






# Prospective Study of Muscle Injuries in Three Consecutive Seasons of the Brazilian Football Championship\*

## *Estudo prospectivo das lesões musculares em três temporadas consecutivas do Campeonato Brasileiro de Futebol*

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Rev Bras Ortop 2020;55(6):687–694.

### Abstract

**Objective** To perform a prospective evaluation of muscle injuries that occurred during the matches of series A and B of the Brazilian Men's Football Championship from 2016 to 2018.

**Prospective** A prospective-cohort study with data collection regarding muscle injuries that occurred during the official matches of the first and second divisions of the Brazilian Men's Soccer Championship in the 2016, 2017 and 2018 seasons.

**Results** The total number of muscle injuries was of 577 throughout the 3 seasons, with a gradual and annual reduction in the incidence of injuries (219 injuries in 2016, 195 in 2017, and 163 in 2018), with a statistically significant difference between the 2016 and 2018 seasons. Muscle injuries represented approximately 35% of the total lesions. The incidence of muscle injuries was of 7.66 per 1,000 hours of play. During the 3 seasons (2016 to 2018), the most common injury was of the hamstring muscle (41.1%, 40.5%, and 33.7% respectively). Wingers were the most affected players, and the most common injury severity scale was moderate (8 to 28 days). The moment of the match with the highest incidence of injuries was in the period between 61 and 75 minutes, with an index of 19.9%, with no statistical difference in relation to the other periods of the match.

**Conclusion** There was an incidence of muscle injuries of 7.7 /1,000 h, and they occurred predominantly in home games, in defenders (wingers and centre-backs), with an average age of 28 years, mainly involving the hamstring muscles, with a moderate mean time of absence (8 to 28 days).

### Keywords

- ▶ athletic injuries
- ▶ athletes
- ▶ football
- ▶ hamstring muscles

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**Resumo**

**Objetivo** Realizar uma avaliação prospectiva das lesões musculares ocorridas durante as partidas das séries A e B do Campeonato Brasileiro de Futebol Masculino dos anos de 2016 a 2018.

**Métodos** Estudo de coorte prospectivo com coleta de dados referentes às lesões musculares ocorridas durante os jogos oficiais da primeira e segunda divisões do Campeonato Brasileiro de Futebol Masculino nas temporadas de 2016, 2017 e 2018.

**Resultados** O número total de lesões musculares foi de 577 ao longo das 3 temporadas, havendo uma redução gradual e anual na incidência delas (219 lesões em 2016, 195 em 2017, e 163 em 2018), com diferença estatística significativa entre os anos de 2016 e 2018. As lesões musculares representaram aproximadamente 35% de todas as lesões. A incidência das lesões musculares foi 7,66 para cada 1.000 horas de jogo. Nas 3 temporadas (2016 a 2018), a mais comum foi a lesão muscular dos isquiotibiais (41,1%, 40,5% e 33,7%, respectivamente). Os laterais foram os mais acometidos, e a escala de severidade de lesão mais comum foi a moderada (8 a 28 dias). O momento da partida com maior incidência de lesões foi no período entre 61 e 75 minutos, com um índice de 19,9%, não havendo diferença estatística em relação aos demais períodos de jogo.

**Conclusão** Houve uma incidência de lesões musculares de 7,7 lesões/1.000 h, e ocorreram predominantemente nos jogos em casa, em defensores (laterais e zagueiros), com idade média de 28 anos, envolvendo principalmente a musculatura isquiotibial, com tempo médio de afastamento moderado (8 a 28 dias).

**Palavras-chave**

- ▶ traumatismos em atletas
- ▶ atletas
- ▶ futebol
- ▶ músculos isquiotibiais

**Introduction**

Football is the most practiced sport in Brazil and in the world. The professional practice of football can predispose the athlete to the development of injuries due to greater physical requirement in addition to increased exposure to risk factors, such as: excessive number of matches and training, high emotional demand, and the presence of previous injuries.<sup>1</sup>

Among the injuries suffered by professional football athletes, muscle injuries are the most common, with an incidence of approximately 35% to 40%.<sup>2</sup> Another important factor lies in the fact that even after the adoption of several programs to prevent injuries in football, such as the one of the International Federation of Association Football (Fédération Internationale de Football Association, FIFA, in French), FIFA 11+, Ekstrand et al.<sup>3</sup> in an 11-year follow-up study, showed that, unlike ligament injuries, there was no reduction in the incidence of muscle injuries in this period. Thus, muscle injuries have been widely studied in recent years due to the high impact generated on professional clubs, both from a sports and financial perspective.<sup>4,5</sup>

In Brazil, despite the increased interest in assessing the causes of sick leave and the main injuries in professional football players, there is still a lack of scientific works in this field, and mainly of studies focused on the injuries specific to this sport, such as muscle injuries.

Therefore, the aim of the present study is to perform a prospective evaluation of the muscle injuries that occurred during the matches of series A and B of the Brazilian Men's Football Championship from 2016 to 2018.

**Methods**

The present is a prospective cohort study with data collection regarding muscle injuries that occurred during the official games of the first and second divisions of the Brazilian Men's Football Championship in the 2016, 2017 and 2018 seasons. The data were collected through the *online* medical portal (portalmedico.cbf.com.br) of the Brazilian Football Confederation (Confederação Brasileira de Futebol, CBF, in Portuguese) at the end of each season. The injury questionnaires were filled out after the end of the matches by the physicians of each club, who were all duly registered at the CBF. All athletes regularly enrolled in series A and B of the 2016, 2017 and 2018 Brazilian Football Championship who played at least one match in the tournament were included in the work. The athletes enrolled by the clubs who did not play at least one match during the championship were excluded from the study. The concept used to define injury was the same as the one chosen by Fuller et al.<sup>6</sup> in the 2005 FIFA consensus: "Any physical claim sustained by a player resulting from a football match or training, regardless of the need for medical attention or loss of time in football activities."

The questionnaire completed by the doctors contained several variables: position of the player in the game, age, number of matches played, and time of participation in the games. With regard to injuries, it included the record of their occurrence, the location, the description and severity, the recurrence, as well as the moment of the championship in which the injury occurred.

The injuries were classified according to the severity, that is, the time the athlete was away on sick leave until his return to activities without limitations: mild (1 to 3 days), minor (4 to 7 days), moderate (8 to 28 days), major (28 days to 8 weeks) and severe (more than 8 weeks away).<sup>7</sup>

After the athlete's return to official games, the club doctor filled out another questionnaire with data regarding the outcome of the injury, such as: time to return to sports, need for surgical intervention, examinations performed, and severity of the injury.

The risk of injury was calculated according to the consensus drawn up by FIFA, in which the incidence of injury is expressed by the number of injuries per 1,000 hours of exposure (number of games x number of players per match x duration of the match in hours).<sup>6</sup> Therefore, the incidence of injuries for every 1,000 hours of play is calculated by the following formula:

$$\text{Incidence} = \frac{\text{total number of injuries} \times 1,000 \text{ hours}}{\text{exposure}}$$

The present study was approved by the Ethics Committee on Research in Human Beings under the number 1,660,701, and the data were provided by the CBF.

### Statistical Analysis

The measures of central tendency and dispersion were expressed as means and standard deviations (SDs) for the continuous variables of symmetric distribution, and as medians and minimum and maximum values for the variables of asymmetric distribution. The categorical variables were expressed in their absolute and relative values. The estimated difference between the categorical variables was calculated using the Fisher exact and Pearson Chi-squared tests. The odds ratio (OR) was calculated to quantify the risk of injuries associated with some study variables.

Since the data were quantitative and continuous, non-parametric statistical tests were used. We used analysis of variance (ANOVA) to compare the quantitative variables. The two-proportion equality test was used to compare whether the proportion of responses of two certain variables and/or levels were statistically significant. Values of  $p < 0.05$  were considered statistically significant. All confidence intervals (CIs) established throughout the work had 95% of statistical confidence.

### Results

Series A and B of the Brazilian Football Championship contain 20 clubs in each division, and the teams face each other in 2 shifts comprising a total of 38 rounds per season. In our study, data from 2016, 2017 and 2018 were collected, accounting for 2,280 matches. The total number of muscle injuries was of 577 during the 3 seasons, with a gradual and annual reduction in the incidence (219 in 2016, 195 in 2017, and 163 injuries in 2018), with a statistically significant difference between 2016 and 2018. There were a total of 1,663 injuries in the 3 seasons, and muscle injuries accounted for approximately 35% of them. The incidence of muscle injuries was of 7.66 per 1,000 hours of play (►Figure 1). In the 3 seasons (2016 to 2018), the most common injury was to the hamstring muscle (41.1%, 40.5% and 33.7% respectively).

Regarding the position of the athletes affected by muscle injuries, we observed a higher prevalence of injuries in the wingers (18.5%), centre-backs (18.4%), midfielders (16.6%), strikers (14.4%), sweepers (10.7%) and goalkeepers (3.8%) (►Figure 2). The most common degree of severity was the moderate type, with a sick leave between 8 and 28 days. The mean sick leave was  $15.8 \pm 1.6$  days. The most affected muscle group was the hamstring muscles. The athletes who suffered

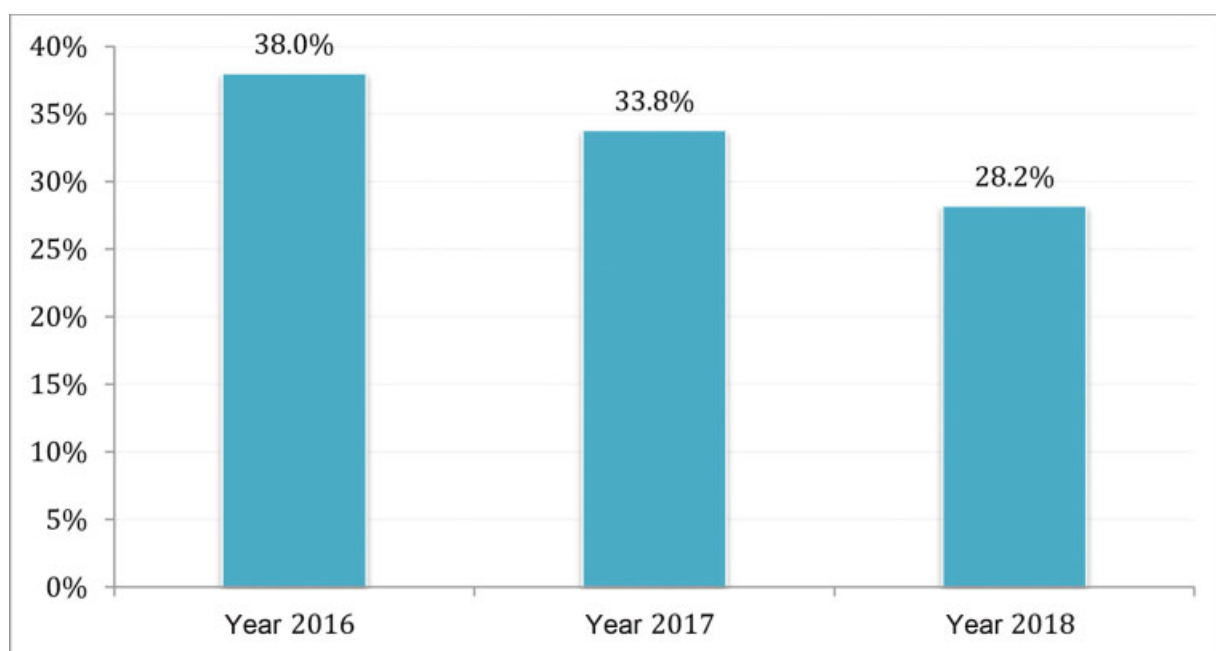
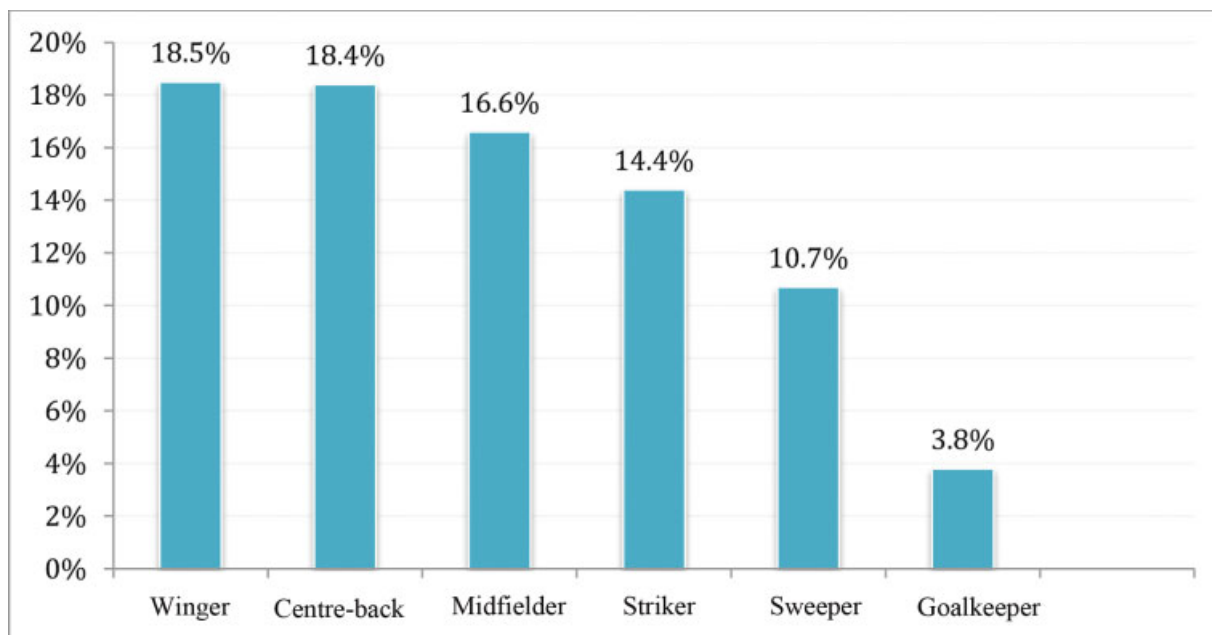


Fig. 1 Percentage of muscle injuries throughout three seasons.

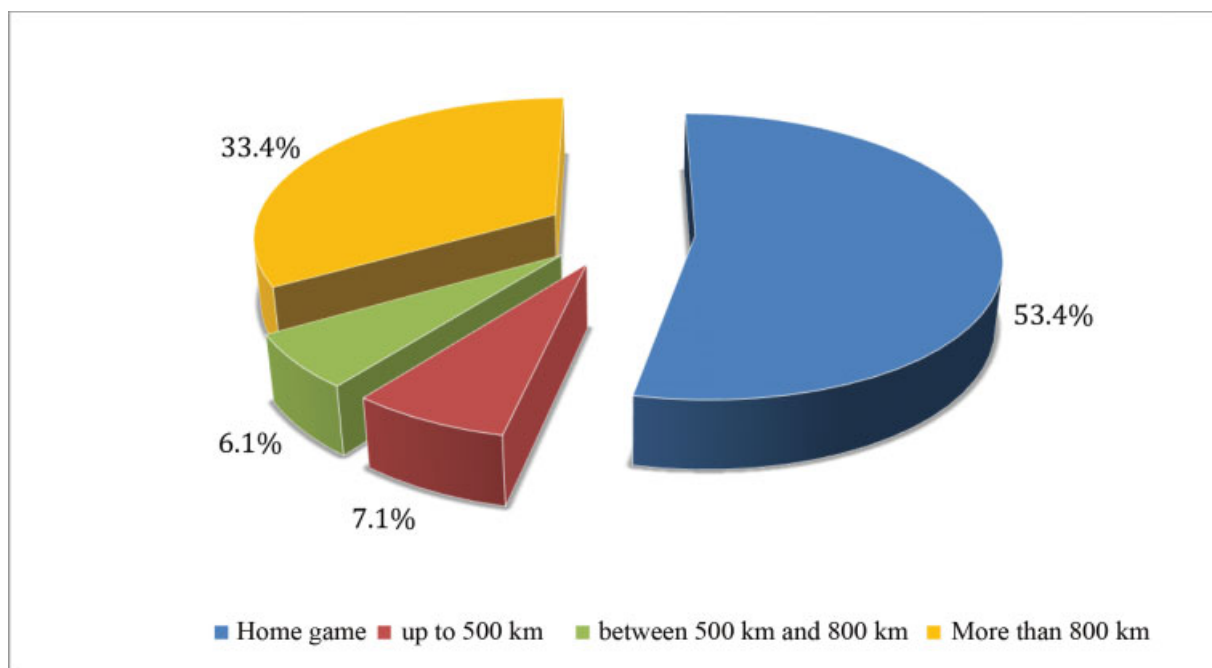


**Fig. 2** Position of the players who suffered muscle injuries.

muscle injuries had an average of approximately 28 years of age. Home teams had a higher rate of muscle injury (54.9%), with statistical significance ( $p < 0.001$ ). Regarding the location (distance) of the match, there was a higher prevalence of muscle injuries in home games and when the teams had to travel distances longer than 800 km for the match (53.4% and 33.4% respectively) (► **Figure 3**). The average temperature in the matches with muscle injuries was 22 °C. Considering the weather, most muscle injuries (38.6%) occurred in sunny days, but there was no statistical difference ( $p = 0.066$ ) in relation to other weather conditions (► **Figure 4**).

The moment of the match with the highest incidence of injuries was the period between 61 and 75 minutes, with an index of 19.9%, with no statistical difference in relation to the other periods of play (► **Figure 5**). Throughout the 3 seasons, we noted that the average number of injuries per club has dropped over the years, as in 2016 there were 5.92 muscle injuries per club, compared to 5.42 injuries in 2017, and 4.79 injuries in 2018.

In relation to the championship shifts, in the three years evaluated, most of the muscle injuries occurred in the first shift (► **Figure 6**).



**Fig. 3** Distribution of muscle diseases according to the distance of the match.

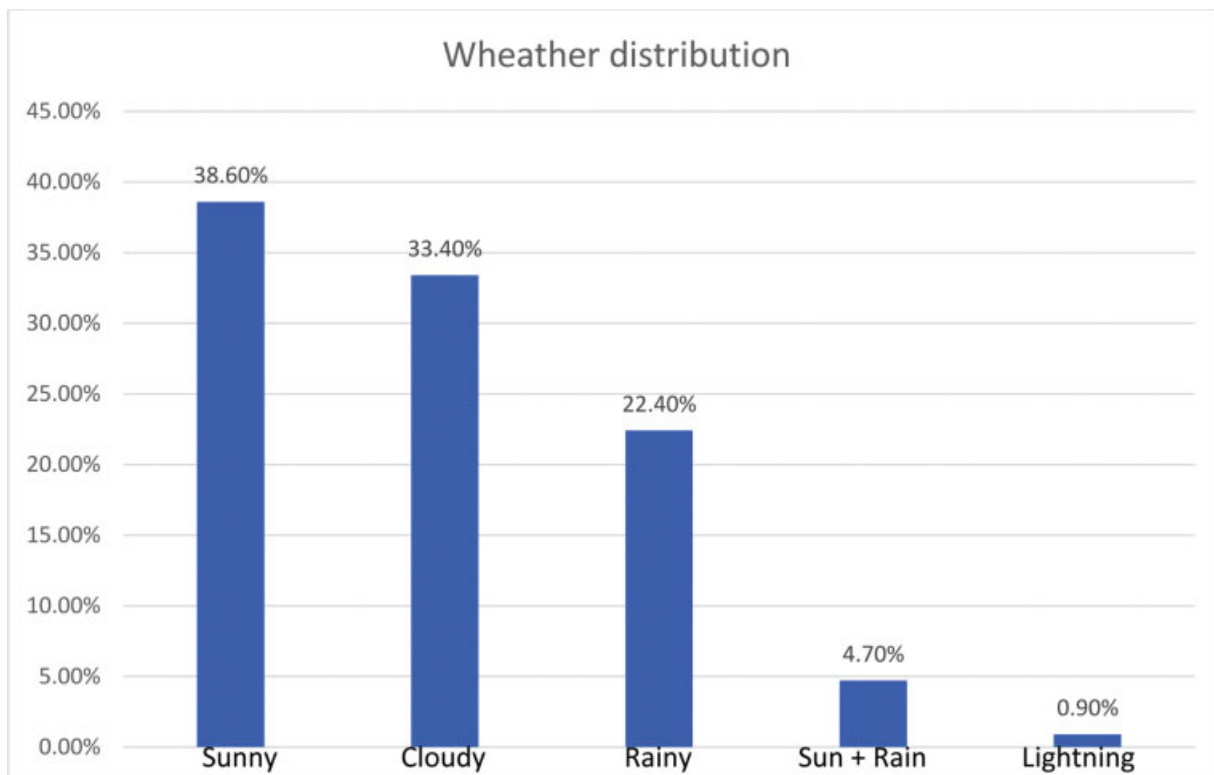


Fig. 4 Distribution of muscle injuries according to the weather during the match.

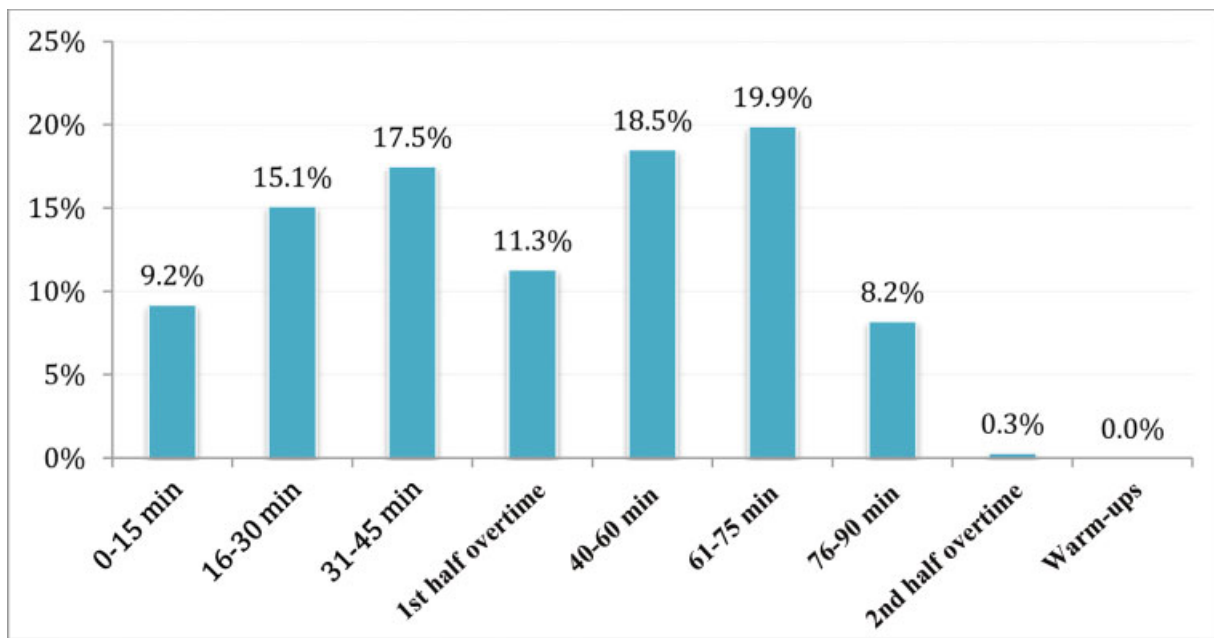


Fig. 5 Distribution of muscle injuries according to the moment the injury occurred.

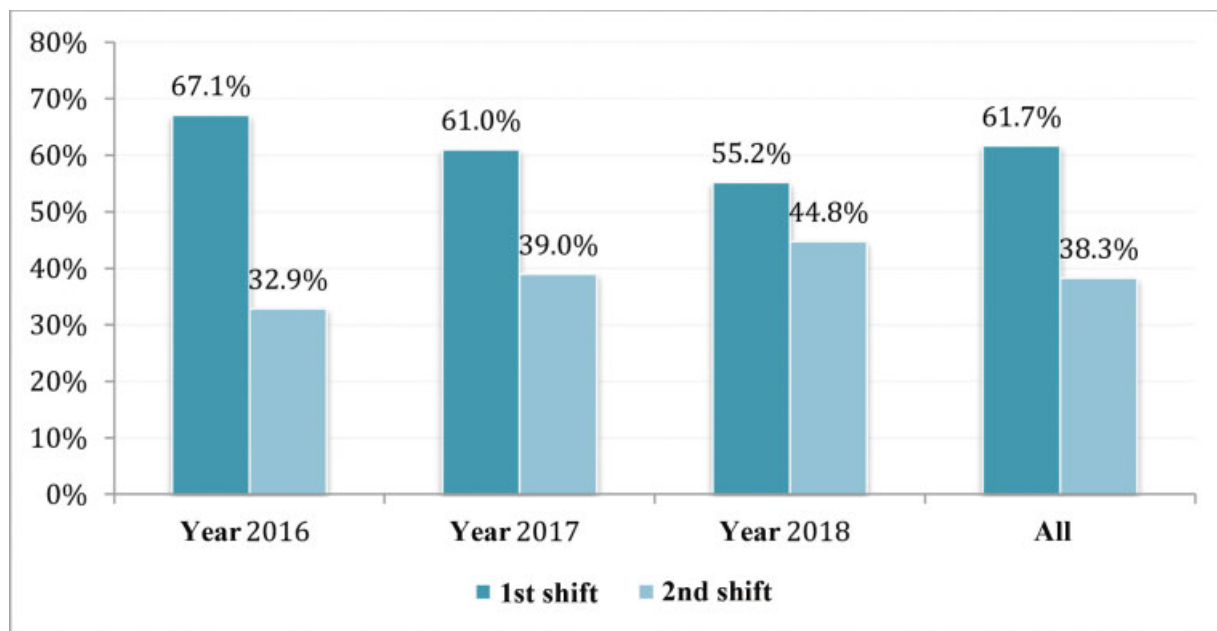
### Discussion

Football is the most practiced sport in Brazil, and the passion of the fans for their respective clubs transcends reason, and this is one of the main reasons for the struggle for better results and the obsession with titles on the part of the clubs. Therefore, it is essential that the football clubs use their athletes as much as they can, for when they suffer an injury

that makes it impossible for them to practice sports, the clubs suffer losses.

In a study by Ekstrand et al.<sup>8</sup> that evaluated 2,299 players from European clubs between 2001 and 2009, about 1/3 of the injuries were muscle injuries, and among those, hamstring muscle injuries were the most common, as in our study.

In another study by Ekstrand et al.,<sup>9</sup> in which Union of European Football Associations (UEFA) Champions League



**Fig. 6** Comparison of muscle injuries according to the championship shifts.

players were evaluated for 11 years, there was a decrease in the rate of ligament injuries, but there was no decrease in the rate of muscle injuries. In the present study, there was a progressive decrease throughout the three seasons evaluated. Previous studies<sup>2,10,11</sup> that evaluated the panorama of injuries in football players in Brazil demonstrated that muscle injuries are the most common ones, and one hypothesis that can be suggested is that these studies stimulated a greater preparation by Brazilian clubs to avoid muscle injuries, and this would justify this drop throughout the three seasons evaluated in the present study. Other hypotheses such as improvement in the conditions of the grass fields in Brazil, clubs seeking larger squads, with more players, in order to preserve athletes, and an advance in the use of technology by the medical departments of the clubs.

Junge and Dvořák<sup>12</sup> evaluated the injuries that occurred during the 2014 FIFA World Cup in Brazil; the most common injury was to the thigh muscle, and the authors recommended interventions to prevent injuries to the lower limbs without contact, which should be part of the training routine of football clubs.

Ekstrand et al.<sup>13</sup> performed a 13-year follow-up in European football clubs, and they observed an increase in the rate of muscle injuries to the hamstrings during training, with maintenance of the rate in relation to the games. The authors hypothesized that this difference was due to a greater muscle requirement during training. In the present study, only the injuries that occurred during the games were evaluated, and there was a decrease in the incidence of muscle injuries throughout the three seasons.

In the study by Bengtsson et al.<sup>14</sup> that evaluated 14 consecutive seasons of UEFA clubs, they found an average of 9.4 muscle injuries per 1,000 hours, a slightly higher value than that of the present study (7.66 muscle injuries per 1,000 hours). Another aspect addressed in the study is

that there were a higher number of injuries when there were less than three days of rest between matches. Previous studies<sup>15-18</sup> have shown a 20% reduction in the number of injuries when there were more than three days of rest between matches. Signs of muscle fatigue after a football match last about 72 hours, which has been demonstrated in previous studies.<sup>19-22</sup> This can alter the movements of the players, causing the muscles to function at levels to which they are not accustomed, which predisposes the athletes to new injuries. In the seasons of the Brazilian Championship in which the injuries were evaluated, there was an average of 3 days of rest between matches, a value associated with a greater number of injuries. In addition, in the present study, it was shown that in away games more than 800 km from the home field, there was a higher incidence of injuries. One hypothesis that can be suggested is that in these games players had shorter rest time and greater wear due to travel, thus resulting in a greater number of injuries.

In a study by Buckthorpe et al.,<sup>23</sup> an evaluation was made of the causes of hamstring injuries, which are the most common among football players. The authors point out the importance of strengthening the core musculature and the integrity of the pelvic balance to avoid hamstring injuries.

In a study by Eirale et al.,<sup>24</sup> the authors demonstrated that an important tool to reduce the occurrence of hamstring injuries is the detection of prodromal symptoms by athletes and/or trainers and performing tests that detect changes before the appearance of the lesion, such as magnetic resonance imaging and laboratory examinations.

Ekstrand et al.<sup>25</sup> evaluated 35 European football teams, and in those in which there was a break during the season, there was a lower rate of sick leave of players due to injuries. It could be hypothesized that the lower injury rate in 2018 may be justified by the break due to the World Cup.



In a study by Jones et al.,<sup>26</sup> 243 professional English football players were evaluated, and the authors demonstrated that hamstring muscle injuries are the most frequent, corresponding to 39.5% of all muscle injuries, and to 16.3% of the total injuries, rates similar to those found in the present study, as well as the severity scale of moderate lesions (8 to 28 days), which was the most common in both studies. In a study by Klein et al.<sup>27</sup> in which 3 seasons of the German championship were evaluated, the most common injury was to the thigh muscle, with 23.6% of the cases, and the severity of the most common injury was moderate (8 to 28 days away).

Regarding the shift of the competition in which the muscle injuries occurred, there is a need for further studies evaluating this aspect, because, in the study, most muscle injuries occurred in the first shift, which is not to be expected, since muscle injuries are often associated with muscle fatigue, which is most expected in the second shift.

Muscle injuries, one of the main causes for athletes to withdraw from sports, have been widely studied in order to understand the risk factors and to establish the appropriate treatment. This understanding will result in benefits to the clubs, the players, and the league, which will have its level of quality increased, and the fans themselves will benefit as well, for they will get to see their idols on the field, increasing the financial and sporting gain of those involved.

In Brazil, despite the high sums of money involved in the two main divisions of the Brazilian Football Championship, there is a lack of studies on the causes that hinder the practice of sports by athletes, including muscle injuries.

A limitation of the present study is the possibility of information bias, since the information may have been modified or even omitted by the doctors of the clubs. In addition, the study evaluated only acute injuries that occurred during games, and did not evaluate injuries sustained during training and diseases not related to sports. Another limitation is that the exposure time was calculated based on 22 players and 90 minutes per game. A more accurate method would be to consider the extra time or the actual duration of each match and the number of minutes of exposure for each player individually. The strengths of the present study include the fact that it is the first study in Brazil to perform the evaluation of muscle injuries for three years in the main championship in the country. In addition, correlations were performed that can be conducted in other studies for comparison, and the present study confirmed certain associations, which, although expected, had not been previously evaluated.

## Conclusion

Muscle injuries in professional soccer players in series A and B of the Brazilian Football Championship between 2016 and 2018 corresponded to 35% of all injuries, with an incidence of 7.7/1,000 h, and they occurred predominantly in home games, in defenders (winger and centre-backs), with an average age of 28 years, mainly involving the hamstring muscles, with a moderate mean time of absence (8 to 28 days).

Despite the advances in epidemiological and demographic studies regarding soccer injuries, we conclude that the literature lacks further studies, and that there is scope for further research in this field.

## Conflict of Interests

The authors have no conflict of interests to declare.

## Acknowledgements

We would like to thank the doctors from the soccer teams and the Brazilian Confederation of Football (CBF, in portuguese acronym) for their help in carrying out this work.

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