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SHORT COMMUNICATION

# Pandemic-Related Stress Increases PTSD and Depression Risk in Traumatic Injury Patients: A Comparative Study of Pre- and Peri-Pandemic Trauma Cases

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## ABSTRACT

The COVID-19 pandemic significantly impacted the psychological well-being of the general population. However, there are limited studies that examine its mental health effects on patients who have experienced traumatic injuries and tracked their recovery over time. This study aimed to: (1) compare the rates and severity of post-traumatic stress disorder (PTSD) and depression between patients who sustained traumatic injuries before the COVID-19 pandemic (pre-pandemic) and those injured during the pandemic (peri-pandemic); and (2) assess whether the degree of pandemic-related stress (e.g., worry about infection, social isolation, loss of home/job) predicted the severity of PTSD or depression symptoms. Participants ($N = 198$) were recruited from a Level 1 Trauma Centre in Southeastern Wisconsin following admission for a single-incident traumatic injury. Symptoms of PTSD and depression were assessed during hospitalisation and at three additional points within the subsequent 6 months. Self-report measures were used to evaluate PTSD and depression severity among patients injured before (pre-pandemic; $n = 126$) and during (peri-pandemic; $n = 73$) the pandemic. Peri-pandemic participants also completed a modified version of the COVID-19 Family Stress Screener to measure pandemic-related stress. Exploratory factor analysis was conducted to identify the dimensions of pandemic-related stress in our sample. The findings indicated that participants injured during the pandemic exhibited higher symptoms of PTSD and depression compared to those injured before the pandemic. Additionally, greater pandemic-related stress correlated with elevated levels of depression and PTSD at baseline. Our results highlight that the broader context in which patients recover from injuries can intensify the negative mental health consequences of traumatic injury. This underscores the need for enhanced access to psychological services for trauma patients, particularly during major societal stressors like a global pandemic.

## 1 | Introduction

In 2019 alone, over 26,000,000 individuals in the United States experienced a single incident traumatic event (e.g., fall, motor-vehicle collision, gunshot wound) resulting in injuries necessitating hospitalisation (Centers for Disease Control and Prevention [CDC] 2020). The impact of injury goes beyond the acute phase, as injury survivors face significant stressors after reaching medical stability and discharging from the hospital. Such stressors include adjustment to changes in functional abilities (e.g., due to an extremity amputation), chronic pain, and intensive physical rehabilitation (Davydow, Katon and Zatzick 2009). Unsurprisingly, survivors of traumatic injury are at markedly heightened risk for negative psychological outcomes such as depression and posttraumatic stress disorder (PTSD) (Bryant 2021; deRoon-Cassini et al. 2019).

The COVID-19 pandemic profoundly affected the psychological wellbeing of the general population (Serafini et al. 2020; J. Xiong et al. 2020). However, limited research has explored its impact on the mental health of patients recovering from traumatic injuries at various stages of their recovery—a population already vulnerable to immense stress and poor quality of life. It is essential to understand how mental health stress arises following traumatic injury, especially during a global crisis. Although hospital trauma cases decreased during the pandemic compared to previous years due to public health regulations and behavioural changes (DiFazio et al. 2020; Sheets et al. 2023), several studies have shown that pandemic-related stressors—such as fear of infection and social isolation—heightened stress levels (Finstad et al. 2022). For many, this exacerbated their recovery from traumatic injuries and diminished their ability to manage stress (Ohliger et al. 2020). Further, disruptions to rehabilitation and follow-up care further exacerbated both the physical and mental health challenges associated with recovery (Rodrigues-Pinto, Sousa and Oliveira 2020).

While patient perceptions on recovery offer valuable insights, few studies have closely examined the immediate psychological effects of a pandemic on traumatic injury patients. Most research has focused on trauma survivors months after discharge (DiFazio et al. 2020). This gap is significant, as survivors of acute injuries face an increased risk of mental health issues (Serafini et al. 2020; X. Xiong et al. 2010). Reports indicate that up to 67% of hospitalised patients experience symptoms of anxiety and depression, and up to 45% suffer from PTSD (Boldea et al. 2023; Necho et al. 2021). Therefore, understanding a pandemic's impact on mental health from the onset of traumatic injury and throughout recovery is critical. Although the urgency of the COVID-19 pandemic has decreased, new infections (Lupu and Tiganasu 2023) and cases of long haul COVID (Pinto et al. 2022) continue to affect recovery from traumatic injuries and mental health. Additionally, it is estimated the probability of a pandemic with a similar impact to COVID-19 is about 2% annually (Marani et al. 2023). This means someone born in 2000 would have roughly a 38% chance of experiencing such a pandemic by now, with that likelihood only increasing. Understanding the effects of pandemics on recovery after physical trauma and mental health is essential for developing adaptable and responsive interventions during similar public health crises.

Thus, the present study used longitudinal data from a sample of traumatic injury survivors to explore two aims. First, we investigated differences in severity of PTSD and depression symptoms post-injury between patients injured before (pre-) and during (peri-) the pandemic. We hypothesised those injured during the pandemic would report greater PTSD and depression symptom severity than those injured before the pandemic. Second, we tested whether the degree of COVID-19-related stress or life disruption was associated with greater PTSD and depression symptoms. To this end, this study aimed to identify the effects of COVID-19-related stressors on the recovery of traumatically injured adults. Then, to identify themes around the types of pandemic-related stressors experienced by our patients and the limited research of established measures for stress related to the COVID-19 pandemic, we conducted an exploratory factor analysis to identify specific COVID-19 related risk factor(s), associated with mental health consequences among injury survivors. We hypothesised survivors of traumatic injury with relatively greater pandemic-related stress would report more severe symptoms of PTSD and depression. This approach may facilitate insight into what aspects of pandemic-related stress are most impactful to recovery post-injury.

## 2 | Method

Data used in these analyses were derived from a broader longitudinal study exploring the biomarkers of PTSD and clinical recovery (Tomas et al. 2022). Recruitment for this project commenced in October 2017 and concluded on March 30, 2021. The primary aim of the parent study was to identify post-trauma risk factors of PTSD development using biospecimen and self-report measures. Participants were asked to complete four study visits: in-hospital baseline (BL), 1-month, 3-month, and 6-month (mo) post-injury. Participants were recruited from a Level 1 Trauma Centre in Southeastern Wisconsin after admission for a single-incident traumatic injury (e.g., fall, motor vehicle crash, gunshot wound). Eligibility criteria included traumatic injury, 18 years of age or older, admitted to hospital for at least 24 h, and a Glasgow Coma Scale (GCS) score of 13 or greater (Teasdale et al. 2014). Participants were excluded if they were on a police hold, were unable to communicate with research staff, or experienced a traumatic brain injury with more than 1 min of peri-traumatic amnesia. From 2017 to 2021, 8167 admitted patients were screened, of which, 2728 were eligible for study participation, and 200 were enrolled. Eligible participants were not enrolled primarily due to scheduling difficulties, inability to communicate in some form, or declined participation. Those enrolled were significantly younger than those who were eligible but did not enroll ($t = -5.72$, $p < 0.001$), but there were no differences between groups in sex and race. All study procedures were approved by the relevant Institutional Review Board. Participants provided written informed consent and were compensated for their participation in the study at each time point.

### 2.1 | Pre- and Peri- Pandemic Groups

The stay-at-home orders in Wisconsin began on March 25, 2020, interrupting our study halfway through recruitment. Adapting

protocols for safe or remote data collection, we added two COVID-19 measures to assess pandemic impact. Participants were classified as pre- or peri-pandemic based on their study visit dates. A total of 198 participants completed BL (124 pre-pandemic; 74 peri-pandemic), 149 completed 1 month (86 pre-pandemic; 63 peri-pandemic), 131 completed 3 months (70 pre-pandemic; 61 peri-pandemic), and 110 completed 6 months (54 pre-pandemic; 56 peri-pandemic) assessments. For analyses, pre-pandemic participants were defined as those who completed their BL visit prior to March 25, 2020 (43% of pre-pandemic participants completed all study timepoints prior to March 25, 2020) and all peri-pandemic participants completed their BL and all subsequent visits on or after March 25, 2020. All BL visits in the peri-pandemic group occurred before public vaccine distribution. More participants were lost to follow-up by 6 months in the peri-pandemic group ($\chi^2 = 4.42$, $p = 0.04$), but baseline PTSD and depression didn't predict this attrition. See Table 1 for sample characteristics.

## 2.2 | Measures

### 2.2.1 | Psychopathology

The PTSD Checklist for DSM-5 (PCL-5; Blevins et al. 2015) was administered at each study timepoint. This 20-item, self-report measure assesses PTSD symptoms based on DSM-5 criteria, scored on a Likert-type scale from 0 to 4, with total scores ranging from 0 to 80 (Cronbach's alpha; full sample = 0.93, pre-pandemic = 0.92, peri-pandemic = 0.93). Symptom clusters were also derived (i.e., reexperiencing, avoidance, negative mood and cognition, and hyperarousal) based on the symptom groupings in DSM-5 criteria. Depression was measured using the Centre for Epidemiological Studies Depression Scale Revised (CESD-R-10; Björgvinsson et al. 2013) at each study time point post-trauma. This 10-item self-report scale rates depressive symptoms from 0 to 4, with scores of 10 or higher indicating clinically significant symptoms (range = 0–30; Cronbach's alpha; full sample = 0.78, pre-pandemic = 0.76, peri-pandemic = 0.80).

### 2.2.2 | Pandemic-Related Stress

We administered select items of the COVID-19 Family Stress Screener (FSS; see Supporting Information S1; Huth-Bocks 2020). This scale assesses changes in stress associated with the pandemic with a time reference of the past few weeks. The scale consisted of 15 items answered on a Likert-type scale from 0 (strongly disagree) to 5 (strongly agree). Items consisted of statements such as 'worrying about being quarantined' and 'loss of social connections, social isolation'.

### 2.2.3 | Covariates

Covariates included gender, age, race, mechanism of injury (MOI), and pain. Pain was evaluated on a 1–10 scale using the Visual Analogue Scale (Langley and Sheppeard 1985).

## 2.3 | Statistical Analyses

All analyses were conducted in R (v4.1.0 'Camp Pontanezen'). Missing data were sparse and were therefore listwise deleted (Table 1). First, we compared PCL-5 total and symptom cluster scores and CESD-R-10 scores between pre- and peri-pandemic participants using *t*-tests. PCL-5 and CESD-R-10 scores were compared between respective groups (e.g., pre-pandemic BL PCL-5 vs. peri-pandemic BL PCL-5) across all study timepoints.

Next, with an adapted version of the FSS, we conducted an exploratory factor analysis for validation and to understand the underlying dimensions of COVID-19 experiences in the peri-pandemic group. To assist selection of maximum number of factors, we used parallel analysis (*fa.parallel*) from the *psych* package in R with maximum likelihood estimation of eigenvalues. Factors were extracted using principal factor solution and varimax rotation.

Finally, we evaluated the relationship of PCL-5 and CESD-R-10 symptoms with both FSS factor scores (i.e., Stress and Resource Impact). General linear models were used with either PCL-5 or CESD-R-10 as the outcome, FSS Stress and FSS Resource Impact were predictors with gender, age, race, MOI, and pain as covariates. Due to small sample sizes of peri-COVID participants with complete data at further timepoints (BL, $n = 72$; 1 month, $n = 53$; 3 months, $n = 40$; 6 months, $n = 34$; $n = 28$ have complete data at all four timepoints), we only evaluated BL FSS factor scores with BL PCL-5 and CESD-R-10 symptoms. As an exploratory analysis, we used linear mixed effects models with the *lme4* package in R (Bates et al. 2015) to evaluate the longitudinal relationships of FSS factor scores with total PCL-5 and CESD-R-10 symptoms. In the mixed effects models, FSS factor scores and aforementioned covariates were fixed effects while time and participant ID were random effects.

# 3 | Results

## 3.1 | Pre- and Peri-Pandemic Group Comparisons

See Table 1 for group means and standard deviations. The full sample was 60% men who were younger to middle aged ($M_{age} = 37.35$, $SD_{age} = 14.68$). The sample was racially and ethnically diverse (49% Black or African American; 31% Hispanic or Latino; 16% White) and educated with only 20% receiving less than a high school education. Mechanism of injury (MOI) was also varied (38% motor vehicle crash, 22% gun shot, 11% fall). There were no significant differences between pre- and peri-pandemic participants in gender, age, race, or MOI (all $p$'s $> 0.05$).

Results comparing PTSD and depression symptoms between groups showed a significant main effect of group at BL (Figure 1). Compared to pre-pandemic participants, peri-pandemic participants reported greater depression symptoms ($t = 2.41$, $p = 0.006$, Cohen's $d = -0.40$). Total PTSD symptom severity ($t = 2.56$, $p = 0.01$, $d = -0.36$), as well as symptom clusters of reexperiencing ($t = 2.77$, $p = 0.006$, $d = -0.40$),

**TABLE 1** | Sample characteristics.

| | Full sample ($N = 198$ BL) | Pre-pandemic ($N = 124$ BL) | Peri-pandemic ($N = 74$ BL) |
|---|---|---|---|
| Gender (women *n*/%) | 77 (39%) | 49 (39%) | 28 (37%) |
| Missing (*n*) | 1 | 1 | 0 |
| Age (*M*/SD) | 37.35/14.68 | 38.59/15.31 | 35.29/13.42 |
| Missing (*n*) | 1 | 1 | 0 |
| Race (*n*/%) | | | |
| American Indian/Alaska Native | < 5% | < 5% | < 5% |
| Asian | < 5% | < 5% | < 5% |
| Black or African American | 99/49% | 75/60% | 24/32% |
| Hispanic or Latino | 62/31% | 24/19% | 38/51% |
| Native Hawaiian or Pacific Islander | < 5% | < 5% | < 5% |
| White | 32/16% | 22/17% | 10/13% |
| Unknown or Not reported | < 5% | < 5% | < 5% |
| Education (*n*/%) | | | |
| Less than high school | 40 (20%) | 20 (16%) | 20 (27%) |
| Graduated high school | 70 (35%) | 47 (37%) | 23 (31%) |
| Some college | 56 (28%) | 37 (30%) | 19 (25%) |
| College graduate | 21 (10%) | 12 (10%) | 9 (12%) |
| Advanced degree (masters or higher) | < 5% | < 5% | < 5% |
| Missing (*n*) | 4 | 4 | 0 |
| Mechanism of injury (%) | | | |
| Motor vehicle crash | 38% | 42% | 35% |
| Gun shot | 22% | 22% | 21% |
| Stab | < 5% | < 5% | 6% |
| Fall | 11% | 6% | 17% |
| Pedestrian struck | 5% | 6% | < 5% |
| Motorcycle crash | 7% | 10% | < 5% |
| Other | 10% | 8% | 13% |
| PCL-5 (*M*/SD) | | | |
| Total | 25.40 (20.5) | 22.60 (19.5) | 30.10 (21.4)* |
| Reexperiencing | 6.97 (6.49) | 5.98 (6.23) | 8.59 (6.62)* |
| Avoidance | 2.81 (2.93) | 2.40 (2.78) | 3.47 (3.08)* |
| Negative mood/cognitions | 8.24 (7.50) | 7.43 (7.13) | 9.59 (7.94) |
| Hyperarousal | 7.40 (6.14) | 6.79 (5.97) | 8.41 (6.32) |
| Missing (*n*) | 2 | 2 | 0 |
| CESD-R-10 (*M*/SD) | 11.80 (8.03) | 10.50 (7.69) | 13.80 (8.21)* |
| Missing (*n*) | 9 | 9 | 0 |

*Note: n*'s and/or % < 5 masked for participant confidentiality.
Abbreviations: BL, baseline; CESD-R-10, Centre for Epidemiological Studies Depression Scale revised; *M*, mean; PCL-5, PTSD checklist for DSM-5; SD, standard deviation.
* Significant difference between pre- and peri-pandemic-19 groups at $p < 0.05$.

avoidance ($t = 2.51$, $p = 0.01$, $d = -0.37$), and negative alterations in cognitions or mood ($t = 1.97$ $p = 0.04$, $d = -0.29$) were also significantly worse among peri-pandemic participants at BL. There were no differences in PTSD-related hyperarousal symptoms at BL ($t = 1.80$, $p = 0.07$, $d = -0.26$). Depression and PTSD symptom severity did not significantly differ between groups at any other timepoint in the study (all *p*'s > 0.05). Time (days) since the start of the COVID-19 stay-at-home orders at BL was not related to baseline PTSD or depression symptom severity or either FSS factor.

### 3.2 | Peri-Pandemic Mental Health Impact

Using only the peri-pandemic participants who completed the FSS at BL ($N = 72$), the FSS data were deemed appropriate for exploratory factor analysis with KMO = 0.82 and a significant Bartlett's test for sphericity ($\chi^2(105) = 541.51$, $p < 0.0001$). No FSS items were removed for poor sampling adequacy designated by KMO < 0.5. The determinant of the item correlation matrix suggests no multicollinearity among items (determinant = 0.0002). Parallel analysis suggested 2 factors were sufficient to extract with satisfactory model fit metrics (variance explained = 49%; RMSR = 0.07; TLI = 0.83; RMSEA = 0.09 [0.06, 0.12]; Table 2). The 10 items that loaded primarily to the first factor are associated with worry or stress related to COVID-19; this factor was named '**Stress**' (e.g., worry about infection, feeling socially isolated, anxiety/depression). The items that loaded primarily onto the second factor were associated with direct resource impacts of COVID-19 on daily life (e.g., job loss, loss of home, loss of food access, etc.); this factor was named '**Resource Impact**'. We report item means and standard deviations for each factor at each time point in Table 3. Notably, mean stress and resource impact generally decreased over time.

After adjusting for covariates (i.e., age, gender, race, MOI, and pain), BL FSS Stress ($t = 2.90$, $p < 0.01$) was related to total BL PTSD symptom severity (Figure 2; Table S1), but BL FSS Resource Impact was not related to BL PTSD symptoms severity ($t = 1.84$, $p = 0.06$). Similarly, BL FSS Stress but not FSS Resource Impact was related to severity of each of the PTSD reexperiencing, avoidance, negative alterations in cognitions or

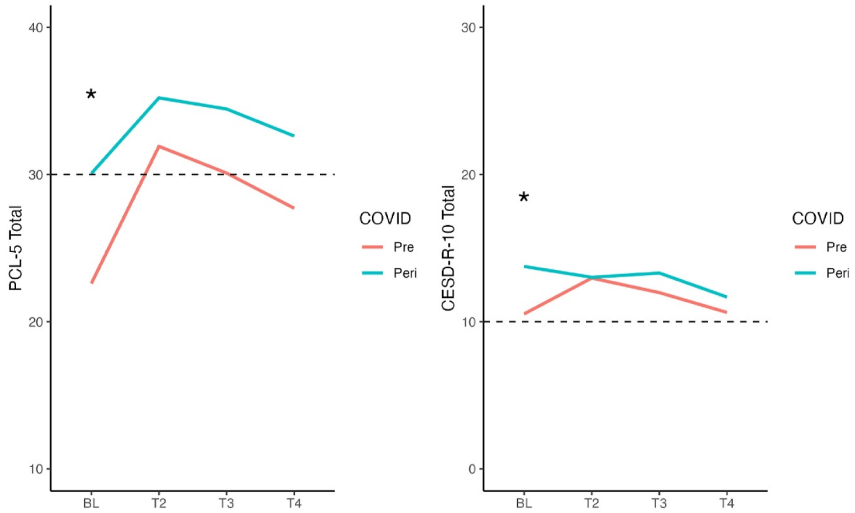


**FIGURE 1** | Mean PCL-5 (PTSD) and CESD-R-10 (depression) total scores by time. BL = in-hospital; T2 = 1 month; T3 = 3 months; T4 = 6 months. Dashed line indicates clinically significant symptoms. * indicates significant group difference at $p < 0.05$.

**TABLE 2** | Factor loadings from FSS EFA ($N = 72$ peri-pandemic participants).

| Factor | Item | PA1 | PA2 | h2 | u2 | Com |
|---|---|---|---|---|---|---|
| Distress | Worrying about being infected with coronavirus | 0.7 | 0.07 | 0.5 | 0.5 | 1 |
| | Worrying about infecting others | 0.71 | 0.12 | 0.51 | 0.49 | 1.1 |
| | Worrying about being quarantined | 0.53 | 0.28 | 0.36 | 0.64 | 1.5 |
| | Worrying about being stigmatised or rejected because of coronavirus | 0.61 | 0.29 | 0.46 | 0.54 | 1.4 |
| | Tension or conflict between household members | 0.53 | 0.41 | 0.45 | 0.55 | 1.9 |
| | Physical health concerns for me or a family member (other than from the coronavirus) | 0.67 | 0.21 | 0.5 | 0.5 | 1.2 |
| | Increased anxiety or depression | 0.49 | 0.3 | 0.33 | 0.67 | 1.7 |
| | Reminders of past stressful/traumatic events | 0.51 | 0.37 | 0.4 | 0.6 | 1.8 |
| | Loss of social connections, social isolation | 0.67 | 0.19 | 0.48 | 0.52 | 1.2 |
| | Overall, I feel a lot of distress about the pandemic and how it might affect me or my family | 0.6 | 0.41 | 0.54 | 0.46 | 1.8 |
| Resource impact | Food running out or being unavailable | 0.35 | 0.57 | 0.45 | 0.55 | 1.6 |
| | Losing a job or decrease in family income | 0.42 | 0.63 | 0.57 | 0.43 | 1.8 |
| | Losing housing or utilities | 0.34 | 0.7 | 0.61 | 0.39 | 1.4 |
| | Loss of or limited childcare | 0.09 | 0.78 | 0.62 | 0.38 | 1 |
| | Taking care of children, including those who are normally in school | 0.11 | 0.71 | 0.52 | 0.48 | 1 |

Abbreviations: com = complexity of factor loadings; h2 = communalities; PA1 and PA2 = standardised loadings from pattern matrix; u2 = uniqueness.

**TABLE 3** | Means of FSS items by factor across study period for peri-COVID participants.

| Factor | Item | BL $N = 72$ $M$ (SD) | 1 month $N = 53$ $M$ (SD) | 3 months $N = 40$ $M$ (SD) | 6 months $N = 34$ $M$ (SD) |
|---|---|---|---|---|---|
| Distress | Worrying about being infected with coronavirus | 3.15 (1.68) | 3.23 (1.69) | 3.29 (1.58) | 2.70 (1.53) |
| | Worrying about infecting others | 2.90 (1.78) | 3.06 (1.59) | 2.81 (1.63) | 2.55 (1.58) |
| | Worrying about being quarantined | 2.96 (1.59) | 2.85 (1.51) | 2.79 (1.57) | 2.42 (1.48) |
| | Worrying about being stigmatised or rejected because of coronavirus | 2.53 (1.66) | 2.40 (1.50) | 2.10 (1.39) | 2.42 (1.56) |
| | Tension or conflict between household members | 2.60 (1.69) | 2.13 (1.36) | 2.07 (1.37) | 2.39 (1.52) |
| | Physical health concerns for me or a family member (other than from the coronavirus) | 2.66 (1.68) | 2.75 (1.48) | 2.74 (1.62) | 2.42 (1.66) |
| | Increased anxiety or depression | 3.38 (1.77) | 3.15 (1.51) | 3.07 (1.73) | 3.12 (1.63) |
| | Reminders of past stressful/traumatic events | 3.00 (1.67) | 2.91 (1.54) | 2.76 (1.65) | 2.73 (1.59) |
| | Loss of social connections, social isolation | 3.39 (1.58) | 3.13 (1.39) | 2.86 (1.62) | 2.76 (1.66) |
| | Overall, I feel a lot of distress about the pandemic and how it might affect me or my family | 3.73 (1.32) | 3.28 (1.46) | 2.98 (1.52) | 2.64 (1.54) |
| Resource impact | Food running out or being unavailable | 2.89 (1.60) | 2.43 (1.46) | 2.21 (1.41) | 2.00 (1.44) |
| | Losing a job or decrease in family income | 3.40 (1.65) | 3.02 (1.57) | 2.83 (1.62) | 2.52 (1.54) |
| | Losing housing or utilities | 2.88 (1.68) | 2.60 (1.59) | 2.52 (1.64) | 2.52 (1.58) |
| | Loss of or limited childcare | 2.23 (1.50) | 1.98 (1.29) | 1.76 (1.12) | 1.85 (1.20) |
| | Taking care of children, including those who are normally in school | 2.41 (1.64) | 2.68 (1.55) | 2.57 (1.59) | 2.61 (1.52) |

*Note:* Each item asked on a scale 1 (strongly disagree) to 5 (strongly agree).
Abbreviations: *M*, mean; SD, standard deviation.

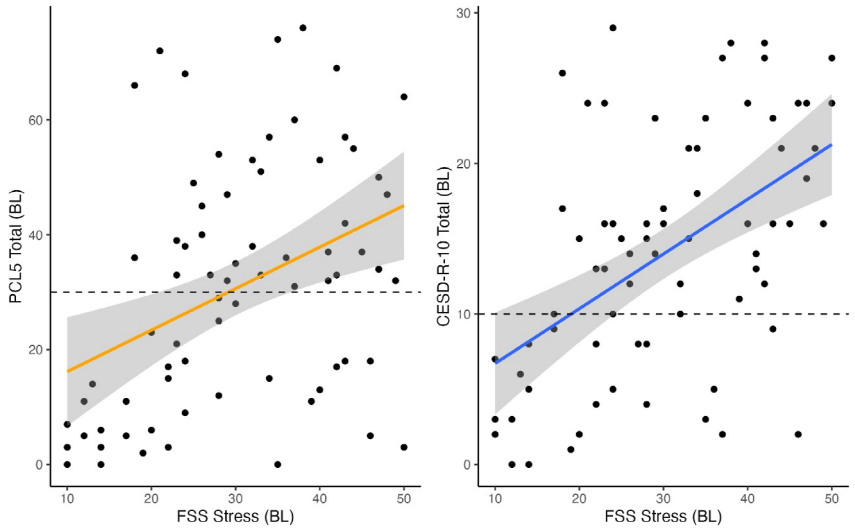


**FIGURE 2** | Pandemic-related distress factor at baseline (BL, in-hospital) is significantly related to PCL-5 Total and CESD-R-10 Total at baseline. Solid lines depict linear regression with 95% confidence intervals in grey shading. Dashed horizontal lines indicate the clinically significant threshold for each respective measure (30 for PCL-5, and 10 for CESD-R-10).

mood, and hyperarousal subscales (all $p < 0.05$). Finally, BL FSS Stress was related to BL depression ($t = 4.07$, $p < 0.001$; Figure 2; Table S1), but BL FSS Resource Impact was not related to BL depression ($t = 1.68$, $p = 0.09$).

Results of the exploratory linear mixed effects models examining the longitudinal relationship of FSS factors and total PTSD and depression symptoms are shown in Table S2. However, as only 28 participants had complete data across all four timepoints (BL, 1-month, 3-month, 6-month) these results should be interpreted with caution. Like the cross-sectional results, greater FSS Distress over time was related to greater PTSD total ($p = 0.003$). FSS Resource Impact was not associated with PTSD or depression symptoms over time. Women had higher PTSD total symptoms.

Greater pain was associated with greater PTSD total symptoms. Compared to White participants, Black and Hispanic or Latino participants had higher PTSD total symptoms.

## 4 | Discussion

Our study found that individuals who experienced traumatic injuries during the COVID-19 pandemic exhibited significantly greater severity of PTSD and depression symptoms at baseline compared to those injured before the pandemic. These findings suggest that pandemic-related stressors, such as infection fears and social isolation, exacerbated these symptoms compared to those observed in individuals sampled prior to the pandemic. This highlights the need for additional support for trauma survivors injured during pandemics. Notably, our research is the first to show that pandemic stress impacts recovery beyond factors like household income or food access. These preliminary findings provide a clinical basis for targeted interventions during times of compounded stress, especially since those assessed shortly after hospitalisation were more likely to report deteriorated mental health due to pandemic-related stress.

These results are similar to those reported from previous outbreaks. For example, individuals' emotional stress during the spread of the H1N1 strain of the influenza virus in 2009, was found to be significantly positively related with mental health problems such as posttraumatic stress and delayed recovery (Wheaton et al. 2012). Previous research has shown that feeling isolated post-injury may lead one to feel pessimistic about one's recovery altogether, producing negative mood states and arousal (Liu et al. 2020). Social isolation was exacerbated by the pandemic, which likely worsened negative mood states and arousal. Further compounding this picture, concerns regarding exposure risks in healthcare settings likely prevented traumatic injury survivors from seeking psychological support despite these symptoms (Dennis et al. 2021; Rodrigues-Pinto, Sousa, and Oliveira 2020; Ohliger et al. 2020), underscoring the importance of mapping and meeting their mental health needs during hospitalization and after discharge.

Our study also replicates previous studies on the impact of COVID-19 on mental health broadly (Necho et al. 2021; Liu et al. 2020; Sheets et al. 2023). Notably, in our study, when taking this further to examine the stress of the pandemic, those who endorsed greater COVID-19 stress also reported greater hyperarousal and depression at baseline, although this group difference diminished over time. Although beyond the scope of our study, this diminished group difference may be due to reductions in the salience of COVID-related stressors later in the pandemic (e.g., as vaccinations became available). Even after accounting for MOI, gender, age, and pain, only pandemic-related stress, not the impact(s) of COVID-19 on resources such as income or access to food, was related to greater hyperarousal and depression. Several clinical implications of these findings bear mentioning. Settings where traumatic injuries are treated (i.e., Emergency Departments, Trauma Centres) are increasingly providing access to screening and referral to early intervention for mental health, and this is now required by the American College of Surgeons, which accredits trauma centres. First, it is common for medical providers treating traumatic injury to focus on the physical injury and its consequences. Yet, there are often significant adjustment issues related to changes in functioning, acute stress, and other pressing clinical needs. Our findings suggest that in the context of a major societal stressor, clinicians or healthcare systems in these settings should broaden their focus to include consideration of how the societal stressor is impacting recovery. For example, early behavioural interventions following traumatic injury often involve reducing behavioural avoidance of stimuli associated with the experience (e.g., avoiding driving after a motor-vehicle collision; avoiding public places after a gunshot wound). If fear of infection is a barrier to overcoming avoidance of stimuli, patients may benefit from solution-focused interventions to identify strategies for reducing avoidance while also maintaining protection from the virus. In these clinical examples, provider consideration of broad contextual factors, in this case, the pandemic, has the potential to guide intervention to promote mental health after injury. Additional research is needed to test these interventions.

This study has its strengths and limitations. The primary study was not initially designed to assess COVID-19 stress; adjustments were made during data collection to evaluate the concurrent effects of COVID-19 stress and acute trauma on injury survivors. Due to the emergent nature of the COVID-19 pandemic and the complexities of assessing its impact on trauma patients, our choice of measurement tools was constrained. Consequently, we reviewed a collection of pandemic-related measures and selected the FSS scale, incorporating questions most relevant to our study sample. Moreover, completeness of self-report measures is limited particularly in the peri-COVID period (e.g., $n = 34$ at 6 months) and limited our ability to analyse longitudinal trends with sufficient power. The inclusion of self-report measures itself has limitations, such that it may be prone to misinterpretation (Brutus, Aguinis and Wassmer 2013). Future work should continue to determine the unique stressors related to both trauma and COVID-19 that are most salient for injury survivors, such as non-urgent surgical procedures and access to inpatient care. Additionally, our sample was confined to individuals with traumatic injuries, which may limit the generalisability of the findings to other patient populations. Further research is necessary to examine the sensitivity and specificity of the Stress and Resource Impact components of the COVID-19 FSS in order to test its clinical utility.

The prospective study design among injury survivors with pre- and peri-pandemic data on PTSD and depression symptoms and well-validated clinical measures, are strengths of the current study. Additionally, our study provides preliminary support for the adaptation and validation of the FSS, which showed a two-factor solution (emotional stress and resource impact) with robust psychometric properties. The FSS has potential to be used in clinical and research settings to measure stress associated with pandemic-like situations. We hope the newly adapted FSS will advance early assessment and intervention of psychological stress and improve understanding of the relationship between sudden emotional stress and psychosocial variables in various illness contexts. For example, with the rise of RSV in paediatric units in the U.S., pandemic-specific scales like the FSS can help identify psychological stress inpatients. Understanding stress sources

among injured patients can inform interventions to enhance recovery and quality of life in future pandemics.


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### Conflicts of Interest

The authors declare no conflicts of interest.

### Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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