

# Correlations between Symptoms of Post-Concussion Syndrome and Anxiety & Depression in Athletes

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## Introduction

An estimated 1.6 to 3.8 million sports-related concussions occur in the United States annually.<sup>1</sup> When concussion symptoms persist 3 months beyond traumatic head injury, this is defined as post-concussion syndrome (PCS).<sup>2,3</sup> Reported prevalence of PCS varies greatly from study to study (between 5 and 80% of concussed patients) due to differences in diagnostic criteria.<sup>3</sup>

Symptoms of PCS range from headache to psychiatric symptoms, most commonly depression and anxiety after TBI.<sup>4,5</sup> Research suggests that independent predictors of post-concussion depression in the general population include female gender, nonwhite ethnicity, previous psychiatric history, alcohol intoxication at the time of TBI, and non-return to work.<sup>4</sup> In addition, post-concussion anxiety, irritability, frustration, confusion, feeling more emotional, and feeling slowed down were significantly associated with the development of post-concussion depression.

Athletes with previous concussions have higher levels of depression than athletes who have not been concussed. Studies suggest that concussed athletes have depression scores elevated beyond their baseline for at least two weeks after concussion.<sup>6,7</sup>

PCS Symptom Prevalence in Patient Sample

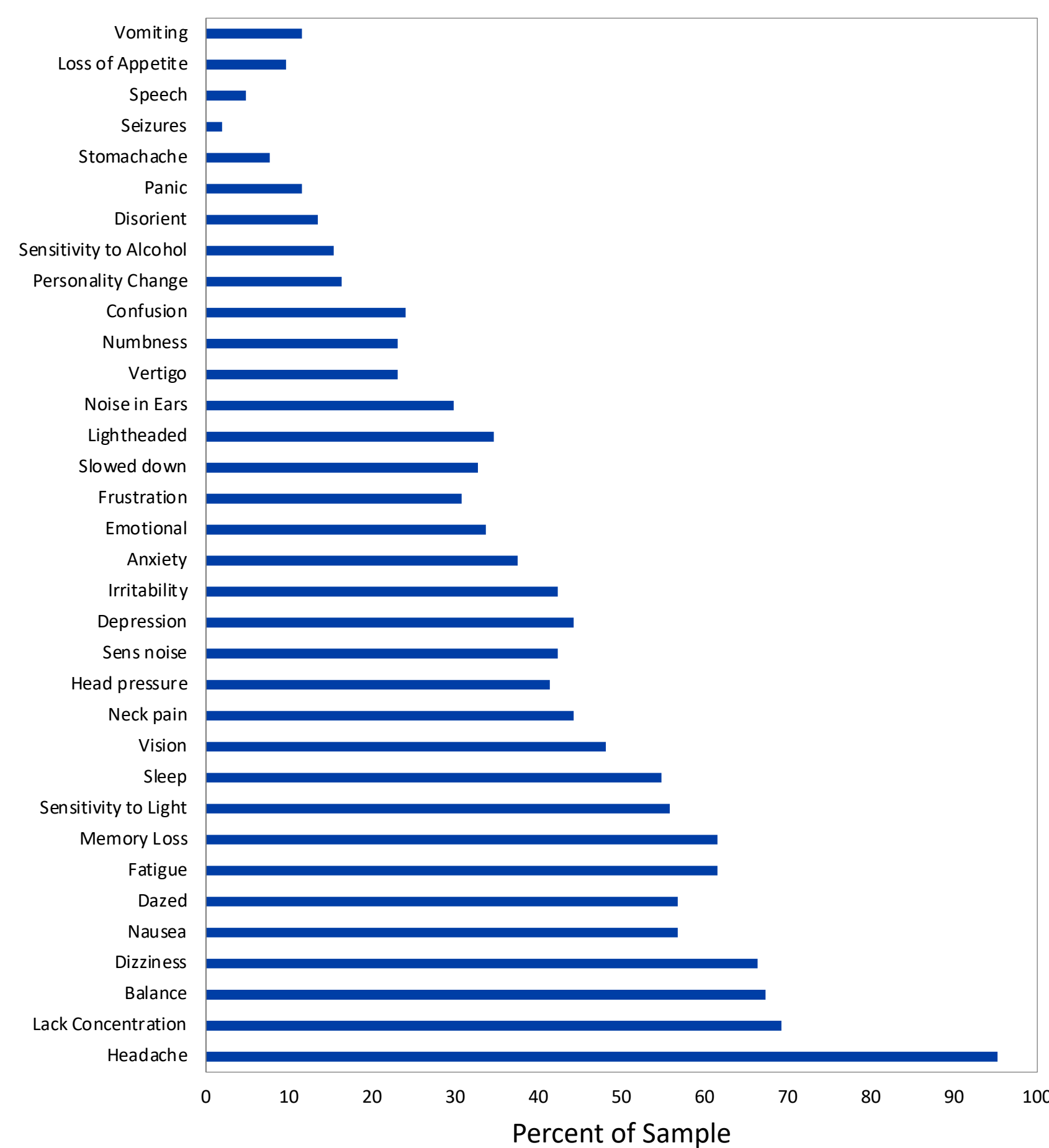


Figure 1. Adapted from: Tator et al.<sup>5</sup> An example of the distribution of PCS symptoms in a population of 221 patients; depression was reported in 44.2% of patients and anxiety was reported in 37.5% of patients.

## Aims and Objectives

For athletes with concussions, multiple studies have shown that the best predictor for depression at any point after concussion was baseline depression.<sup>8,9</sup> The primary goal of this project was to determine which PCS symptoms correlate with reported depression and anxiety in adult athletes at 3 months or greater after injury.

### Specific Aims

The objective is to improve the detection of athletes who suffer from persistent depression and anxiety as a consequence of traumatic brain injury. The following aims guided this investigation.

1. Identify symptoms of post-concussion syndrome that correlate with post-concussion depression or sadness at  $\geq 3$  months after injury in adult athletes with and without a prior psychiatric diagnosis.
2. Identify symptoms of post-concussion syndrome that correlate with post-concussion anxiety at  $\geq 3$  months after injury in adult athletes with and without a prior psychiatric diagnosis.

## Methods

A scoping review was performed using PubMed to identify studies that reported the frequency of symptoms in sport-related PCS. Monte Carlo simulations of the reported data were used to simulate the symptom combinations of individual patients, which were then used to calculate odds ratios between PCS symptoms or patient demographics and depression/sadness or anxiety.

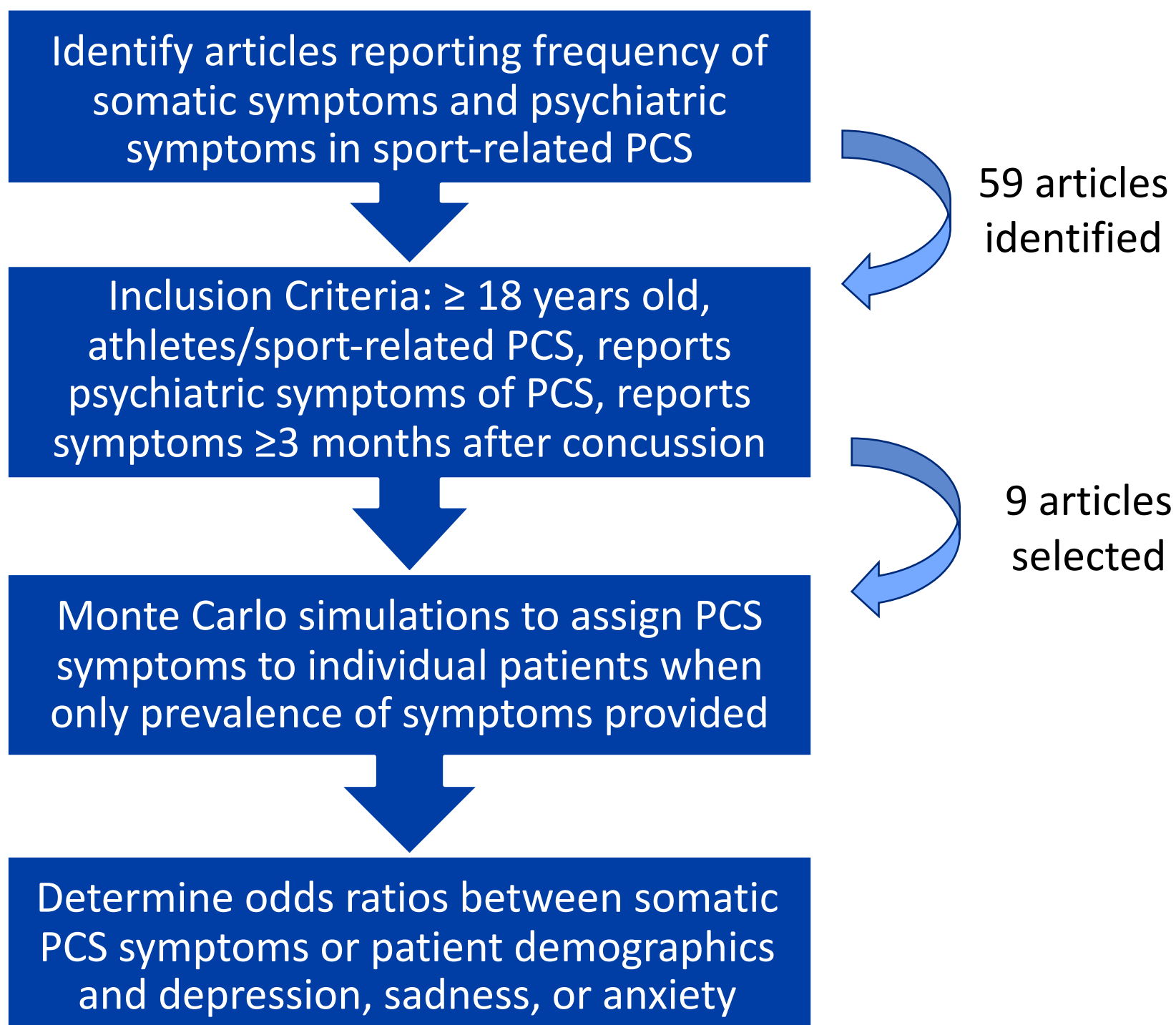


Figure 2. Map of methodology for the scoping review and statistical analysis of data identified for PCS in adult athletes.

## Results

For the patients from the selected articles, athletes who reported restlessness at  $\geq 3$  months after a concussion had significantly higher odds that they would also report depression/sadness or anxiety. Conversely, if they reported the other somatic symptoms shown below at  $\geq 3$  months after a concussion, there were significantly lower odds that they would also report depression or sadness (aside from double vision, seizures, or sleep disturbance) or report anxiety (aside from double vision or seizures). Women had lower odds of reporting anxiety, but not depression, at  $\geq 3$  months after a concussion than men.

In this study, there was no significant difference in the odds that a patient would report depression, sadness, or anxiety  $\geq 3$  months after concussion when comparing those with or without a history of psychiatric diagnosis.

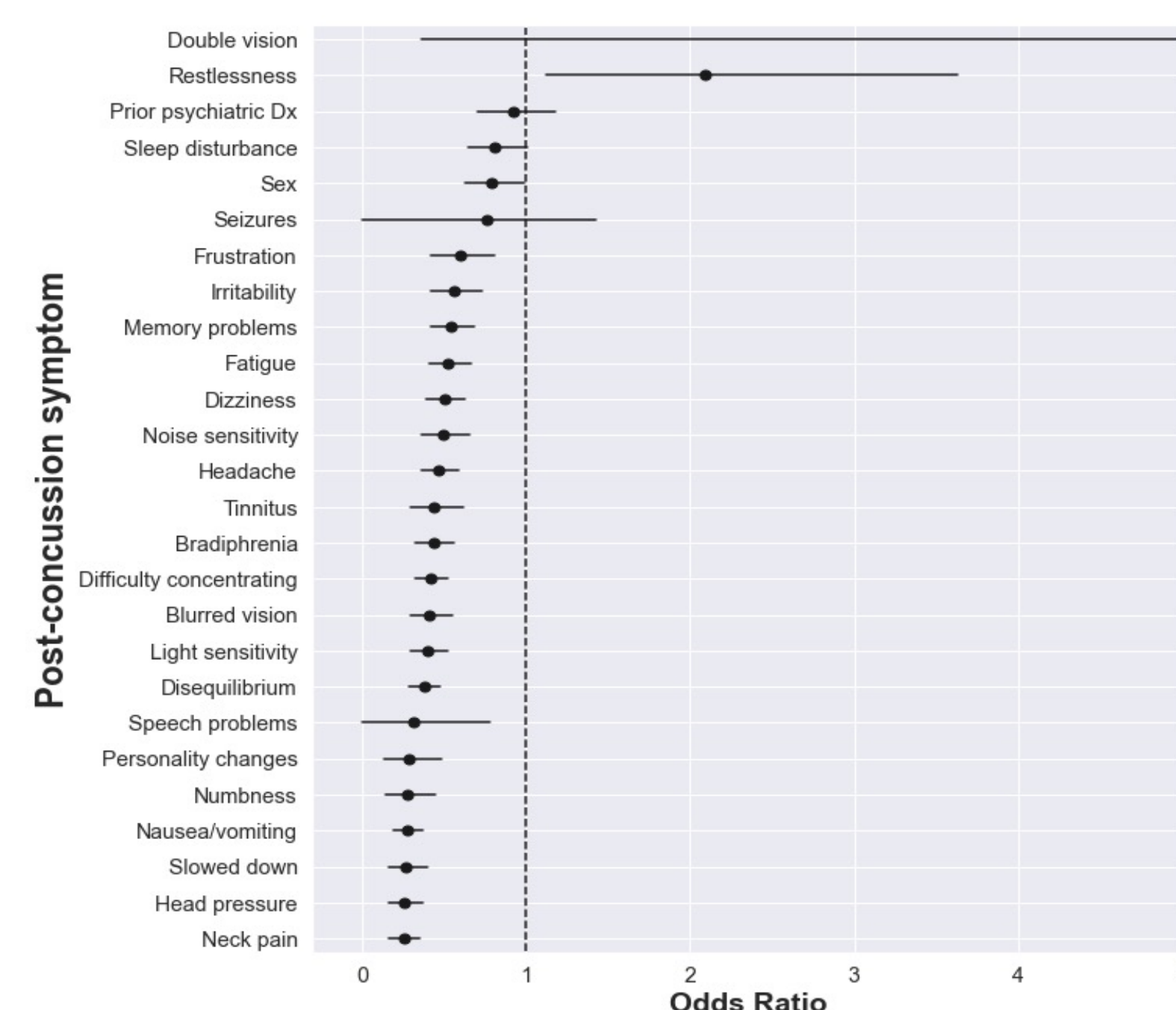


Figure 3a. Reported symptoms or demographics and odds ratios for reporting depression or sadness at  $\geq 3$  months after injury.

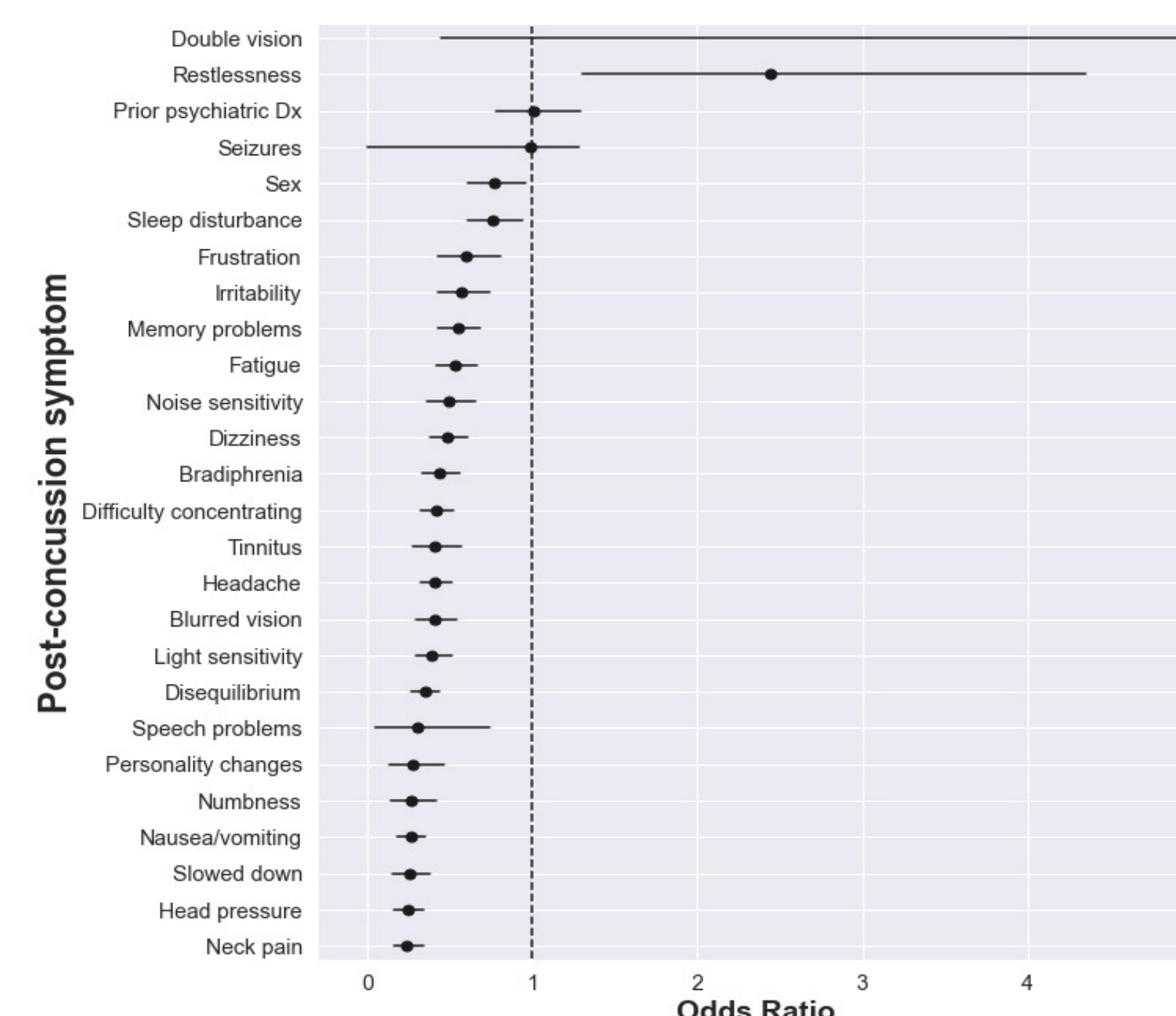


Figure 3b. Reported symptoms or demographics and odds ratios for reporting anxiety at  $\geq 3$  months after injury.

## Conclusions

In adult athletes still suffering from concussion symptoms at 3 or more months after injury, the presence of restlessness conferred increased odds of also reporting depression (or sadness) and anxiety. The majority of other symptoms reported were actually associated with lower odds of reporting depression/sadness or anxiety, and women had lower odds of reporting anxiety than men. Interestingly, this analysis did not show any significant relationship between prior psychiatric diagnosis and reporting depression, sadness, or apathy at 3 or more months after a concussion.

As a scoping review, these analyses are limited in that they do not represent all available data as a systematic review would. However, the results are a starting point for identifying relationships between PCS symptoms, patient demographics, and depression or anxiety in athletes.

These results may help healthcare professionals more effectively screen for anxiety and depression in adult athletes with PCS so that necessary support can be provided earlier to improve the lives of these athletes.

## References

1. Daneshvar DH, Nowinski CJ, Mckee AC, Cantu RC. The Epidemiology of Sport-Related Concussion. *Clin Sports Med.* 2011;30(1):1-17. doi:10.1016/j.csm.2010.08.006
2. *Diagnostic and Statistical Manual of Mental Disorders - Fifth Edition.*; 2013.
3. Randolph W Evans. Postconcussion syndrome - UpToDate. *UpToDate.* 2019.
4. Singh R, Mason S, Lecky F, Dawson J. Prevalence of depression after TBI in a prospective cohort: The SHEFBIT study. *Brain Inj.* 2018;32(1):84-90. doi:10.1080/02699052.2017.1376756
5. Tator CH, Davis HS, Dufort PA, et al. Postconcussion syndrome: demographics and predictors in 221 patients in: *Journal of Neurosurgery* Volume 125 Issue 5 (2016). *J Neurosurg.* 2016;(125):1206-1216. <https://thejns.org/view/journals/j-neurosurg/125/5/article-p1206.xml>. Accessed November 9, 2019.
6. Rice SM, Parker AG, Rosenbaum S, Bailey A, Mawren D, Purcell R. Sport-Related Concussion and Mental Health Outcomes in Elite Athletes: A Systematic Review. *Sport Med.* 2018;48(2):447-465. doi:10.1007/s40279-017-0810-3
7. Kontos AP, Deitrick JM, Reynolds E. Mental health implications and consequences following sport-related concussion. *Br J Sports Med.* 2015;50(3):139-140. doi:10.1136/bjsports-2015-095564
8. Vargas G, Rabinowitz A, Meyer J, Arnett PA. Predictors and prevalence of postconcussion depression symptoms in collegiate athletes. *J Athl Train.* 2015;50(3):250-255. doi:10.4085/1062-6050-50.3.02
9. Yang J, Peek-Asa C, Covassin T, Torner JC. Developmental Neuropsychology Post-Concussion Symptoms of Depression and Anxiety in Division I Collegiate Athletes. *Dev Neuropsychol.* 2015;40(1):18-23. doi:10.1080/87565641.2014.973499

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