Regular-Season Injury Rates in the National Football League After an Attenuated Preseason Due to COVID-19

Alexander Volpi,*† MD, William Haselman,† BS, Christos Photopoulos,† MD, and Michael Banffy,† MD

Investigation performed at Cedars-Sinai Kerlan-Jobe Institute, Los Angeles, California, USA

**Background:** The preseason is a crucial time period for professional athletes to prepare for the upcoming season. However, due to the coronavirus 2019 (COVID-19) pandemic, the 2020 National Football League (NFL) preseason was canceled. As the regular season progressed, an increased number of injuries became apparent.

**Purpose/Hypothesis:** The purpose of this study was to compare injury rates between the 2019 and 2020 NFL regular seasons after the canceled 2020 preseason. It was hypothesized that injury rates in the 2020 season would be the same or higher compared with 2019.

**Study Design:** Descriptive epidemiology study.

**Methods:** A public database of all 32 NFL teams was used to examine the movement of all players to injured reserve status as well as every player who missed a regular-season game due to injury for both the 2019 and the 2020 NFL regular seasons. Data collection consisted of tallying the total number of reported musculoskeletal injuries for each team. Comparisons of injury rates between the 2 seasons were made using a Wilcoxon signed-rank statistical analysis.

**Results:** The total number of musculoskeletal injuries was 632 for the 2019 regular season and 765 for the 2020 regular season ($P = .0324$). Compared with 2019, statistically significant increases in injury rates in 2020 were seen for calf or Achilles tendon strain (17 vs 39; $P = .009$), groin injury (25 vs 46; $P = .018$), and anterior cruciate ligament tear (14 vs 29; $P = .016$). There were several other increased trends in soft tissue injury rates in the 2020 season (eg, hamstring injury [87 vs 114; $P = .085$]); however, these did not reach statistical significance.

**Conclusion:** This study showed a significant increase in total injuries during the 2020 COVID-19-affected NFL regular season compared with 2019. Several major soft tissue injuries reached statistical significance in their increase from 2019 to 2020 after the cancellation of the 2020 preseason due to COVID-19. These findings suggest that organized team preseason training and conditioning could have an effect on the prevention of sport-related injury at the highest level.

**Keywords:** epidemiology; injury prevention; injury rates; professional football

It has been shown in the literature that American football has some of the highest rates of injury in team sports at both the collegiate and professional level in the United States.8 Preseason training camp and preseason games help condition and prepare athletes for the regular season. With the outbreak of the coronavirus 2019 (COVID-19) pandemic in early 2020, the National Football League (NFL) suspended the 2020 preseason on July 21, 2020.16 In addition, in following COVID-19 protocols and gathering mandates, NFL training camp rosters were limited to 80 players.16 Traditionally, the preseason is a time when players focus on conditioning and preparation for the upcoming regular season. However, due to the COVID-19 shutdown, athletes were forced to prepare for the season on their own.1

It has been reported previously that fatigue and deconditioning place athletes at a higher risk of injury.10 In past research, as demonstrated by the Centers for Disease Control, it was determined that formal, team-organized preseason training results in increased athlete safety during the first half of the competitive season.7,12 In addition, the importance of a positive dose-response relationship has been shown, and a minimum of 6 to 8 weeks of training is necessary for induction of positive changes toward enhanced injury prevention profiles.9,19 The effect of an absence of preseason training and conditioning has been shown in other professional sports affected by COVID-19.17 Platt et al17 found a significant increase in injury incidence for
The purpose of this study was to evaluate regular season injury rates after the cancellation of the 2020 NFL preseason and compare them with injury rates during the 2019 regular season. It was hypothesized that injury rates in the 2020 season would be the same or increased compared with 2019 due to an absent preseason.

METHODS

Information on injuries during the 2019 and 2020 NFL regular season was collected retrospectively from publicly available online resources. Institutional review board approval was waived for this study because data were collected from public sources. Pro Sports Transactions was used to collect injury data from all 32 NFL teams. These injuries were cross-referenced with each team’s ESPN and NFL.com pages. Each NFL team was queried between September 5, 2019, and December 29, 2019, for the 2019 regular season and September 10, 2020, and January 3, 2021, including all 16 games in the 2020 regular season, excluding any preseason or playoff games. Inclusion criteria consisted of all players who missed ≥1 regular season game or were placed on the injured reserve (IR) list due to a musculoskeletal injury. Exclusion criteria included nonmusculoskeletal injuries (n = 181), players who were placed on the IR list due to COVID-19 regulations (n = 332), and injuries without a diagnosis (n = 17). Data were not collected on players who were listed on the practice squad roster at the time of their injury because practice squad size and criteria changed between the 2019 season and the 2020 season. In addition, less detailed injury data were available for practice squad players.

Musculoskeletal injuries were then categorized by team and diagnosis. Injury rates were analyzed by comparing the number of injuries per team and the total number of injuries between the 2019 and 2020 NFL regular seasons. In addition, the relative numbers of injuries with the same diagnosis were compared between the 2 seasons. Number of injuries per team between the 2 seasons was reported as mean plus standard deviation as well as medians with interquartile ranges, and the diagnosis comparisons were reported as mean number of injuries per team with standard deviations. All comparisons between the 2 seasons were made using a Wilcoxon signed-rank statistical analysis with the significance level set at P < .05.

RESULTS

After searching the available information in the public database Pro Sports Transactions, the total number of musculoskeletal injuries for the 2019 NFL Regular season was 632 and 765 for the 2020 season. The median number of injuries per team was 20.5 in 2019 and 22.5 in 2020 (Table 1). A comparison of all reported injuries, including nonmusculoskeletal injuries, as well as their incidence in each season can be found in Supplemental Table S1.

Statistical analysis demonstrated a significant difference regarding total number of injuries recorded in the 2019 versus 2020 seasons (P = .0324; Wilcoxon signed-rank test). In addition, several soft tissue injury rates were significantly different between seasons. There were 17 calf or Achilles tendon strain injuries in 2019 and 39 reported in 2020 (P = .0091), 25 groin injuries in 2019 compared with 46 in 2020 (P = .0177), and 14 anterior cruciate ligament (ACL) tears in 2019 versus 29 in 2020 (P = .0157). Hamstring injuries demonstrated an increased trend in incidence from 2019 to 2020 (from 87 to 114), although this difference was not statistically significant (P = .0847). There were several other soft tissue injuries that demonstrated a nonsignificant increase in incidence from the 2019 to 2020 seasons: biceps injury (2 in 2019 vs 6 in 2020; P = .13), medial collateral ligament injury (3 vs 6; P = .23), quadriceps injury (18 vs 25; P = .25), Achilles tendon tear (4 vs 10; P = .18), and torn pectoralis major tendon (8 vs 11; P = .44). A summary of these injuries can be found in Table 2.

TABLE 1
Comparison of Total Musculoskeletal Injuries Between the 2019 and 2020 NFL Seasonsa

| Season | Injuries, n | Injuries per Team, Median [Q1-Q3] | Injuries per Team, Mean ± SD (Range) | P          |
|--------|-------------|----------------------------------|-------------------------------------|------------|
| 2019   | 632         | 20.5 [16.0-22.3]                 | 19.8 ± 5.49 (9.0-30.0)              | .0324      |
| 2020   | 765         | 22.5 [18.0-27.3]                 | 23.9 ± 8.72 (13.0-51.0)             |            |

aNFL, National Football League; Q1, first quartile; Q3, third quartile.

both pitchers and fielders during a 2020 Major League Baseball season that saw an extended layoff between March and July and a shortened preseason.

Ethical approval for this study was waived by Cedars-Sinai Hospital (ref. No. STUDY00001733).

†Cedars-Sinai Kerlan-Jobe Institute, Los Angeles, California, USA.

*Address correspondence to Alexander Volpi, MD, 2800 Marcus Avenue, Suite 102, Lake Success, NY 11042, USA (email: alex.volpi20@gmail.com)

(36x156)addition, the relative numbers of injuries with the same number of injuries per team and the total number of injuries were analyzed by comparing the practice squad players.

addition, less detailed injury data were available for practice squads during a 2020 Major League Baseball season that saw an extended layoff between March and July and a shortened preseason.

The purpose of this study was to evaluate regular season injury rates after the cancellation of the 2020 NFL preseason and compare them with injury rates during the 2019 regular season. It was hypothesized that injury rates in the 2020 season would be the same or increased compared with 2019 due to an absent preseason.

METHODS

Information on injuries during the 2019 and 2020 NFL regular season was collected retrospectively from publicly available online resources. Institutional review board approval was waived for this study because data were collected from public sources. Pro Sports Transactions was used to collect injury data from all 32 NFL teams. These injuries were cross-referenced with each team’s ESPN and NFL.com pages. Each NFL team was queried between September 5, 2019, and December 29, 2019, for the 2019 regular season and September 10, 2020, and January 3, 2021, including all 16 games in the 2020 regular season, excluding any preseason or playoff games. Inclusion criteria consisted of all players who missed ≥1 regular season game or were placed on the injured reserve (IR) list due to a musculoskeletal injury. Exclusion criteria included nonmusculoskeletal injuries (n = 181), players who were placed on the IR list due to COVID-19 regulations (n = 332), and injuries without a diagnosis (n = 17). Data were not collected on players who were listed on the practice squad roster at the time of their injury because practice squad size and criteria changed between the 2019 season and the 2020 season. In addition, less detailed injury data were available for practice squad players.

Musculoskeletal injuries were then categorized by team and diagnosis. Injury rates were analyzed by comparing the number of injuries per team and the total number of injuries between the 2019 and 2020 NFL regular seasons. In addition, the relative numbers of injuries with the same diagnosis were compared between the 2 seasons. Number of injuries per team between the 2 seasons was reported as mean plus standard deviation as well as medians with interquartile ranges, and the diagnosis comparisons were reported as mean number of injuries per team with standard deviations. All comparisons between the 2 seasons were made using a Wilcoxon signed-rank statistical analysis with the significance level set at P < .05.

RESULTS

After searching the available information in the public database Pro Sports Transactions, the total number of musculoskeletal injuries for the 2019 NFL Regular season was 632 and 765 for the 2020 season. The median number of injuries per team was 20.5 in 2019 and 22.5 in 2020 (Table 1). A comparison of all reported injuries, including nonmusculoskeletal injuries, as well as their incidence in each season can be found in Supplemental Table S1.

Statistical analysis demonstrated a significant difference regarding total number of injuries recorded in the 2019 versus 2020 seasons (P = .0324; Wilcoxon signed-rank test). In addition, several soft tissue injury rates were significantly different between seasons. There were 17 calf or Achilles tendon strain injuries in 2019 and 39 reported in 2020 (P = .0091), 25 groin injuries in 2019 compared with 46 in 2020 (P = .0177), and 14 anterior cruciate ligament (ACL) tears in 2019 versus 29 in 2020 (P = .0157). Hamstring injuries demonstrated an increased trend in incidence from 2019 to 2020 (from 87 to 114), although this difference was not statistically significant (P = .0847). There were several other soft tissue injuries that demonstrated a nonsignificant increase in incidence from the 2019 to 2020 seasons: biceps injury (2 in 2019 vs 6 in 2020; P = .13), medial collateral ligament injury (3 vs 6; P = .23), quadriceps injury (18 vs 25; P = .25), Achilles tendon tear (4 vs 10; P = .18), and torn pectoralis major tendon (8 vs 11; P = .44). A summary of these injuries can be found in Table 2.

TABLE 1
Comparison of Total Musculoskeletal Injuries Between the 2019 and 2020 NFL Seasonsa

| Season | Injuries, n | Injuries per Team, Median [Q1-Q3] | Injuries per Team, Mean ± SD (Range) | P          |
|--------|-------------|----------------------------------|-------------------------------------|------------|
| 2019   | 632         | 20.5 [16.0-22.3]                 | 19.8 ± 5.49 (9.0-30.0)              | .0324      |
| 2020   | 765         | 22.5 [18.0-27.3]                 | 23.9 ± 8.72 (13.0-51.0)             |            |
The Orthopaedic Journal of Sports Medicine

Injury Rates in the Post-COVID-19 NFL Season

TABLE 2
Comparison of Soft Tissue Injury Types Between the 2019 and 2020 NFL Seasons

| Injury                               | 2019 NFL Season | 2020 NFL Season |
|--------------------------------------|-----------------|-----------------|
|                                      | Injuries Overall, n | Injuries per Team, Mean ± SD | Injuries Overall, n | Injuries per Team, Mean ± SD | P     |
| Biceps injury                        | 2               | 0.063 ± 0.246    | 6               | 0.188 ± 0.397    | .1294 |
| Calf/Achilles tendon strain          | 17              | 0.531 ± 0.718    | 39              | 1.219 ± 0.975    | .0091 |
| Groin injury                         | 25              | 0.781 ± 0.975    | 46              | 1.438 ± 1.458    | .0177 |
| Hamstring injury                     | 87              | 2.719 ± 2.303    | 114             | 3.563 ± 2.590    | .9847 |
| MCL injury                           | 3               | 0.984 ± 0.296    | 6               | 0.188 ± 0.397    | .2330 |
| Quadriceps injury                    | 18              | 0.563 ± 0.948    | 25              | 0.781 ± 0.975    | .2546 |
| Torn Achilles tendon                 | 4               | 0.125 ± 0.336    | 10              | 0.313 ± 0.644    | .1851 |
| Torn ACL                             | 14              | 0.438 ± 0.619    | 29              | 0.906 ± 1.201    | .0157 |
| Torn pectoralis major tendon         | 8               | 0.250 ± 0.508    | 11              | 0.344 ± 0.483    | .4374 |

*aBoldface P values indicate statistically significant difference in overall injuries between 2019 and 2020 (P < .05). ACL, anterior cruciate ligament; MCL, medial collateral ligament; NFL, National Football League.

DISCUSSION

After querying the public database Pro Sports Transactions for reported injury data in the 2019 and 2020 NFL regular seasons, we found a statistically significant increased number of total injuries in the COVID-19-affected 2020 regular season compared with 2019. Three injury comparisons reached a statistically significant increase from 2019 to 2020: calf or Achilles tendon strains (17 vs 39; $P = .009$), groin injuries (25 vs 46; $P = .018$), and ACL tears (14 vs 29; $P = .016$). As listed in Table 2, there were also multiple soft tissue injuries that increased from 2019 to 2020 but did not reach statistical significance. The number of injuries increased significantly in the 2020 regular season after the cancellation of the preseason due to COVID-19, from 632 total injuries in 2019 to 765 total injuries in 2020 ($P = .0324$). Our data confirm our hypothesis of similar and, in many cases, increased injury rates in 2020 after a canceled preseason due to COVID-19. This suggests that formal organized team preseason training might have an effect on injuries sustained in the regular season.

This is not the first time in NFL history that an attenuated off-season and preseason affected injury rates. From March 11 to July 25, 2011, the NFL Lockout occurred due to a disagreement on a new collective bargaining agreement and players did not have access to normal offseason training facilities or staff. After the lockout there was a rapid progression to training camp starting on July 27 and the preseason on August 11, 2011. An article by Myer et al.12 reported on Achilles tendon tears after the NFL lockout and found that there were 10 Achilles tendon tears within the first 12 days of training camp in 2011. Typically, it has been reported that between 4 and 10 Achilles tendon tears happen in the entire NFL season, with about 1 to 3 of those injuries occurring in the preseason.2 These injuries are particularly devastating injuries, requiring nearly 11 months for full rehabilitation. Although not statistically significant, our data showed an increase in Achilles tendon tears from 4 in 2019 to 10 in 2020.

It has been well studied that training and conditioning before an athletic season may aid in injury prevention. With significant injury data being shown after the COVID-19 shut-down at the professional level, this can have effects down to the high school and youth levels of sports, stressing the importance of training and conditioning.13,14 Myer et al.13,14 have studied at length that integrative strength and conditioning programs are becoming recognized as a necessary component to help ensure safe sport participation in youth athletes. In addition, they reported that if risk factors associated with athletic injuries (eg, low fitness level, muscle imbalances, neuromuscular deficits, and errors in training) are properly addressed, both acute and overuse injuries can be reduced.12 Gabbett6 discussed the paradox of high-intensity training to prevent injuries actually causing athletic injuries. He reported that high excessive and rapid increases in training loads are probably responsible for a proportion of noncontact soft tissue injuries. However, hard and appropriate training often leads to development of physical qualities that also protect against injury. The importance of preseason conditioning has also been studied in other professional sports.20 Tyler et al20 reported on a preventative training program to decrease adductor injuries in National Hockey League players. They found that, among players who participated in the preventative training program, there was a significantly lower incidence of adductor strains during the regular season.20

Recent studies have also shown similar findings in the COVID-19-affected 2020 NFL season.1,3,5,11 Baker et al.1 reported increased injury rates in weeks 1 to 4 of the 2020 regular season compared with weeks 1 to 4 of the 2016 to 2019 seasons. Interestingly, they also found more injuries occurred in the first 2 weeks of each of the preseason and the regular season in 2020. They proposed risk factors for early preseason and regular season injuries, including deconditioning and muscle weakness that occurs during the offseason, as well as fatigue, suggesting that fatigued muscles are more vulnerable to injury.1,3,5,11 In a study by Orchard et al.15 of Australian Rules Football, they found that players with hamstring injuries had weaker hamstring muscles and lower hamstring-to-quadriceps muscle ratios than the contralateral leg. Bailey et al.4 recently published a similar study showing that an increased number of players missed games due to injury in 2020 compared with 2017 to 2019 and that defensive players were more prone to injury and missing games. In contrast, when Platt et al.18 investigated NFL injury rates in 2020, they
found slightly increased rates in 2020 compared with the 2018 and 2019 seasons, although their findings did not reach statistical significance.

**Limitations**

This study has several limitations. Given that this is a public database study, incomplete data, omissions of injuries, and inaccurate reporting could potentially confound the differences between seasons. Details regarding injury diagnosis, including severity, exact pathology, and imaging reports were not available for all players. We did not assess the injuries over multiple past seasons, as we wanted to compare all 16 games and all 32 teams from a single unaffected 2019 season with the 2020 regular season. In addition, only the number of each injury was extracted from the database. We did not analyze time or the number of games missed from injury or extrapolate injury severity from time spent on IR. NFL teams often utilize the IR to open a roster spot and we did not want to confuse a move to IR status with increased injury severity. There was also no way for us to determine whether any or all of the players participated in unorganized informal preseason training and to what extent, which could confound the data somewhat since it is not known whether they all had the same unorganized preseason training.

**CONCLUSION**

The findings of this study showed an increased injury rate during the COVID-19-affected 2020 NFL regular season compared with 2019. Several major lower extremity soft tissue injuries increased at a statistically significant rate. These data suggest that structured team-organized NFL preseason training could play a role in injury prevention during the NFL regular season. With the increasing COVID-19 variants and further disruption of professional sports, a potential future direction could be a standardized training and conditioning regimen for players to implement if faced with further shutdowns and forced to train away from the team facility. Ultimately, the goal is to ensure the safety of all athletes and prevent injury while navigating uncertain times during the COVID-19 pandemic.

**ACKNOWLEDGMENT**

The authors thank Karen Ladnier and Jeffrey Gornbein.

**REFERENCES**

1. Baker HP, Pirkle S, Cahill M, Reddy M, Portney D, Athiviraham A. The injury rate in National Football League players increased following cancellation of preseason games because of COVID-19. Arthrosc Sport Med Rehabil. 2021;3(4):e1147–e1154. doi:10.1016/j.asmr.2021.05.002

2. Battista J, An early surge in an injury the N.F.L., wasn’t expecting. The New York Times Company. 2011.

3. Croisier JL, Ganteaume S, Binet J, Genty M, Ferret JM. Strength imbalances and prevention of hamstring injury in professional soccer players: a prospective study. Am J Sports Med. 2008;36(8):1469-1475. doi:10.1177/0363546508316764

4. Bailey EP, Goodloe JB, McNeely RA, Traven SA, Woolf SK, Slone HS. COVID-19 modifications of offseason and preseason training for NFL athletes are associated with increased risk of regular season injuries. Published online September 8, 2021. Phys Sportsmed. doi: 10.1080/09913847.2021.1976602

5. Sisley BT, Kenneth S, Barnes RP, et al. Epidemiology of National Football League training camp injuries from 1998 to 2007. Am J Sports Med. 2008;36(8):1597-1603. doi:10.1177/0363545808016021

6. Gabbett TJ. The training-injury prevention paradox: should athletes be training smarter and harder? Br J Sports Med. 2016;50(5):273-280. doi:10.1136/bjsports-2015-095788

7. Gilchrist J, Mandelbaum BR, Melancon H, et al. A randomized controlled trial to prevent noncontact anterior cruciate ligament injury in female collegiate soccer players. Am J Sports Med. 2008;36(8):1476-1483. doi:10.1177/0363546508318188

8. Hootman JM, Dick R, Agel J. Epidemiology of collegiate injuries for 15 sports: summary and recommendations for injury prevention initiatives. J Athl Train. 2007;42(2):311-319.

9. Klugman MF, Brent JL, Myer GD, Ford KR, Hewett TE. Does an in-season only neuromuscular training protocol reduce deficits quantified by the tuck jump assessment? Clin Sports Med. 2011;30(4):825-840. doi:10.1016/j.csm.2011.07.001

10. Mack CD, Kent RW, Coughlin MJ, et al. Incidence of lower extremity injury in the National Football League: 2015 to 2018. Am J Sports Med. 2020;48(9):2287-2294. doi:10.1177/0363546520925457

11. Mair SD, Seaber AV, Glisson RR, Garrett WE. The role of fatigue in susceptibility to acute muscle strain injury. Am J Sports Med. 1996;24(2):137-143. doi:10.1177/036354659602400203

12. Myer GD, Faigenbaum AD, Cherry CE, Heidt RS, Hewett TE. Did the NFL lockout expose the Achilles heel of competitive sports. J Orthop Sports Phys Ther. 2011;41(10):702-705. doi:10.2519/jospt.2011.0107

13. Myer GD, Faigenbaum AD, Chu DA, et al. Integrative training for children and adolescents: techniques and practices for reducing sports-related injuries and enhancing athletic performance. Phys Sportsmed. 2011;39(1):74-84. doi:10.3810/psm.2011.02.1864

14. Myer GD, Faigenbaum AD, Ford KR, Best TM, Bergeron MF, Hewett TE. When to initiate integrative neuromuscular training to reduce sports-related injuries and enhance health in youth? Curr Sports Med Rep. 2011;10(3):155-166. doi:10.1249/JSR.0b013e31821b1442

15. Orchard J, Marsden J, Lord S, Garlick D. Preseason hamstring muscle weakness associated with hamstring muscle injury in Australian footballers. Am J Sports Med. 1997;25(1):81-85. doi:10.1177/036354659702500116

16. Pickman B. NFL scraps 2020 preseason amid COVID-19 pandemic. Sports Illustrated. 2020. Accessed August 18, 2021. https://www.si.com/nfl/2020/07/21/nfl-preseason-2020-canceled-coronavirus

17. Platt BN, Uhr TL, Sciascia AD, Zacharias AJ, et al. Injury rates in Major League Baseball during the 2020 COVID-19 season. Orthop J Sports Med. 2021;9(3):2325967121199946.

18. Platt BN, Colofello B, Stockwell N, Jacobs CA, et al. Injury rates in the National Football League during the 2020 COVID-19 season. Published online October 6, 2021. Phys Sportsmed. doi: 10.1080/09913847.2021.1984819

19. Sugimoto D, Myer GD, Bush HM, Klugman MF, Jennifer MMM, Hewett TE. Compliance with neuromuscular training and anterior cruciate ligament injury risk reduction in female athletes: a meta-analysis. J Athl Train. 2012;47(6):714-723. doi:10.4085/1062-6050-47.6.10

20. Tyler TF, Nicholas SJ, Campbell RJ, Donellan S, McHugh MP. The effectiveness of a preseason exercise program to prevent adductor muscle strains in professional ice hockey players. Am J Sports Med. 2002;30(5):680-683.

**Supplemental Material for this article is available at**
https://journals.sagepub.com/doi/suppl/10.1177/2325967121133776#supplementarymaterials.