. The physicians were reminded to complete the forms on a monthly basis.

All players with shoulder injuries were included in the study without age limitations. The evaluated variables were player age and position (attacker, midfielder, defensive midfielder, sideback, defender, and goalkeeper), injury diagnosis, laterality, location on the field where the injury occurred, playing time, imaging examinations performed, need for surgical treatment, time to return to play (TRP), and recurrence of injury. An injury was defined as a musculoskeletal complaint that occurred during a game and caused the player to miss at least one game or training session. The incidence of injuries was evaluated using the FIFA incidence formula: (total injuries × 1000)/total number of playing hours.

Excel 2016 (Microsoft Corporation, Redmond, WA, USA) was used for the descriptive statistical analysis of the quantitative variables. SPSS Statistics 20 (IBM Corp., Armonk, NY, USA) was used for the statistical inference of continuous variables. Qualitative variables were analysed using the chi-square test, while multivariate analysis was conducted using the ANOVA test. The confidence interval was set at 95%, with a significance level of 5% (p < 0.05). The Shapiro–Wilk test was used to assess the normality of the sample. There was no missing data.

During the study period, there were four CBF seasons, with 20 clubs participating per year in each division, playing 38 matches per season. During the same period, there were four CPF seasons, with 16–20 clubs participating per year in each division, playing 17–22 matches per season. In total, 15 seasons were analysed between 2016 and 2019, totalling 3828 matches and 126,357 h of play.

RESULTS

During the study, 7899 medical evaluations were recorded, of which 2486 resulted in an injury diagnosis. Over the years, there has been a progressive reduction in the total number of injuries, from 37 in 2016 to 27 in 2018. Approximately 60% of injuries occurred in the second half of the season, with 15 injuries occurring in July, 15 in August, 14 in September, and 15 in November. The months with the lowest injury rates were January (3), March (4), April (4), and October (4). The difference between the months with the highest and lowest injuries was statistically significant (p = 0.003).

Diagnosis, age, and imaging exams

A total of 107 shoulder injuries were recorded (4.30% of all injuries), with a FIFA incidence of 0.847 (Table 1). Six different injury diagnoses were identified during the championships, with glenohumeral dislocation (GHD) representing 37.38% of all shoulder injuries and acromioclavicular dislocation (ACD) in 35.51% of all cases; this difference was statistically significant (p < 0.001). Other diagnoses included shoulder contusions, clavicular fractures, proximal humeral fractures, and rotator cuff injuries (Fig. 1).

The average age of the injured players was 26.87 years, and different injuries showed a similar distribution among age groups. However, fractures occurred only in players aged <28 years. ACDs showed a decreased prevalence in players aged 25–28 years and became more prevalent in those aged >29 years. However, no statistically significant association was found between age and injury diagnosis (p = 0.796), injury recurrence (p = 0.864), or surgical treatment (p = 0.482).
In terms of player position, goalkeepers experienced the highest rate of injury (8.67%), followed by defenders (6.22%), defensive midfielders (4.47%), midfielders (4.25%), sidebacks (3.47%), and attackers (3.06%) (Fig. 2). In comparison with the other positions, goalkeepers and midfielders presented a 2.15 \( (p = 0.007) \) and 1.57 \( (p = 0.049) \) times increased risk of suffering shoulder injuries, while attackers presented a 0.63 decreased risk \( (p = 0.037) \). Contusions were the most common injury for goalkeepers and midfielders, whereas ACDs and GHDs were the most common injuries for other positions (Table 2).

The defence area had the highest percentage of injuries (42.06%), followed by the offensive area (20.56%); this difference was statistically significant \( (p < 0.001) \). The attackers experienced the majority of injuries in the offensive field, whereas other positions presented injuries in the defensive field most of the time (Table 1). The location on the field where the injury occurred was statistically associated with the player’s position \( (p < 0.001) \) but not with injury diagnosis \( (p = 0.429) \).

Fifty-seven percent of shoulder injuries occurred in the second half of the games, with the time intervals of 46–60 and 61–75 min having the highest prevalence of injuries; this difference was statistically significant \( (p = 0.032) \). Additionally, these periods had the highest incidence rates of ACDs, GHDs, and contusions and accounted for half of all fractures and rotator cuff injuries.

### Table 1

Main characteristics (incidence, age, recurrence, surgery and time to return to play), location in the field where the injuries occurred, and their relationship with the diagnosis and positions of the players.

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>FIFA incidence</th>
<th>Age (years)</th>
<th>Recurrence</th>
<th>Surgery</th>
<th>TRP (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoulder injuries</td>
<td>0.85</td>
<td>26.87</td>
<td>16 (14.95%)</td>
<td>10 (9.35%)</td>
<td>22.37</td>
</tr>
<tr>
<td>Shoulder contusion</td>
<td>0.17</td>
<td>27.38</td>
<td>0</td>
<td>0</td>
<td>3.76</td>
</tr>
<tr>
<td>Clavicle fracture</td>
<td>0.02</td>
<td>24.00</td>
<td>0</td>
<td>0</td>
<td>62.5</td>
</tr>
<tr>
<td>Proximal humerus fracture</td>
<td>0.02</td>
<td>24.5</td>
<td>0</td>
<td>1 (0.93%)</td>
<td>42</td>
</tr>
<tr>
<td>Rotator cuff tear</td>
<td>0.03</td>
<td>27.5</td>
<td>0</td>
<td>2 (1.87%)</td>
<td>91.75</td>
</tr>
<tr>
<td>Acromioclavicular dislocation</td>
<td>0.30</td>
<td>27.29</td>
<td>2 (1.87%)</td>
<td>2 (1.87%)</td>
<td>18.87</td>
</tr>
<tr>
<td>Glenohumeral dislocation</td>
<td>0.32</td>
<td>26.4</td>
<td>14 (13.08%)</td>
<td>5 (4.67%)</td>
<td>25.55</td>
</tr>
<tr>
<td><strong>Player position</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attacker</td>
<td>0.19</td>
<td>25.42</td>
<td>2 (1.87%)</td>
<td>2 (1.87%)</td>
<td>18.75</td>
</tr>
<tr>
<td>Midfield</td>
<td>0.14</td>
<td>26.71</td>
<td>2 (1.87%)</td>
<td>2 (1.87%)</td>
<td>27.47</td>
</tr>
<tr>
<td>Defensive midfielder</td>
<td>0.10</td>
<td>27.92</td>
<td>2 (1.87%)</td>
<td>0</td>
<td>10.08</td>
</tr>
<tr>
<td>Sideback</td>
<td>0.14</td>
<td>26.94</td>
<td>2 (1.87%)</td>
<td>1 (0.93%)</td>
<td>21.12</td>
</tr>
<tr>
<td>Defender</td>
<td>0.18</td>
<td>26</td>
<td>6 (5.61%)</td>
<td>2 (1.87%)</td>
<td>22.48</td>
</tr>
<tr>
<td>Goalkeeper</td>
<td>0.10</td>
<td>30.15</td>
<td>2 (1.87%)</td>
<td>3 (2.80%)</td>
<td>36.15</td>
</tr>
</tbody>
</table>

### Note

The percentages are described in relation to the total shoulder injuries.

FIFA, Federation Internationale de Football Association; TRP, time to return to play.

**Player’s position, location on the field, and moment of injury**

Injuries were recurrent in 14.95% of cases, with dislocations being the only factor responsible \( (p = 0.001) \). The recurrence rates of ACDs and GHDs were 5.26% and 35.00%, respectively.

Injuries were surgically treated in 9.35% of cases, with GHDs representing 50.00% of all surgeries. No clavicular fractures were treated surgically, and only 5.26% of ACDs and 12.50% of GHDs were treated surgically. Recurrent and non-recurrent injuries were surgically treated in 18.75% and 7.69% of cases, respectively. The need for surgical treatment was significantly associated with injury diagnosis \( (p = 0.009) \) but not associated with recurrent injuries \( (p = 0.161) \).

Injuries were classified according to severity based on the athlete’s TRP as follows: mild \((0–3 \text{ days})\), minor \((4–7 \text{ days})\), moderate \((8–28 \text{ days})\), major \((4–8 \text{ weeks})\), and severe \((-8 \text{ weeks})\) \[7\]. The mean TRP was 22.37 days, with severe and major injuries accounting for 11.21% and 10.28% of all injuries, respectively \( (p < 0.001) \). GHD injuries were responsible for 41.00% of severe injuries, and 100% of major injuries were due to GHDs and ACDs (Table 3).

Goalkeepers had the highest average TRP (36.15 days), whereas midfielders had the lowest average TRP (10.08 days). Recurring injuries had a higher average TRP (33.44 days) than non-recurring injuries (20.43 days). However, TRP was not statistically associated with the player position \( (p = 0.539) \) or recurring injuries \( (p = 0.178) \). Surgically...
treated injuries had a higher average TRP of 112.5 days (p < 0.001), whereas conservatively treated injuries had an average TRP of 13.08 days.

DISCUSSION

Although lower limb injuries are the most common in football [8], shoulder injuries should also be of great concern in this sport. In our study, we identified a FIFA incidence of 0.847 for shoulder injuries, which is higher when compared to 0.41 for anterior cruciate ligament injuries [9], but lower compared to 1.34 for total upper limb injuries [10] and 7.66 for muscle injuries [11]. We found that approximately 60% of shoulder injuries occurred in the second half of the season and 57% in the second half of matches. Similar results were also found in other studies that evaluated overall injuries in football [9,11–13]. An explanation for this is the psychological and muscle fatigue in the final stages of championships and matches, which reduces focus and coordination, leading to more injuries.

Compared to previous studies, our study showed a decrease in the incidence of shoulder injuries (8–13% compared with 4.3% in our sample) [1,4,5,7]. This is probably due to the increased attention and prevention of injuries that this area has been receiving, mainly after the adoption of specific training for the prevention of upper limb injuries (FIFA 11+S) in 2016 [14]. As the highest number of injuries occurred in goalkeepers [5,6], the application of this protocol and the subsequent decrease in the incidence in goalkeepers resulted in a lower incidence of shoulder injuries overall. Nevertheless, a study conducted between 2001 and 2008 on professional European teams presented a shoulder injury rate of 2% [12]. During the Athens Olympics and European Championship (both in 2004), shoulder injuries were responsible for 3.8% and 4.4% of all injuries, respectively [15].

Historically, upper-limb injuries have been reported more frequently in goalkeepers [5,6], and we found similar results in our study, as they had the highest rate of shoulder injuries when compared to other positions. Since goalkeepers are the ones who use the upper limb the most, this result is justifiable. In addition, by not including preseason and training data in our analysis, we may have underestimated the injury rate among goalkeepers, as this is the period during which diving and repeated falls tend to increase the risk of injury compared to official competitive football matches, when goalkeepers tend to be less active [6]. On the other hand, the number of injuries suffered by line players is not to be ignored, since they represent 87.8% of all shoulder injuries. This is due to the proportionally greater number of line players than goalkeepers during a match and probably because line players experience more frequent and intense physical contact with other players. This is especially true for attackers and defenders.

We found that goalkeepers required a longer TRP, particularly after undergoing surgery. This finding is consistent with those of previous studies, such as Cerciello et al. [16] on surgical treatment of anterior shoulder instability and Ennisman et al. [4], who reported a return to training of approximately 3–8 weeks. Hart et al. [17] recorded a longer recovery time of approximately 12 weeks in 2013 when studying shoulder injuries in newly operated goalkeepers. Goalkeepers evaluated by Goodman et al. [6] also exhibited a longer time of absence and more severe cases compared to line players. This could be because goalkeepers require more accurate sensory-motor function and proprioception in the upper limbs, which can take longer to recover than other players who make more use of the lower limbs in their position.

Table 2

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Attacker</th>
<th>Midfielder</th>
<th>Defensive midfielder</th>
<th>Sideback</th>
<th>Defender</th>
<th>Goalkeeper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoulder injuries</td>
<td>24 (22.43%)</td>
<td>17 (15.89%)</td>
<td>13 (12.15%)</td>
<td>17 (15.89%)</td>
<td>23 (21.50%)</td>
<td>13 (12.15%)</td>
</tr>
<tr>
<td>Shoulder contusion</td>
<td>4 (3.74%)</td>
<td>2 (1.87%)</td>
<td>6 (5.61%)</td>
<td>2 (1.87%)</td>
<td>2 (1.87%)</td>
<td>5 (4.67%)</td>
</tr>
<tr>
<td>Clavicle fracture</td>
<td>0</td>
<td>1 (0.93%)</td>
<td>0</td>
<td>1 (0.93%)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Proximal humerus fracture</td>
<td>0</td>
<td>1 (0.93%)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1 (0.93%)</td>
</tr>
<tr>
<td>Rotator cuff tear</td>
<td>0</td>
<td>1 (0.93%)</td>
<td>0</td>
<td>0</td>
<td>2 (1.87%)</td>
<td>1 (0.93%)</td>
</tr>
<tr>
<td>Acromioclavicular dislocation</td>
<td>11 (10.28%)</td>
<td>4 (3.74%)</td>
<td>5 (4.67%)</td>
<td>8 (7.48%)</td>
<td>7 (6.54%)</td>
<td>3 (2.80%)</td>
</tr>
<tr>
<td>Glenohumeral dislocation</td>
<td>9 (8.41%)</td>
<td>8 (7.48%)</td>
<td>2 (1.87%)</td>
<td>6 (5.61%)</td>
<td>12 (11.21%)</td>
<td>3 (2.80%)</td>
</tr>
</tbody>
</table>

Note: The percentages are described in relation to the total shoulder injuries evaluated.
During the European Championship, a study by the Union of European Football Associations (UEFA) [12] found that 28% of shoulder injuries required at least 28 days of TRP. In our study, the average TRP was slightly lower (22 days) but still had a major impact on the athlete’s return to training. In 2013, Hawkins et al. [13] reported that 22% of football injuries were recurrent. In our study, the recurrence rate was 14.95%, with GHDs and ACDs accounting for 35.00% and 5.26% of cases, respectively.

Among the shoulder injuries that occurred in our analysis, GHDs were the most frequent, followed by ACDs. This result was also found in a previous study of athletes in general, wherein a disproportionate incidence of these injuries was found in male athletes [4]. Hart et al. [15] reported a similar finding in 2013 when studying goalkeepers with shoulder injuries.

Although the severity of shoulder injuries in the American study [6] was similar to that reported by Durand et al. [18], the injuries in the former were primarily caused by fractures rather than dislocations (43.7% vs. 18.89% in our study). A higher incidence of fractures was observed in the younger age group (high school), whereas dislocations occurred more frequently in older athletes (college). Our findings are consistent with previous research, indicating that older athletes experience more GHDs and ACDs, while younger players tend to have a higher number of fractures, as reported by de Putter et al. [19]. Avi et al. [6] analysed injuries in college athletes in the National American League from 2009 to 2014 and found higher rates of ACDs (31.4% of the total injuries) and 5.1% of GHDs. We also found that this discrepancy regarding the injury type and age of the athlete is due to a possible history of previous trauma that contributes to instability and acute dislocation as the athlete ages. In a study by Terra et al. [20], the average age was 28.9 years, which was higher than the average age of the athletes in our study and in a previous study [4]. However, more recent data did not show a difference in the incidence of injury among athletes aged 18–24, 25–31, and >31 years [21]. Age does not seem to alter the incidence, but rather the type of injury. As reported by Durand et al. [18], younger patients tend to experience more fractures, whereas older patients experience more dislocation, instability, ACDs, and injury recurrence.

In our study, 9.35% of patients underwent surgery. Delaying surgical treatment of injuries, especially GHDs, can lead to injury recurrence. Stirm et al. [22] studied the surgical treatment of anterior shoulder instability in professional football players and found a recurrence rate of 4.3 cases per individual while waiting an average of 12 months for surgery. The condition worsens during this interval, and there is also a risk of accentuating the bone defect, which can complicate future treatments.

In 2016, the protocol for preventing shoulder injuries (FIFA 11–S) was developed in collaboration with other experts, focusing on warm-up exercises, optimisation of shoulder, elbow, wrist, finger strength, and balance, and advanced exercises for core strengthening and muscle control [14]. Before the development of this specific shoulder protocol, as in Avi et al.’s analysis [6], the incidence of shoulder and elbow injuries was 4.6 times higher in goalkeepers than in outfield players. The considerable decrease in this rate in our study could be attributed to the application of the FIFA 11–S protocol during the period when we evaluated professional players in the Brazilian championships. This was consistent with the results reported by Al Attar et al. [21]. Their study examined the effectiveness of FIFA 11–S in 726 goalkeepers, and a 70% reduction in upper-limb injuries was noted. These results further reinforce the programme’s effectiveness in reducing the incidence and recurrence of upper limb injuries in professional football players.

An important contribution of our study is that the evaluated athletes were professionals, something that has not been evaluated in the most recent literature. Additionally, the analysis was conducted during official games, where sports practice is more intense and closer to the reality of professional football. This adds great value in reinforcing the need for the application of FIFA 11–S in training and official games. It is important to consider applying such protocols not only for goalkeepers but also for line players that are exposed to severe physical contact and, therefore, also have a high rate of shoulder injuries, recurrence, and absence, as seen in this study.

This study has several limitations. The main ones are those inherent of epidemiological research, such as data collection bias. Several club physicians were responsible for filling out the forms, and due to the large number of data collectors, errors may have occurred. Furthermore, during the study period, some of the physicians were replaced by the clubs, but we ensured that all of them received training on how to complete the survey. Another limitation is the lack of consensus on the definition of injury in the literature, making it difficult to compare our results with those of other studies.

Our study is limited by a superficial analysis of each injury. Important data such as the history of previous shoulder injuries, trauma mechanisms, number of recurrences, imaging analysis, injury classification, and treatment method were not collected. Additionally, data were not collected for injuries that occurred during training sessions, and so we may have underestimated the total number of shoulder injuries. Despite these limitations, this was an extensive prospective study lasting four years and included a large sample of athletes and injuries, in which we were able to collect unpublished data from two major professional football championships in Brazil.

For future studies, it would be important to address these limitations and develop a deeper injury analysis. GHD and ACD were the most common injuries seen in our study, and other research analysing these specific injuries would be valuable for understanding them and proposing preventive actions and special treatment for these athletes. In addition, due to the high rate of surgical treatment and the long time to return to play, it would also be important to evaluate the treatment costs of these injuries.

**CONCLUSION**

Shoulder injuries in the professional football scenario are of great concern due to the high recurrence rate and need for surgical treatment, which will lead to a long TRP. Although they represent a small proportion...
of all lesions, they may hinder athletes’ careers and club investments. GHDs and ACDs were found to be the most frequent injuries. Goalkeepers had the highest rate of injuries. Attackers and defenders suffered most of the injuries. Our study findings demonstrate the importance of shoulder injuries in football and emphasize the need to implement prevention protocols and effective treatments to reduce the consequences of these injuries, which are usually underestimated in football.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Author contributions

Conceptualization - GGA, MC, JRP, BE; Methodology - EBSL, PHSL, LMR; Formal analysis EBSL, PHSL, LMR, EAF; Writing - EBSL, PHSL; Supervision and project administration CVA, ACP, PSB, EAF. All authors have read and agreed to the published version of the manuscript.

Declaration of competing interest

The authors declare that they have no known competing interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

The authors gratefully acknowledge the contribution of Federação Paulista de Futebol and Confederação Brasileira de Futebol who assisted with the data gathering. We also would like to thank Rafaela Stavale and Editage (www.editage.com) for language editing and manuscript revision.

References