**Participants**

A total of 382 participants ages 18-39 and enrolled in Psychology Courses at a Southeastern U.S. university consented to participate. Participants were excluded if they reported a history of a neurological or neurodevelopmental condition (e.g., epilepsy, stroke, meningitis, autism, brain surgery) (*n*=15), a history of a moderate or severe traumatic brain injury (*n*=7), a concussion within 3 months of initiating participation in the study (*n*=8), or an ambiguous mechanism of concussion (i.e., blood drive) (*n*=1). This resulted in final sample of 351 participants, including 90 participants with self-reported concussion history and 261 participants with no reported lifetime concussions. The demographics of the full sample are presented in Table 1.

**Materials**

Participants completed a demographics form that asked about and a concussion history form that asked…

Participants also completed the Post-Concussion Symptom Scale (PCSS)…

**Procedures**

Participants enrolled in the study via Sona Systems® participant pool management software. The study was advertised to students enrolled in undergraduate psychology courses, who (i.e., Intro to Psychology, Experimental Psychology, and Statistics in Psychology) who completed study participation for course credit. All data collection occurred through the Research Electronic Data Capture (REDCap) system (Harris et al., 2009, 2019). Participants were emailed a survey link to REDCap three times daily at 10:00am, 3pm, and 8pm for 30 days, and were prompted if they did not provide a response after one hour. The average number of participant responses was *M*=65 (*SD*=31), with a range from 1 to 91.

**Statistical Analysis**

The longitudinal PCSS data was analyzed using within-person network analysis…

**Results**

Table 1. Demographic characteristics

|  |  |  |  |
| --- | --- | --- | --- |
|  | Total Sample  (*N*=351) | Control  (*n*=261) | Concussion  (*n*=90) |
| Age, *M* (*SD*), range | 18.9 (1.5), 18-35 | 18.9 (1.3), 18-32 | 18.9 (1.9), 18-35 |
| Sex, *n* (*%*) |  |  |  |
| Male | 54 (15.4) | 40 (15.3) | 14 (15.6) |
| Female | 297 (84.6) | 221 (84.7) | 76 (84.4) |
| Gender identity, *n* (*%*) |  |  |  |
| Cisgender Man | 54 (15.4) | 40 (15.3) | 14 (15.6) |
| Cisgender Woman | 292 (83.2) | 218 (83.5) | 74 (82.2) |
| Transgender Man | 1 (0.3) | 0 (0) | 1 (1.1) |
| Nonbinary | 4 (1.1) | 3 (1.1) | 1 (1.1) |
| Race/Ethnicity, *n* (*%*) |  |  |  |
| White | 270 (76.9) | 195 (74.7) | 75 (83.3) |
| Black | 36 (10.3) | 31 (11.9) | 5 (5.6) |
| Asian | 9 (2.6) | 9 (3.4) | 0 (0) |
| Hispanic | 10 (2.8) | 9 (3.4) | 1 (1.1) |
| Multiracial | 26 (7.4) | 17 (6.5) | 9 (10.0) |
| Concussion count, *M*(*SD*), *Mdn*(range) | – | – | 1.8 (1.3), 1 (1-8) |
| Time since last concussion | – | – | – |
| 3-5 months | – | – | 6 (6.7) |
| 6-12 months | – | – | 19 (21.1) |
| >1 year | – | – | 65 (72.2) |
| LOC, *n* (*%*) | – | – | 31 (34.4) |
| LOC count, *M*(*SD*), *Mdn*(range) | – | – | 1.3 (0.6), 1 (0-3) |
| PTA, *n* (*%*) | – | – | 28 (31.1) |
| PTA count, *M*(*SD*), *Mdn*(range) | – | – | 1.1 (0.6), 1 (0-3) |
| Age at first injury, *M*(*SD*), range | – | – | 13.4 (3.7), 14 (4-19) |
| Mechanism of injury | – | – | – |
| Sport | – | – | 64 (71.1) |
| Motor vehicle accident | – | – | 4 (4.4) |
| Assault | – | – | 1 (1.1) |
| Fall | – | – | 7 (7.8) |
| Multiple mechanisms | – | – | 9 (10.0) |
| Other | – | – | 5 (5.6) |

Table 2. Frequencies of most central symptoms

|  |  |  |  |
| --- | --- | --- | --- |
|  | Total Sample  (*N*=351) | Control  (*n*=261) | Concussion  (*n*=90) |
| Symptoms | Most central, *n* (*%*) | Most central, *n* (*%*) | Most central, *n* (*%*) |
| Headache |  |  |  |
| Nausea |  |  |  |
| Vomiting |  |  |  |
| Balance Problems |  |  |  |
| Dizziness |  |  |  |
| Fatigue |  |  |  |
| Trouble Falling Asleep |  |  |  |
| Sleeping More Than Usual |  |  |  |
| Sleeping Less Than Usual |  |  |  |
| Drowsiness |  |  |  |
| Sensitivity to Light |  |  |  |
| Sensitivity to Noise |  |  |  |
| Irritability |  |  |  |
| Sadness |  |  |  |
| Nervousness |  |  |  |
| Feeling More Emotional |  |  |  |
| Numbness or Tingling |  |  |  |
| Feeling Slowed Down |  |  |  |
| Feeling Mentally “Foggy” |  |  |  |
| Difficulty Concentrating |  |  |  |
| Difficulty Remembering |  |  |  |
| Visual Problems |  |  |  |

Table 3. Overall centrality of symptoms

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Total Sample  (*N*=351) | Control  (*n*=261) | Concussion  (*n*=90) | Group Comparison |
| Symptom | EI [95% CrI] | EI [95% CrI] | EI [95% CrI] | EIdiff [95% CrI] |
| Headache |  |  |  |  |
| Nausea |  |  |  |  |
| Vomiting |  |  |  |  |
| Balance Problems |  |  |  |  |
| Dizziness |  |  |  |  |
| Fatigue |  |  |  |  |
| Trouble Falling Asleep |  |  |  |  |
| Sleeping More Than Usual |  |  |  |  |
| Sleeping Less Than Usual |  |  |  |  |
| Drowsiness |  |  |  |  |
| Sensitivity to Light |  |  |  |  |
| Sensitivity to Noise |  |  |  |  |
| Irritability |  |  |  |  |
| Sadness |  |  |  |  |
| Nervousness |  |  |  |  |
| Feeling More Emotional |  |  |  |  |
| Numbness or Tingling |  |  |  |  |
| Feeling Slowed Down |  |  |  |  |
| Feeling Mentally “Foggy” |  |  |  |  |
| Difficulty Concentrating |  |  |  |  |
| Difficulty Remembering |  |  |  |  |
| Visual Problems |  |  |  |  |

Table 4. Edge weights with 95% credible intervals among participants with concussions (*n*=90)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Symptoms | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | 11. | 12. | 13. | 14. | 15. | 16. | 17. | 18. | 19. | 20. | 21. | 22. |
| 1. Headache |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2. Nausea |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3. Vomiting |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 4. Balance Problems |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 5. Dizziness |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 6. Fatigue |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 7. Trouble Falling Asleep |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 8. Sleeping More Than Usual |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 9. Sleeping Less Than Usual |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 10. Drowsiness |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 11. Sensitivity to Light |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 12. Sensitivity to Noise |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 13. Irritability |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 14. Sadness |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 15. Nervousness |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 16. Feeling More Emotional |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 17. Numbness or Tingling |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 18. Feeling Slowed Down |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 19. Feeling Mentally “Foggy” |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 20. Difficulty Concentrating |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 21. Difficulty Remembering |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 22. Visual Problems |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Table 5. Edge weights with 95% credible intervals among control participants without concussions (*n*=261)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Symptoms | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | 11. | 12. | 13. | 14. | 15. | 16. | 17. | 18. | 19. | 20. | 21. | 22. |
| 1. Headache |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2. Nausea |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3. Vomiting |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 4. Balance Problems |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 5. Dizziness |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 6. Fatigue |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 7. Trouble Falling Asleep |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 8. Sleeping More Than Usual |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 9. Sleeping Less Than Usual |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 10. Drowsiness |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 11. Sensitivity to Light |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 12. Sensitivity to Noise |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 13. Irritability |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 14. Sadness |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 15. Nervousness |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 16. Feeling More Emotional |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 17. Numbness or Tingling |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 18. Feeling Slowed Down |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 19. Feeling Mentally “Foggy” |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 20. Difficulty Concentrating |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 21. Difficulty Remembering |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 22. Visual Problems |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Table 6. Edge weight differences with 95% credible intervals between participants with and without concussions.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Symptoms | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | 11. | 12. | 13. | 14. | 15. | 16. | 17. | 18. | 19. | 20. | 21. | 22. |
| 1. Headache |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2. Nausea |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3. Vomiting |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 4. Balance Problems |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 5. Dizziness |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 6. Fatigue |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 7. Trouble Falling Asleep |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 8. Sleeping More Than Usual |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 9. Sleeping Less Than Usual |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 10. Drowsiness |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 11. Sensitivity to Light |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 12. Sensitivity to Noise |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 13. Irritability |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 14. Sadness |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 15. Nervousness |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 16. Feeling More Emotional |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 17. Numbness or Tingling |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 18. Feeling Slowed Down |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 19. Feeling Mentally “Foggy” |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 20. Difficulty Concentrating |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 21. Difficulty Remembering |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 22. Visual Problems |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |