


## CLINICAL INQUIRIES

Evidence-based answers from the  
Family Physicians Inquiries Network 

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doi: 10.12788/fjp.0142

# Q/ Is the incidence of depressive disorders increased following cerebral concussion?

## EVIDENCE-BASED ANSWER

**A** YES, IN SOME POPULATIONS. Youth and adolescents with self-reported history of concussion had increased risk of depressive disorders (strength of recommendation [SOR]: **B**, based on a prospective cohort study and a retrospective cohort study). Evidence was inconsistent for college athletes. Athletes with  $\geq 3$  concussions exhibited more depressive disorders, but no association was observed for those with 1 or 2 concussions compared to nonconcussion injuries (SOR: **B**, based on a cross-sectional study, a small prospective cohort study, and a case-control study).

In semiprofessional and professional athletes, evidence was variable and may be

sport related. Retired rugby players with a history of concussion showed no increase in depression compared to controls with no concussion history (SOR: **B**, based on a case-control study). Retired football players with previous concussions displayed increased incidence of depression, especially after  $\geq 3$  concussions (SOR: **B**, based on a prospective cohort study and a small case-control study).

There is a significant risk of bias in these studies because of their reliance on self-reported concussions, differing definitions of depression, and possible unmeasured confounders in the study designs, making a causative relationship between concussion and depression unclear.

## Evidence summary

## Higher odds of depression in youth and adolescents with concussion

A 2019 prospective cohort study used data from the 2017 Nevada Youth Risk Behavior Surveillance Survey (YRBSS) to evaluate the relationship between concussion and depression in high school students.<sup>1</sup> Included students were physically active for at least 60 minutes on 5 or more days per week or played on at least 1 sports team ( $N = 3427$ ; 9th-12th grade students from 98 schools). When compared to the total population of included students and controlled for covariates, those who self-reported a concussion within the past 12 months ( $N = 664$ ) had a higher adjusted odds ratio (aOR) of depressive symptoms (aOR = 1.5; 95% confidence interval [CI], 1.1-1.9). Depressive symptoms

were reported in 38.1% of patients with a history of concussion, compared to 29.2% of patients who did not report a concussion in the past 12 months.

A 2014 retrospective cohort study examined data from the 2007-2008 National Survey of Children's Health and evaluated the association between previous concussion and current depression diagnosis in youth ages 12 to 17 years without a current concussion ( $N = 36,060$ ).<sup>2</sup> Parents were contacted by random-digit dialing, prompted with a description of depression, and asked if their child currently had a clinical diagnosis of depression and whether a concussion had ever been diagnosed. A prior diagnosis of concussion was associated with greater risk for current depression compared to youth with no concussion history (aOR = 3.3; 95% CI, 2-5.5).

Current depression was reported in 10.1% of patients with a history of concussion compared to 3.4% of patients with no history of concussion.

### Findings vary among college athletes

A 2015 case-control study examined the prevalence of depressive symptoms in college athletes diagnosed with concussion compared to an athletic control group.<sup>3</sup> The intervention group (N = 84; 77% male; average age, 18.4 years) received a concussion diagnosis from the team physician or certified athletic trainer. The athletic control group (N = 42; 55% male; average age, 18.9 years) reported no concussions in the past year.

The Beck Depression Inventory–Fast Screen (BDI-FS) was administered to the concussion group at baseline and postconcussion, and to the control group at 2 time points, with an average interval of 6.8 weeks. A score of  $\geq 4$  on the BDI-FS (scoring range, 0-21; higher score suggestive of more severe depression) indicated athletes at risk for depression. Concussed athletes exhibited a statistically significant increase in depression symptoms compared to control participants (20% vs 5%;  $\chi^2_1 = 5.2$ ;  $P = .02$ ).

A 2018 cross-sectional study examined the association between concussion and adverse health outcomes in former college football players who played at least 1 year in college (1999-2001) but had no professional football experience.<sup>4</sup> The cohort (N = 204; average age, 35) self-reported (15 years after their college career ended) the number of concussions sustained during high school and college sports performance. Reports were then stratified into 3 categories: no concussions, 1 or 2 concussions, and  $\geq 3$  concussions. The Patient Health Questionnaire (PHQ-9) was used to screen for depression, with scores categorized to no or mild depression ( $< 10$ ) and moderate-to-severe depression ( $\geq 10$ ).

Controlling for body mass index, athletes reporting  $\geq 3$  concussions had a higher prevalence of depression compared to those reporting no concussions (prevalence ratio [PR] = 4.2; 95% CI, 1.0-16.3) or 1 to 2 concussions (PR = 2.8; 95% CI, 1.3-6.0). No statistically significant association between concussion

and depression was observed with athletes reporting 1 to 2 concussions compared to 0 concussions.


A 2015 prospective longitudinal cohort study examined postinjury depressive symptoms in 3 groups of Division 1 male and female college student athletes (N = 21; ages 18-22).<sup>5</sup> Physician-diagnosed concussed (N = 7) and injured but nonconcussed (N = 7) athletes completed the Center for Epidemiological Studies Depression Scale (CES-D) at baseline and at 1 week, 1 month, and 3 months postinjury. Sport-matched healthy athletes (N = 7) completed it only at baseline. A CES-D score of  $\geq 16$  (range, 0-60) indicated a risk for clinical depression. Participants with a history of depression or other injury resulting in  $\geq 1$  day of time lost within the past 3 months were excluded.

While both groups showed a significant increase from baseline CES-D scores, there were no significant differences in depressive symptoms between concussed (mean CES-D score  $\pm$  standard deviation [SD]: baseline,  $6.7 \pm 3.9$ ; 1 week,  $11 \pm 5.3$ ; 1 month,  $8.3 \pm 5$ ; 3 months,  $6.4 \pm 5.4$ ) and injured but nonconcussed participants (mean CES-D score  $\pm$  SD: baseline,  $5.7 \pm 2.8$ ; 1 week,  $9.1 \pm 4$ ; 1 month,  $8.9 \pm 4.6$ ; 3 months,  $6.9 \pm 2.8$ ) at any of the postinjury time points.

### Findings among semipro and pro athletes appear to vary by sport

A 2016 prospective cohort study assessed the impact of concussive events on incidence of depression in active semiprofessional and professional football players who had previously sustained  $\geq 1$  concussions.<sup>6</sup> Participants (N = 27) answered an anonymous online survey that included the revised version of the CES-D (CESD-R) to determine level of depression (a score of  $\geq 16$  defined clinical depression). Players with a CESD-R score  $\geq 16$  (N = 16) sustained a significantly greater average number of concussions compared to those who scored  $< 16$  (N = 11; 3.8 vs. 1.6,  $P = .0004$ ). Players who sustained  $\geq 3$  concussions scored significantly higher on the CESD-R than players with  $\leq 2$  concussions (average score, 24 vs 15.6;  $P = .03$ ).

A 2017 case-control study examined the long-term health outcomes of retired Scot-

 **The exact relationship—degree and context—between concussion and depression remains vague.**

tish male rugby players (N = 52; mean age, 54 years) with a history of mild concussion compared to males of similar age with no previous history of concussion (N = 29; mean age, 55).<sup>7</sup> The Hospital Anxiety and Depression Scale (HADS) was used to assess depression on a 21-point scale (normal = 0-7; borderline, 8-10; abnormal, 11-21). There was no significant difference observed in mean HADS scores between the rugby players and controls, respectively ( $2.8 \pm 2.1$  vs  $2.6 \pm 2.8$ ;  $P = .941$ ).

A 2013 case-control study of 30 retired NFL players with 29 controls matched for age, estimated IQ, and education examined the relationship between a remote history of concussion and current symptoms of depression.<sup>8</sup> Concussion history was self-reported by the retired players. Controls with a history of concussion were excluded from the study. The Beck Depression Inventory-II (BDI-II) was used to measure depression symptoms, with a score of 1 to 9 designating minimal depression and  $\geq 10$  mild-to-moderate depression. Retired players scored significantly higher on the BDI-II compared to the controls ( $8.8$  vs  $2.8$ ;  $P = .001$ ).

## Editor's takeaway

Concussions include cognitive compromise. An astute clinician's concern for depression

as a sequela makes sense. This evidence contributes to that conjecture. However, the authors of this Clinical Inquiry correctly outline the limitations, inconsistencies, and biases of the evidence. The exact relationship—degree and context—between concussion and depression remains vague. **JFP**

## References

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