

Impact of the COVID-19 Pandemic on Injury Incidence in Japanese Male Professional Soccer Players

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Background: The outbreak of the 2019 novel coronavirus disease (COVID-19) led to an enforced quarantine period and limited training and match activities for athletes.

Purpose: To report the influence of the COVID-19 pandemic on the occurrence of injury in Japanese male professional soccer players.

Study Design: Descriptive epidemiology study.

Methods: In total, 21 clubs in the 2019 season and 28 clubs in the 2020 season from the Japan Professional Football League were prospectively followed, and 16 clubs in 2019 and 24 clubs in 2020 were analyzed in this study. Individual training, match exposure, and time-loss injuries were recorded using an electronic data capture system. The influence of COVID-19–related suspension during the 2020 season was retrospectively investigated via comparisons with the 2019 season.

Results: Total activity time included 114,001 hours in training and 16,339 hours in matches in 2019 and 170,798 hours in training and 25,411 hours in matches in 2020. The mean training interruption period caused by COVID-19 in 2020 was 39.9 days (range, 3–65 days), and the mean game-interruption period was 70.1 days (range, 58–79 days). The total number of injuries was 1495 in 2019 and 1701 in 2020. The overall injury incidence per 1000 hours of exposure was 5.7 in 2019 and 5.8 in 2020. The overall injury burden per 1000 hours of exposure was 155.5 days in 2019 and 130.2 days in 2020. The muscle injury incidence was highest in May 2020, immediately after the suspension period.

Conclusion: The overall injury incidence did not differ between 2019 and 2020. However, muscle injury incidence notably increased in the 2 months after the COVID-19 pandemic suspension period.

Keywords: COVID-19; muscle injury; Japan Professional Football League (J-League); injury incidence

Since the outbreak of the novel coronavirus disease (COVID-19) in December 2019, the severe acute respiratory syndrome caused by this new virus spread worldwide.³³ In an attempt to minimize the expansion of COVID-19, quarantine periods and lockdowns were enforced. During lockdowns, sporting team training sessions were canceled and athletic activities were limited to individual training at home,^{13,37} potentially affecting the maintenance of physical fitness in athletes. Furthermore, major sports events, including the Olympic games, were postponed, and the game schedules for regular seasons were discontinued in many countries to prevent the spread of infection at large gatherings and events. Both athletes and medical staff faced challenges in resuming athletic activities without contributing to the

spread of the virus and without increasing injuries, as a rapid change of training load could have increased the risk of injury.^{6,13,26,33,34,37}

After confirmation of the first case of COVID-19 in Japan in January 2020, the Japan Professional Football League (J-League) committee decided to cancel the league schedule on February 25, soon after the first game of the season was played. A lockdown was introduced after the declaration of a state of emergency on April 7 and lasted for 7 weeks, until May 25.¹ It took approximately 4 months to resume league matches on June 27. Team training was also restricted during the lockdown, and players had only 4 to 6 weeks of team training sessions before league matches resumed. Even after this resumption, matches were postponed because of SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2) infection in some players, making the schedule even tighter because the schedule for the final matches of the league was fixed. Also, in response to the COVID-19

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pandemic, several regulatory changes were made to protect players from injuries. The new regulations allowed 2 additional substitutions, with up to 5 substitutions per match,³⁰ a refreshment break in each half during the match,²⁶ and an additional transfer period. Therefore, the 2020 season was played in a considerably different environment compared with that of a typical season.

In January 2019, 1 year before the COVID-19 pandemic, the Japan Football Association (JFA) initiated an injury and illness surveillance program (JFA–Survey). This project aimed to identify the risk of injury and illness in soccer, using a similar format to that of existing surveillance programs conducted by the Union of European Football Associations (UEFA).^{14,17,36} To our knowledge, no studies have analyzed the influence of the COVID-19 pandemic for male professional soccer players based on accurate data. Furthermore, the influence of COVID-19–related suspensions on injury incidence is unknown. Clarifying the influence of COVID-19–related suspension on the injury incidence, injury burden, and most frequent injury, muscle injury, may provide useful information about resumption of sport after prolonged periods of limited training.

The purpose of this study was to investigate the influence of restrictions of activity imposed in response to the COVID-19 pandemic on the occurrence of injury in Japanese male professional soccer players.

METHODS

Study Setting

The JFA Surveillance Subcommittee, affiliated with the JFA Medical Committee, was responsible for organizing the JFA–Survey. This study was conducted as a retrospective analysis of prospectively collected data. The study group consisted of members of the JFA Medical Committee, the JFA Surveillance Subcommittee, and club physicians from the participating teams. Written informed consent was collected from all participating clubs. The study design and publication were approved by an institutional review board.

Participants

From the 58 clubs (first division, J1; second division, J2; third division, J3) registered in the J-League, 21 clubs (J1, 8; J2, 9; J3, 4) in the 2019 season and 28 clubs (J1, 10; J2, 13; J3, 5) in the 2020 season participated in the JFA–Survey. Among these clubs, 5 clubs in 2019 and 4

clubs in 2020 were excluded because of insufficient data. Thus, a total of 16 clubs (J1, 7; J2, 8; J3, 1) in the 2019 season and 24 clubs (J1, 9; J2, 11; J3, 4) in the 2020 season were enrolled for analysis in this study. All players with a first team contract were eligible, and 581 players and 753 players, all male, were included in 2019 and 2020, respectively.

Data Collection

An electronic data capture (EDC) system for soccer teams was developed for this study and maintained by the JFA. Each participating club assigned ≥ 1 staff member involved in medical management (eg, physician, physical therapist, athletic trainer) to provide required data through the EDC system. Meetings to explain the definition of injury, illness, and how to enter the data into the system to the team physicians of the participating clubs were held before the beginning of the season by the JFA Surveillance Subcommittee. Injury was defined as physical discomfort that occurred during training or a match and prevented full participation in >1 training session or match.^{17,24} Injury was diagnosed by the team physician of each club. The full return date was defined as the first day of return to full participation in training without restriction caused by medical concerns determined by the medical team. The total hours of training and match activities, the number of each type and location of injury, and the time to return to play (days) were recorded based on the method of the injury study program by UEFA and the Asian Football Confederation.^{14,17} Injuries that were unrelated to soccer activities were not included in the present study. To ensure the data reliability, data completeness was regularly monitored by the JFA Surveillance Subcommittee, and any suspected errors in data entry were confirmed with the data administrator of each team.

Data Analysis

The JFA Surveillance Subcommittee analyzed the anonymized data from the EDC. All reported injuries were classified by the type of injury and injury location according to the classification applied in the UEFA injury study,^{14,16,17} based on the diagnosis provided by the corresponding team physician.²²

The injury incidence in the study period was calculated as the number of injuries divided by the hours of exposure in each season. The injury burden was calculated as the number of days of absence divided by the hours of exposure.

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Ethical approval for this study was obtained from Chiba University (reference No. 4185).

Injury incidence and injury burden were analyzed for injuries that occurred during training and matches, and the combined total, including training and match injuries as well as injuries with unknown onset, was also analyzed. Injury severity was defined by the required days to return to playing as minimal (1-3 days), mild (4-7 days), moderate (8-28 days), or severe (>28 days). Subsequently, the influence of competition suspension caused by COVID-19 in the 2020 season was investigated by comparing the overall injury incidence and injury burden between 2019 and 2020. In addition, the injury incidence, injury burden, injury location, injury severity, reinjury, and monthly incidence of muscle injury that appeared to be most affected by the COVID-19–related suspension of competition were secondarily analyzed.

RESULTS

In 2019, the total activity of 16 teams comprised 94,520 sessions and 114,001 hours in training and 13,827 sessions and 16,339 hours in matches. In 2020, the total activity of 24 teams was 156,659 sessions and 170,798 hours in training and 23,291 sessions and 25,411 hours in matches. The mean training interruption period in 2020 caused by COVID-19 was 39.9 days (range, 3-65 days), and the mean game interruption period was 70.1 days (range, 58-79

days). The total number of injuries was 1495 in 2019 and 1701 in 2020, respectively (Table 1).

Injury Incidence and Injury Burden

The overall injury incidence per 1000 hours of exposure, including injuries that occurred during both training and matches, was 5.7 in 2019 and 5.8 in 2020 (Figure 1A). The injury incidence for matches was 17.5, which was approximately 5 times higher than the injury incidence in training, in 2020. The mean injury burden per 1000 hours of exposure, including injuries that occurred in both training and matches, was 155.5 days in 2019 and 130.2 days in 2020 (Figure 1B).

The overall muscle injury incidence per 1000 hours of exposure was 2.1 in 2019 and 2.5 in 2020 (Figure 2A), and the overall muscle injury burden per 1000 hours of exposure was 41.7 days in 2019 and 51.1 days in 2020 (Figure 2B).

Location, Severity, and Reinjury Incidence of Muscle Injury

Figure 3A shows the muscle injury incidence classified by the injury location, severity, and reinjury incidence. The thigh was the most common injury location in both years, accounting for 58.8% and 63.2% of all muscle injuries in 2019 and 2020, respectively. The second most common injury location in 2019 and 2020 was the lower leg/Achilles tendon, accounting for 17.3% and 16.4% of injuries, respectively, followed by the hip/groin, accounting for 17.0% and 14.3% of injuries, respectively (Figure 3A).

Severe muscle injuries accounted for 24.9% of injuries in 2019 and 23.8% of injuries in 2020. Moderate injuries accounted for 47.3% and 45.3% of injuries in 2019 and 2020, respectively, whereas mild muscle injuries accounted for 15.5% of injuries in 2019 and 18.4% of injuries in 2020 (Figure 3B). Recurrent injury incidence was 12.3% in 2019 and 10.1% in 2020, and the incidence of exacerbation was 2.2% in 2019 and 1.6% in 2020 (Figure 3C).

TABLE 1

Number of Clubs, Participants, and Injuries and Exposure Characteristics

	2019 Season	2020 Season
No. of clubs	16	24
No. of participants	581	753
No. of injuries	1495	1701
Training		
Total No. of sessions	94,520	156,659
Total hours	114,001	170,798
Matches		
Total No. of sessions	13,827	23,291
Total hours	16,339	25,411

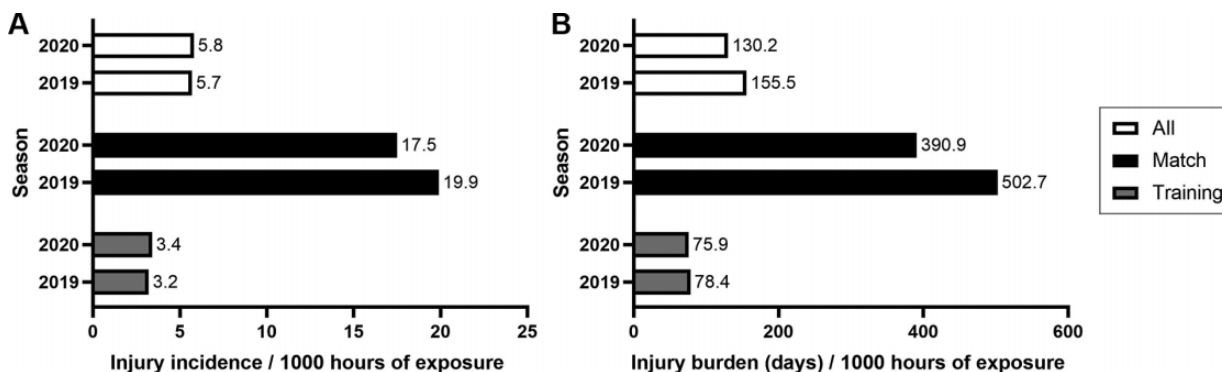


Figure 1. Overall injury (A) incidence and (B) burden (in days) per 1000 hours of exposure.

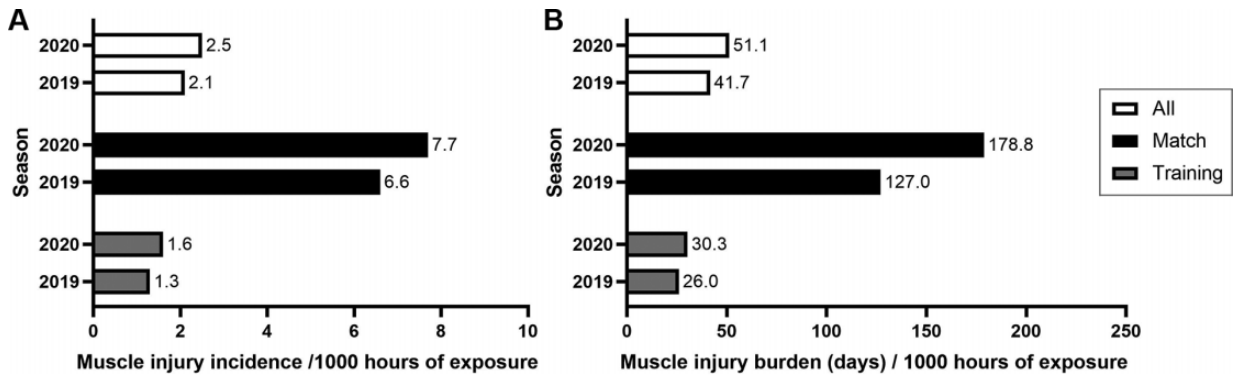


Figure 2. Muscle injury (A) incidence and (B) burden (in days) per 1000 hours of exposure.

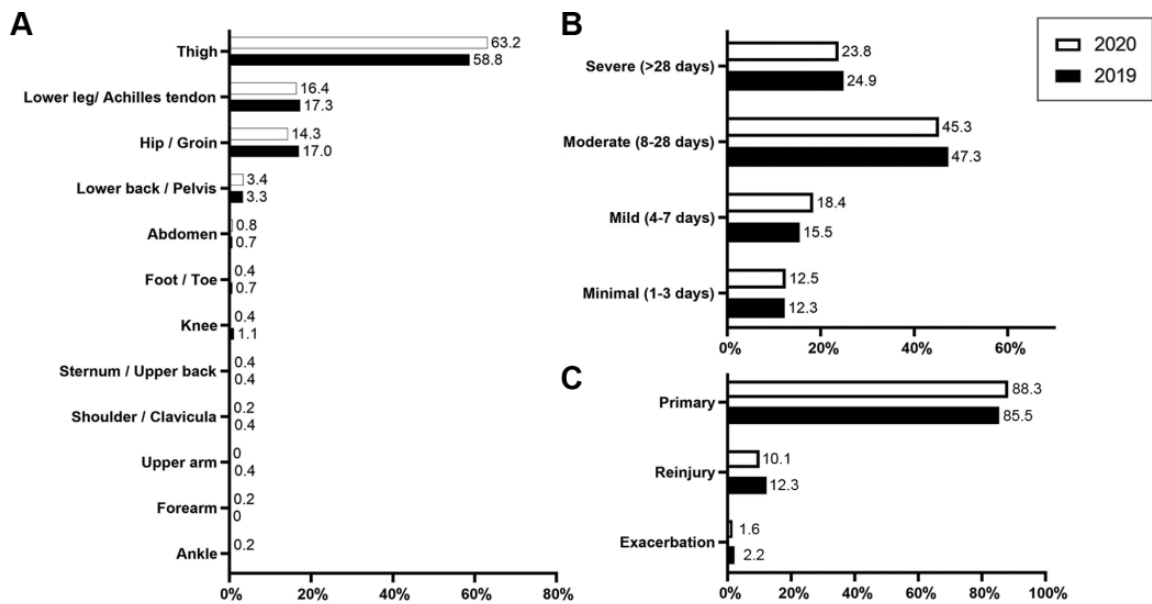


Figure 3. Muscle injury incidence classified by (A) injury location, (B) severity, and (C) reinjury incidence.

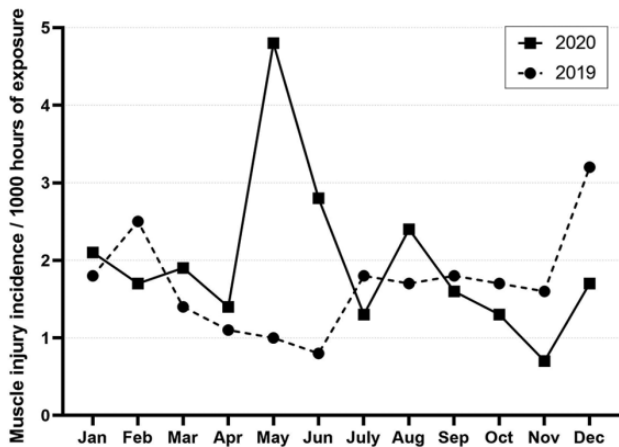


Figure 4. Monthly muscle injury incidence by month. The Japan Professional Football League season begins at the end of February and ends at the end of December.

Muscle Injury Incidence by Month

The incidence of muscle tears, strains, and muscle spasms (per 1000 hours of exposure) was highest in May 2020, immediately after the suspension period. The incidence of muscle tears, strains, and muscle spasms in the 2 months after resuming training was relatively higher than that before suspension (Figure 4). Compared with the previous season, the number of monthly injuries increased to 4.8 injuries in May 2020 (4.8 vs 1.0) and 2.8 injuries in June 2020 (2.8 vs 0.8).

DISCUSSION

The current study revealed 2 main findings: the overall injury incidence and injury pattern were similar between the 2019 and 2020 seasons, and the incidence of muscle injury in the 2020 season increased in May 2020, immediately after the suspension period.

Compared with previous injury surveillance studies, the overall injury incidence in the present study was similar to that reported by UEFA and the Asian Football Confederation.^{2,7,10,12,18,27-29,35} In addition, injury patterns regarding the anatomical location of muscle injuries were similar to those reported in previous studies.^{27,29,35} Despite the suspension of competition during the season in 2020, the overall injury incidence per 1000 hours of exposure did not change substantially: 5.7 in 2019 and 5.8 in 2020. Considering the results of previous injury surveillance studies, the current results appear to suggest that the suspension of competition due to COVID-19 did not exacerbate the overall injury incidence.[¶]

The J-League season typically begins at the end of February and ends at the end of December. Noya Salces et al^{31,32} reported that the match injury incidence increased toward the end of the season because of the promotion or relegation of the competition. Our data for 2019 indicated that the muscle injury incidence tended to increase toward the end of the season. However, in the 2020 season, the muscle injury incidence increased dramatically in May and June, which differed from the 2019 season. Because of the no-relegation rule that was implemented in the J-League for the 2020 season, it is possible that the players did not push themselves too hard even at the end of the season. This may be one reason why the increase in muscle injury incidence toward the end of the season was not seen in the 2020 season.

Ekstrand et al¹⁹ reported that teams given time off for winter break had a lower team injury burden than teams without a winter break in European professional soccer. In addition, they confirmed that greater preseason training volume decreased the injury burden but was not correlated with the injury incidence.²⁰ The suspension period caused by the COVID-19 pandemic imposed training restrictions on the players, and these periods might have provided a short break during the season. Congestion of match schedules has been suggested to affect injury incidence.¹² Match schedules in 2020 were often changed because of the COVID-19 pandemic. Eirale et al¹³ suggested that after the COVID-19–related competition suspension period, match congestion with several games every week would be expected, potentially inducing more injuries. However, several previous studies reported that the overall injury incidence during congested periods did not differ significantly from that during noncongested periods.^{8,9,11} Although the overall injury incidence was not substantially affected by the COVID-19 pandemic in the current study, it has been reported that congested match schedules can affect muscle injury incidence because of the shorter recovery period between matches, causing fatigue among players and increasing the incidence of injuries.^{4,5}

Because the total official match number per team in the 2020 season was not different from that in 2019, the short break may have led the match schedule to be tightened. However, the competition suspension period may have influenced overall injury incidence at the same time by

reducing accumulated fatigue, thus resulting in a similar overall injury incidence in spite of congested match schedules. In addition, as mentioned above, the no-relegation rule introduced to the league in 2020 might have affected the overall injury incidence as well as muscle injury incidence.

The overall muscle injury incidence and overall muscle injury burden were similar between the 2 seasons, as were the injury location, severity, and reinjury incidence of muscle injury. Considering the effects of the COVID-19 pandemic on a monthly basis, the muscle injury incidence per 1000 hours of exposure increased to 4.8 injuries in May 2020 and 2.8 injuries in June 2020 compared with the incidence in 2019. These 2 months correspond to the 2 months immediately after the resumption of the season. A previous study of hamstring injuries over 13 years reported that the mean overall injury incidence was 1.20 injuries and the mean injury burden was 19.7 days per 1000 hours of exposure.²¹ In addition, previous studies have reported that the muscle injury incidence has not decreased for decades, despite many clubs adopting prevention programs.^{15,18} In a recent report from Ekstrand et al,¹⁸ a 3% reduction per season of the overall injury incidence in men's elite professional soccer was observed over 18 years, but muscle injury incidence remained stable, with no decrease in injuries during training or matches. In the current study, the muscle injury incidence rates in May and June 2020 were relatively high, suggesting that they were affected by the COVID-19–related suspension. Although most clubs started team training before the end of the state of emergency on May 25, the period of approximately 40 days without training would be expected to affect players' physiological capabilities, including neuromuscular coordination, thus increasing the risk of injury.^{6,23}

Muscle strain frequently occurs during the preseason period because of high training intensity, a sudden increase in training load from off-season to preseason, and an insufficient preseason training period.^{25,38} Thus, the situation after the suspension period caused by the COVID-19 pandemic may involve a similar set of circumstances to the preseason period, causing an increase in muscle injuries.

Moreover, several regulatory changes, such as 2 additional substitutions,³⁰ a refreshment break in each half during the match,²⁶ and an additional transfer period, could be enacted to reduce the risk of injuries. However, assessing the effects of these measures may be challenging. Furthermore, in consideration of the influence of COVID-19, the J-League decided to change the rules so that there was no relegation of teams in the 2020 season, which may have changed the strategies, tactics, and player changes of each team, potentially affecting the occurrence of injury.

Limitations

The current study had several limitations. First, we compared the injury incidence and injury burden with those of the previous season. Because this study was a retrospective cohort study by prospective data collection, it was challenging to determine causality between findings of the 2

[¶]References 2, 3, 7, 10, 12, 17, 18, 27–29, 35.

seasons. Therefore, the conclusions that can be drawn regarding the influence of the COVID-19 pandemic are limited. Despite this, the current findings provide important data and could be useful in guiding the resumption of sporting activities after a period of competition suspension.¹⁶

Second, we did not account for the influence of COVID-19 on infected players and those who had close contact with infected individuals while they were infectious and required quarantine. The players who were specified as close contacts were not counted for illness, but they could not participate in team training with other players. Finally, we analyzed only 16 clubs in 2019 and 24 clubs in 2020, which is approximately 28% and 41% of all clubs, respectively. The relatively low percentage of the participating clubs could have affected the results as a selection bias.

CONCLUSION

The overall injury incidence did not differ between 2019 and 2020. However, the muscle injury incidence notably increased in the 2 months after the COVID-19 pandemic suspension period.

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