

# Injury Rates Remained Elevated in the Second National Football League Season After the Onset of the COVID-19 Pandemic

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**Purpose:** The purpose of this study was to compare the injury incidence of the 2018-2019 and 2020 National Football League (NFL) seasons with the 2021 season. **Methods:** Publicly released NFL weekly injury reports were queried to identify players listed as “out” or placed on injured reserve (IR) for at least 1 game in the 2018-2021 seasons. Injuries were then categorized into upper extremity, lower extremity, spine/core, and head. Incidence per 1,000 athlete exposures were calculated for each season, and proportions of injuries by position were calculated separately for the 2018-2019, 2020, and 2021 cohorts. Incidence rate ratios (IRR) were used to compare injury rates. **Results:** Overall injury incidence in the 2021 NFL season increased compared to the pre-COVID-19 seasons (2018-2019) in all anatomical zones except for the upper extremity (28.70 vs 23.09 per 1,000 exposures, IRR 1.24 [95% CI: 1.14-1.36];  $P < .001$ ). The injury rate remained elevated and further increased in 2021 compared to the 2020 season for all anatomical zones other than the spine/core [28.70 vs 21.64 per 1,000 exposures, IRR 1.33 (1.19-1.47);  $P < .001$ ]. No significant difference existed during the early season (weeks 1-4); however, injury rates after week 4 increased in 2021 compared to both the 2018-2019 and 2020 seasons. **Conclusion:** The injury incidence in the 2021 season remained elevated and increased further compared to both the 2018-2019 and 2020 seasons. Traumatic injuries resulting in missed games increased despite return to a more traditional season since the beginning of the COVID-19 pandemic. The injury rates significantly increased in mid-season to late season.

## Introduction

The SARS-CoV-2 (COVID-19) virus has had an unprecedented impact on the day-to-day lives of people around the world. Professional sports leagues specifically have had to make dramatic changes to their daily protocols to keep their operations running and players safe. The National Football League (NFL), in particular, has made regular protocol updates to combat

the ever-changing nature of the COVID-19 pandemic.<sup>1</sup> During the 2020 season, they shortened their preseason by four games and modified training camps, which has now shown to increase both upper and lower extremity injury rates of their athletes.<sup>2</sup> Previous studies have shown that decreased physical training, preparation, and endurance training result in increased injury rates,<sup>3</sup> while soft tissue injuries increase in athletes when they experience large fluctuations in soft tissue loadbearing over a short period of time, which can cause altered kinematics and decreased joint stability.<sup>4</sup> As a result, the 2020 NFL season was found to have an increased rate of injury, especially during weeks 1-4 of the season compared to the previous three seasons.<sup>2,4</sup>

For the 2021 season, several protocol amendments were made in correlation to decreased infection rates and increased vaccination status.<sup>5</sup> Concurrently, the 2021 season was the first in which the NFL expanded their regular season from a traditional 16 games to 17.<sup>6</sup> It is unknown whether the disruptions in play and training sustained during the 2020 season had long-term effects on the subsequent 2021 season. By

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**Table 1.** Injury Incidence per 1,000 Player Exposures by Anatomic Zone in the Entire Season (2018-2020 Versus 2021)

Anatomic Zone	Incidence per 1,000 Exposures in 2018-2020	Incidence per 1,000 Exposures in 2021	IRR (95% CI)	P Value
Overall	22.20	28.70	1.29 (1.19-1.40)	<.001
Lower extremity	14.43	18.84	1.31 (1.18-1.44)	<.001
Spine/Core	1.63	2.47	1.51 (1.14-2.02)	.004
Upper extremity	3.06	3.83	1.25 (1.00-1.56)	.048
Head	1.94	3.07	1.58 (1.22-2.04)	<.001

IRR, incidence rate ratio.

analyzing the 2018-2019 seasons, an average baseline of injuries can be established to later be compared to the 2020 COVID season and the 2021 post-COVID season. The reason for these comparisons is due to the belief that restricting athletes to proper training raises concern for their ability to maintain essential physical attributes, such as strength, acceleration, change of direction, tackling ability, and decision-making abilities, which can impair performance and promote injury risk.<sup>7</sup> It is important to assess whether the disruption in play during COVID resulted in lasting effects.

The purpose of this study was to compare the injury incidence of the 2018-2019 and 2020 National Football League seasons with the 2021 season. We hypothesized that injury rates in the 2021 season would return to pre-COVID-19 pandemic (2018-2019) levels, affecting all body regions equally, representing an increased acute to chronic work ratio (ACWR) that has previously been shown to be predictive of injury in athletes.<sup>8,9</sup>

## Methods

### Data Collection

Injuries in the 2021 season were collected with utilization of multiple resources, as previously described.<sup>3</sup> Injury listings for each of the 18 weeks of the 2021 NFL season, as well as the playoffs, were extracted from both [fftoday.com](http://fftoday.com)<sup>10</sup> and [nfl.com](http://nfl.com).<sup>11</sup> Data from NFL

injury reports for 17 weeks of the regular season and 4 weeks of the playoffs from 2018 to 2020 were extracted from [fftoday.com](http://fftoday.com),<sup>10</sup> as previously used by Platt et al.<sup>3</sup> This database compiles and formats injury reports that are released publicly by the NFL, which has itself been used in NFL epidemiological studies.<sup>3,12-15</sup>

Data from these resources were extracted to an Excel spreadsheet, including position, player, team, and injury severity. The most serious injury grades in the injury reports, those players listed as “out” for that week’s game and those players placed on the injured reserve (IR) were collected for analysis. Of note, in 2020 and 2021, those placed on the injured reserve were allowed to return after missing 3 games, whereas those in previous seasons were to sit out the remainder of the season.<sup>16</sup> If one injury resulted in multiple games missed for a single player, this was only tabulated as a single injury. If a player reported multiple injuries accounting for one game missed, this was counted as multiple injuries. Injuries were sorted by position and body area injured. Body areas were subdivided into lower extremity, upper extremity, spine and core, and head.

### Statistical Analysis

Injury incidence was calculated per 1,000 player exposures using a similar methodology used by Platt et al. to analyze injury incidence in the National Football League in 2021 compared to prior seasons.<sup>3</sup> One player exposure was defined as one game per athlete. Therefore, for the pre-COVID-19 cohort (2018 through 2019 seasons), total exposures were calculated using a 16-game season, 46-man active roster, and 32 teams in the NFL with individual playoff weeks consisting of 12 teams, 8 teams, 4 teams, and 2 teams. In 2020, exposures were calculated using the expanded 48-man active roster, expanded for the COVID-19 season. In 2021, an additional game was added for each team, leading to a total calculation of 87,132 in 2018-2020 and 28,710 player exposures in the 2021 season. Incidence rate for the 2018-2020 cohort was calculated using the cumulative number of injuries and exposures for 3 years. Incidence rate ratio (IRR) was calculated by dividing incidence in the 2021 group by the incidence in the 2018-2020 cohort for overall injury rates and injury rates for each anatomic zone. Significant differences were determined using the z-test for proportions.

**Table 2.** Comparison of Proportion of All Injuries by Position in the Entire Season (2018-2020 Versus 2021)

Position	2018-2020		2021		Difference (%)
	Players Out	Percentage (%)	Players Out	Percentage (%)	
DB	443	23.59	174	22.05	-1.54
DL	244	12.85	106	13.43	0.59
K/P	22	1.16	5	0.63	-0.52
LB	207	10.90	115	14.58	3.67
OL	344	18.11	146	18.23	0.11
QB	43	2.26	20	2.53	0.27
RB/FB	186	9.79	83	10.52	0.73
TE	138	7.27	48	6.08	-1.18
WR	267	14.06	104	13.18	-0.88
Total	1,899	100.00	801	100.00	

DB, defensive back; DL, defensive lineman; K/P, kicker/punter; LB, linebacker; OL, offensive lineman; QB, quarterback; RB/FB, running back/fullback; TE, tight end; WR, wide receiver.

**Table 3.** Injury Incidence per 1,000 Player Exposures by Anatomic Zone in the Entire Season (2018-2019 Versus 2021)

Anatomic Zone	Incidence per 1,000 Exposures in 2018-2019	Incidence per 1,000 Exposures in 2021	IRR (95% CI)	P Value
Overall	23.09	28.70	1.24 (1.14-1.36)	<b>&lt;.001</b>
Lower extremity	15.31	18.84	1.23 (1.11-1.37)	<b>&lt;.001</b>
Spine/Core	1.60	2.47	1.55 (1.14-2.11)	<b>.005</b>
Upper extremity	3.30	3.83	1.16 (0.92-1.47)	.208
Head	1.95	3.07	1.57 (1.19-2.08)	<b>.001</b>

IRR, incidence rate ratio.

We also analyzed injury incidence over the first four weeks of the season and the remainder of the season separately. This was done to analyze how the “early season” may have differed between the 2018-2020 and the 2021 season after having a year of disruption from COVID-19. We chose 4 weeks as the cutoff for early season, as this is commonly the referenced cutoff for acute versus chronic workload.<sup>17,18</sup>

Finally, the proportion of injuries occurring in each position was analyzed. Fisher’s exact test was used to determine significant overall differences between groups in injury distribution by position. Because of the nominal nature of the data, no normality assumption was required. Post hoc testing was done using z-test for proportions, as appropriate. P values were adjusted for the number of comparisons within each table using Bonferroni correction. R software version 4.0.2 (R Foundation for Statistical Computing, Vienna, Austria) was used for data analysis. Statistical significance was set at  $P \leq .05$ .

## Results

From 2018 to 2020, there were 1,934 individual injuries leading to an out or IR listing for at least 1 week, with an incidence of 22.20 injuries per 1,000 player exposures. In 2021, there were 824 such injuries, leading to an incidence of 28.70 per 1,000 player exposures in 2021 for an IRR of 1.29 (95% CI: 1.19-1.29,  $P < .001$ ). The incidence of lower extremity, spine/core,

**Table 4.** Injury Incidence per 1,000 Player Exposures by Anatomic Zone in Weeks 5 and Beyond of the Season (2018-2019 Versus 2021)

Anatomic Zone	Incidence per 1,000 Exposures in 2018-2019	Incidence per 1,000 Exposures in 2021	IRR (95% CI)	P Value
Overall	22.10	28.92	1.31 (1.19-1.44)	<b>&lt;.001</b>
Lower extremity	14.49	18.75	1.29 (1.14-1.46)	<b>&lt;.001</b>
Spine/Core	1.65	2.72	1.65 (1.17-2.31)	<b>.004</b>
Upper extremity	3.11	3.90	1.25 (0.96-1.64)	.097
Head	2.04	3.20	1.57 (1.15-2.14)	<b>.004</b>

IRR, incidence rate ratio.

**Table 5.** Injury Incidence per 1,000 Player Exposures by Anatomic Zone in the Entire Season (2020 Versus 2021)

Anatomic Zone	Incidence per 1,000 Exposures in 2020	Incidence per 1,000 Exposures in 2021	IRR (95% CI)	P Value
Overall	21.64	28.70	1.33 (1.19-1.47)	<b>&lt;.001</b>
Lower extremity	13.47	18.84	1.40 (1.23-1.59)	<b>&lt;.001</b>
Spine/Core	1.79	2.47	1.38 (0.96-1.98)	.077
Upper extremity	2.77	3.83	1.38 (1.04-1.85)	<b>.027</b>
Head	2.03	3.07	1.51 (1.08-2.10)	<b>.015</b>

IRR, incidence rate ratio.

upper extremity, and head injuries significantly increased in 2021 over the course of the whole season (Table 1). Fisher’s exact test showed that there were no significant differences in the distribution of injuries by position in 2021 versus prior seasons (Table 2).

When comparing the 2018-2019 NFL seasons with the 2021 season, overall injury incidence increased in all anatomical zones other than the upper extremity (28.70 vs 23.09 per 1,000 exposures, IRR 1.24 [95% CI: 1.14-1.36];  $P < .001$ ) (Table 3). On subanalysis, we observed that it was after week 5 that significant differences in injury rates were seen between the 2018-2019 and 2021 seasons (Table 4), as there was no significant difference during weeks 1-4.

Similarly, when comparing the 2020 and 2021 seasons, overall injury incidence was increased for all anatomical zones other than the spine/core (28.70 vs 21.64; IRR: 1.50 [1.19-1.47];  $P < .001$ ) (Table 5). It was from week 5 and beyond that injury rates increased (Table 6), as there was no significant difference during weeks 1-4.

## Discussion

The present study found that the overall out and IR designations were significantly increased in the 2021 season compared to either the 2018-2019 or the 2020 seasons; however, there was no difference in the distribution of injuries. This finding affected all players proportionally, as no specific position was affected more than another. Injury rates remained elevated in 2021, despite it being the second season since the onset of the COVID-19 pandemic.

Baker et al. analyzed the 2020 NFL season in regard to injury rates and found that weeks 1-4 had a statistically increased rate of injury compared to the same timeframe from the 2016 to 2019 seasons.<sup>2</sup> Likewise, Omari et al. found that Achilles tendon and hamstring tendon injuries rose in the 2020 season compared to the 2017-2019 seasons.<sup>19</sup> Our study builds upon these, reporting how being 1 year removed from the start of the COVID-19 pandemic affected NFL play. Surprisingly, it was after week 4 when players were getting injured more

**Table 6.** Injury Incidence per 1,000 Player Exposures by Anatomic Zone in Weeks 5 and Beyond of the Season (2020 Versus 2021)

Anatomic Zone	Incidence per 1,000 Exposures in 2020	Incidence per 1,000 Exposures in 2021	IRR (95% CI)	P Value
Overall	19.25	28.92	1.50 (1.33-1.69)	<b>&lt;.001</b>
Lower extremity	11.35	18.75	1.65 (1.42-1.92)	<b>&lt;.001</b>
Spine/Core	1.75	2.72	1.55 (1.05-2.30)	<b>.028</b>
Upper extremity	2.39	3.90	1.63 (1.17-2.28)	<b>.004</b>
Head	2.13	3.20	1.50 (1.05-2.15)	<b>.026</b>

IRR, incidence rate ratio.

frequently instead of the expected weeks 1-4, as seen in the past.<sup>2</sup> This is in contrast to what we expected based on the greater acute to chronic work ratio (ACWR). ACWR has been studied in multiple sports, including football,<sup>8,9</sup> and takes into account the current training load (acute) and the training load that an athlete has been prepared for (chronic).<sup>20</sup> However, our findings showcase the opposite, with week 5 and beyond reporting an increase in injury rate compared to weeks 1-4. We hypothesize that this could be due to various reasons, one being that with a decreased workload in the 2020 season, players came into the 2021 season rehabilitated from injuries sustained the season prior. Then, as the weeks progressed, and workload increased, their bodies were not adapted to undertake the increased physicality of a football game, regardless of practice.<sup>21</sup> The 2021 season was also the first with an 18-week regular season instead of 17, which increases player exposure risk. Similarly, the multiple disruptions seen in the 2020 season could have had lasting effects into the 2021 season. With players not participating in training activities as in the past, as well as social distancing, this culmination of events could have led to the rise in injury incidence seen. More research is needed to determine the extent this may have raised injury risk, which would allow trainers to be better prepared in the event more stoppages of play occur in the future.

Changes in workload, stress, and mood from the COVID-19 pandemic can impact a player's injury risk and recovery.<sup>22-24</sup> Baker et al. proposes that the NFL considers implementing self-reported questionnaires to monitor an athlete's level of exhaustion in response to training, mood, and stress. They propose that the benefits of monitoring the well-being of athletes can aid in recovery to prevent injury, guide appropriate training regimens, and monitor fatigue.<sup>2</sup> Patient-Reported Outcomes Measurement Information System (PROMIS) can be utilized, as their ability to exist in a computer-adaptive testing environment results in ease of access.<sup>25</sup> PROMIS has already been incorporated into orthopaedic practice and care,<sup>26</sup> and may benefit NFL athletes by assessing not only their physical function levels, but also pain, mood, and

fatigue status to give trainers an overarching picture of their player's health to assist in decreasing injury risk and improving recovery.<sup>27,28</sup>

### Limitations

This study was not without limitations. Publicly available, online sources were used to gather data, which can limit the extent of detail for each individual injury. Furthermore, only injuries that caused a missed game were accounted for. On-field injuries, in which a player returned to play in the same game, was uncounted for. As a result, this study can potentially be underestimating the true incidence rate of total injuries, even if they are less severe. Without access to medical records, injuries were classified into anatomical areas where they best fit. Finally, with the heterogeneity of NFL seasons, it is difficult to objectively control for every confounding variable that can influence injury rates.

### Conclusion

The injury incidence in the 2021 season remained elevated and increased further compared to both the 2018-2019 and 2020 seasons. Traumatic injuries resulting in missed games increased despite return to a more traditional season since the beginning of the COVID-19 pandemic. The injury rates significantly increased in mid-season to late season.

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