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Longitudinal PTSD symptom trajectories: Relative contributions of state anxiety, depression, and emotion dysregulation

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ABSTRACT

Background: Prospective research on the development and trajectory of PTSD symptoms after a traumatic event is crucial for assessment and early intervention. Further, examining predictors of PTSD pathology provides a better conceptualization of the temporal course of PTSD in trauma victims.

Methods: The present study examined PTSD symptom severity in individuals presenting to the emergency department (ED) following a traumatic event. Participants ($N = 147$) were assessed at four timepoints: 2-weeks, 3-months, between 6 and 9 months, and 12-months after ED admission. Growth curve modeling was conducted to examine changes in PTSD symptom severity over time. Age, sex, state anxiety, trait anxiety, emotion dysregulation, depression, and trauma type (motor vehicle accident [MVA] and assault), and PTSD diagnosis were included as covariates in the model.

Results: Results demonstrated that baseline PTSD symptom severity was positively associated with severity of depression and state (but not trait) anxiety, emotion dysregulation, and PTSD diagnosis. Results also revealed significant associations with PTSD symptom changes over time; greater state anxiety and depression symptoms at baseline were associated with steeper declines in PTSD symptoms over time.

Limitations: Data were collected at only four timepoints over the course of 12-months. Results may be different with more measurement points over longer periods and inclusion of pre-, peri- and post-trauma risk factors.

Conclusions: Results illustrate the relevance of assessing state anxiety, depression, and emotion dysregulation in following trauma victims for trauma-related psychopathology over the course of time to alleviate the negative impact of the same.

1. Introduction

According to the Centers for Disease Control and Prevention (CDC), approximately 130 million people are admitted to emergency departments (EDs) annually in the United States (CDC, 2018). Two important and prevalent incidents triggering ED admissions include motor vehicle accidents (MVAs; Albert and McCaig, 2015) and interpersonal trauma (physical/sexual assault, intimate partner violence; Davidov et al., 2015; Kothari et al., 2015). Recent longitudinal findings suggest over 30% of civilian-related injury survivors admitted to EDs experience moderate-to-high levels of posttraumatic stress disorder (PTSD) within the first-year post-trauma (Lowe et al., 2020). Yet little data have been published on the longitudinal course of PTSD symptoms and associated risk factors, among ED-presenting trauma victims.

PTSD symptoms are most acute immediately following a traumatic event (Sareen, 2014); however, severity of baseline PTSD is not the most robust predictor of long-term PTSD prognosis (Takahashi et al., 2020; Tay et al., 2016). Morina et al.'s (2014) meta-analysis of spontaneous PTSD remission rates (i.e., without treatment) revealed that approximately half of individuals with PTSD at baseline (<5 months post-trauma) were non-cases at follow-up.

Research on predictors of PTSD symptoms has identified numerous factors which may contribute to pathology. Factors influencing increased PTSD symptoms are often distinguished in relation to the

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traumatic event via three domains: pre-traumatic factors (demographic variables, mental health history, personality characteristics), peri-traumatic factors (emotional reactivity during the trauma), and post-traumatic factors (social support and treatment interventions; DiGangi et al., 2013; Sayed et al., 2015).

Female sex, depression, anxiety, emotion dysregulation, and trauma type have been identified as pre-trauma risk factors for PTSD symptoms. Females are at higher risk for developing PTSD at a ratio of 2:1 compared to males (Hyland et al., 2017; Lowe et al., 2020; Tortella-Feliu et al., 2019); and females report more PTSD symptoms and greater symptom severity compared to males (Christiansen and Hansen, 2015; Farhood et al., 2018; Hyland et al., 2017). Additionally, comorbid depression symptoms are common among trauma victims with PTSD symptoms (Ayazi et al., 2012; Farhood et al., 2016; Shalev et al., 1998). In a study of female victims of rape presenting to the ED, those presenting with comorbid depression at baseline were at greater risk of developing PTSD at 6-month follow-up (Tiihonen Möller et al., 2014). Furthermore, post-trauma anxiety (e.g., uncontrollable/excessive worry, restlessness, irritability) and anxiety sensitivity (fear of anxiety-related sensations) have demonstrated significant associations with PTSD symptom severity (Bardeen et al., 2015; Berenz et al., 2012; Marshall et al., 2010; Norr et al., 2016; Price and van Stolk-Cooke, 2015) and slower recovery from PTSD symptoms (Zlotnick et al., 1999). Although anxiety is associated with worse outcomes after a traumatic event, few studies have examined trait or state anxiety as a predictor of PTSD symptoms in adults. Emotion dysregulation (difficulty regulating emotional response; Gross, 2002) is a transdiagnostic construct (Gross and Muñoz, 1995) and an underlying mechanism associated with increased psychopathology, associated with PTSD symptom severity (Demir et al., 2020; Ehring and Quack, 2010; Spies et al., 2020; Tull et al., 2007). Additionally, the type of traumatic event experienced may differentially impact severity of PTSD symptoms (Benfer et al., 2018), with interpersonal trauma (sexual and physical assault) predicting higher severity of PTSD symptoms (Ehring and Quack, 2010; Forbes et al., 2014; Kelley et al., 2009) and worse outcomes (e.g., suicidality; Yoo et al., 2018) compared to non-interpersonal trauma.

Not only are the above variables risk factors for short-term symptoms of PTSD, but they are also implicated in long-term prognosis of PTSD (i.e., trajectory of symptoms over time). For example, Lowe et al. (2020) found that individuals reporting assaultive violence were at increased risk of both immediate and longer-term PTSD symptoms. Additionally, Irish et al. (2011) found that initial PTSD symptoms and peritraumatic dissociation served as partial mediators of the relationship between sex and PTSD symptoms six weeks and six months post-MVA. In a longitudinal study of trauma victims recruited from the ED, approximately 43% were diagnosed with PTSD-major depression comorbidity 4 months post-trauma (Shalev et al., 1998). Thus, measuring risk factors implicated in increased PTSD symptom severity over time may provide a more accurate prognosis for PTSD.

1.1. Aims

Although most trauma victims admitted to the ED do not subsequently develop PTSD (Sayed et al., 2015), understanding risk factors that distinguish those vulnerable for developing PTSD is important to understanding trauma-related psychopathology. One aim of this study was to assess PTSD symptoms prospectively in trauma victims admitted to the ED and examine baseline predictors of PTSD pathology via growth modeling analyses. Another aim was to expand research on potential risk factors for PTSD symptoms by including state and trait anxiety as covariates. Predicting who will develop PTSD proximately after a trauma (such as after ED admission) may have implications for preventative treatment options and may attenuate functional impairment associated with PTSD (e.g., depression; Kessler, 2000; McFarlane, 2010).

1.2. Hypotheses

Our hypothesized growth model is presented in Fig. 1. We hypothesized the following for predicting the latent intercept (i.e., baseline PTSD severity) and slope (change in PTSD symptoms over time) based on literature presented on risk factors for PTSD symptoms. We use the term “assault trauma” to refer to instances of interpersonal trauma (i.e., physical and/or sexual assault).

1.2.1. Hypothesis 1 (H1)

Baseline PTSD severity would be positively associated with mental health variables (depression, anxiety [state/trait], and emotion dysregulation; Farhood et al., 2016; Demir et al., 2020; Norr et al., 2016).

1.2.2. Hypothesis (H2)

Baseline PTSD would be positively associated with female sex (Lowe et al., 2020; Tortella-Feliu et al., 2019).

We also hypothesized the following for predicting the slope (changes over time) based on literature presented. Positive associations refer to the direction of change (versus magnitude of change) in PTSD severity.

1.2.3. Hypothesis 3 (H3)

Change in PTSD severity would be positively associated with mental health variables (depression, anxiety [state/trait], and emotion dysregulation; Sareen, 2014).

1.2.4. Hypothesis (H4)

Change in PTSD severity would be positively associated with female sex (Christiansen and Hansen, 2015; Farhood et al., 2018; Hyland et al., 2017).

1.2.5. Hypothesis (H5)

Compared to MVA trauma, assault trauma would be more strongly positively associated with PTSD severity (Lowe et al., 2020).

2. Method

2.1. Participants and procedure

Participants were individuals presenting to the ED following a traumatic event (index trauma) and were contacted within 48 h of their visit. Participants with elevated PTSD symptoms initially following the trauma (PTSD Checklist-5 score $\geq$ 28 [Blevins et al., 2015] during consent process) and who provided informed consent were enrolled for follow-up assessment within 2-weeks of ED admission to complete baseline measures. Participants were excluded if they were pregnant, under the influence of alcohol or illicit use of substances at the time of the trauma, had any major injuries including moderate to severe traumatic brain injuries, had substantial medical concerns affecting their general health, or had conditions prohibiting further assessment and involvement in the larger study. Eligible participants were assessed at four timepoints: 2-weeks, 3-months, between 6 and 9 months, and 12-months after ED admission. Clinical psychology graduate students were trained and administered structured clinical interviews at 3-months and 12-months. Participants were compensated for completing measures at each timepoint. Approval for the study was obtained through the University of Toledo Institutional Review Board.

After excluding participants for careless responding (>26 consecutive same-item responses) and missingness, a total of 147 participants were included. Of these participants, 137 (93.2%) participated in the first timepoint assessment, 133 (90.5%) participated at the second timepoint, 75 (51.0%) at the third timepoint, and 79 (53.7%) at the fourth timepoint; all 147 participants were analyzed, with longitudinal missing data estimated as discussed below. A majority of participants were male (67.3%; $n = 99$; sex was coded as: male = 1, female = 2) and average age was 33.27 years old ($SD = 10.9$; min = 18; max = 59).

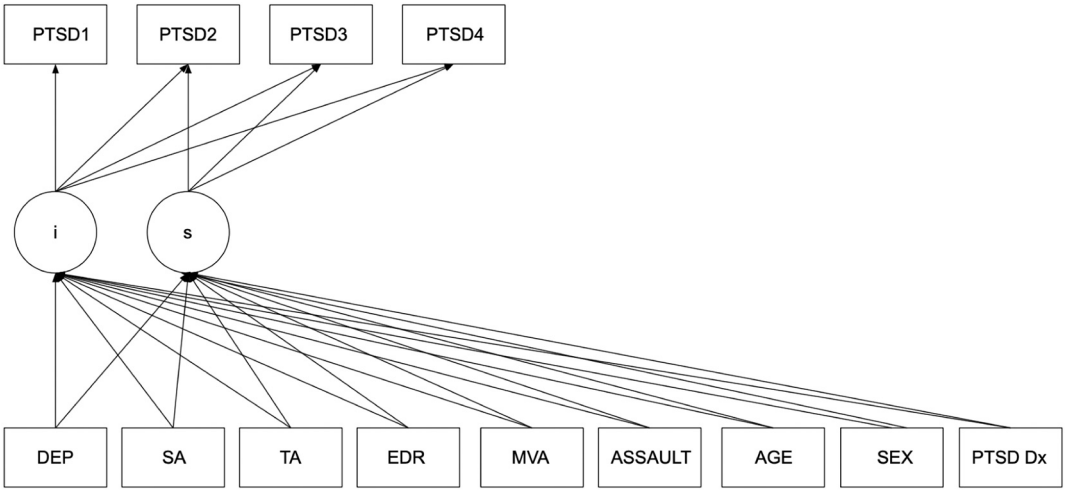

Fig. 1. Hypothesized growth curve model predicting four repeated PTSD symptom severity measurements.
Notes: i = intercept; s = slope; DEP = depression; SA = state anxiety; TA = trait anxiety; EDR = emotion dysregulation; MVA (coded as: MVA = 1, assault/other = 0); ASSAULT (coded as: assault = 1, MVA/other = 0); PTSD Dx = PTSD diagnosis at 3 months (coded as: 0 = non-PTSD group, 1 = PTSD group); PTSD=PTSD symptom severity whereby PTSD1 = 2-week assessment, PTSD2 = 3-month assessment, PTSD3 = 6- to 9-month assessment, PTSD4 = 12-month assessment.

Racial breakdown included: 53.1% (n = 78) Black and 44.9% (n = 66) White, with all other racial identities accounting for 2% (n = 3) of the sample. Approximately 20.4% (n = 30) of participants identified as Latinx. With respect to index trauma, 55.1% (n = 81) of participants experienced an MVA, 42.9% (n = 63) experienced either physical or sexual assault, and 2% (n = 3) experienced some other form of trauma (e.g., animal bite, fall, bicycle accident).

2.2. Measures

In addition to demographic information (age, sex, ethnicity), the following measures were administered at baseline (2 weeks) except as otherwise noted in bold font. Coefficient alpha values are displayed in Table 1.

2.2.1. State and Trait Anxiety

The State-Trait Anxiety Inventory (STAI; Spielberger et al., 1983) is a reliable and valid 40-item self-report measure with two subscales (20 items each), evaluating current state anxiety (State Anxiety Scale [S-Anxiety]) and more stable aspects of anxiety (Trait Anxiety Scale [T-Anxiety]; Julian, 2011). Higher scores on each subscale (ranging from 20 to 80) indicate greater anxiety. We reverse-coded items so that higher item responses indicate greater anxiety. Examples of items on the S-Anxiety subscale include: "I am tense", and "I am worried," with responses ranging from 1 ("Not at all") to 4 ("Very much so"). T-Anxiety subscale items include: "I worry too much over something that really doesn't matter" and "I am content" with responses ranging from 1 ("Almost never") to 4 ("Almost always").

Table 1
Means and standard deviations for psychological variables and 4 repeated PCL-5 measurements.

Variable	Alpha	*M*	*SD*	Male *M*(*SD*)	Female *M* (*SD*)
CAPS PTSD scores	–	20.67	15.09	22.52 (15.34)	16.88 (13.94)
State anxiety	0.77	37.20	11.94	36.91 (12.28)	37.81 (11.30)
Trait anxiety	0.88	34.91	10.28	34.92 (10.23)	34.90 (10.49)
Depression	0.77	20.46	7.31	20.94(7.17)	19.48(7.57)
Emotion dysregulation	0.88	104.9	19.58	105.96 (19.54)	102.71 (19.70)
PCL5-1	0.91	50.05	15.27	50.24 (14.83)	49.67 (16.30)
PCL5-2	0.94	37.95	18.23	40.16 (16.99)	33.40 (19.98)
PCL5-3	0.92	36.09	16.16	36.62 (15.58)	35.00 (17.41)
PCL5-4	0.94	30.28	17.86	31.05 (18.00)	28.69 (17.67)

Notes: PCL-5-1 = 2-week assessment, PCL-5-2 = 3-month assessment, PCL-5-3 = 6- to 9-month assessment, PCL-5-4 = 12-month assessment.

2.2.2. Depression

The Quick Inventory of Depressive Symptomatology (QIDS; Rush et al., 2003) is a 16-item self-report screening measure of depressive symptom severity with adequate psychometric properties. Total scores range from 0 to 27 with higher scores demonstrating greater symptom severity (Brown et al., 2008). Total scores >4 indicate mild depression symptoms with an optimal cutoff score of 13 for provisional major depressive episode (Surís et al., 2016).

2.2.3. Emotion dysregulation

Emotion dysregulation was assessed with the Difficulties in Emotion Regulation Scale (DERS; Gratz and Roemer, 2004). The DERS is a reliable and valid 36-item self-report measure with responses ranging from 1 "almost never (0–10%)" to 5 "almost always (91–100%)". Higher scores indicate greater emotion dysregulation.

2.2.4. Trauma exposure

The Life Events Checklist for DSM-5 (LEC-5; Weathers et al., 2013) was used to identify and assess participants' ED-presenting index traumatic event and other traumas. The LEC-5 is a self-report measure that assesses an individual's exposure to 16 potentially traumatic events. The LEC-5 is based on the LEC for DSM-IV which has demonstrated adequate psychometric properties including good convergent validity with other similar measures (Gray et al., 2004).

2.2.5. PTSD symptoms

The PTSD Checklist for DSM-5 (PCL-5; Blevins et al., 2015) was used to assess PTSD severity. The PCL-5 is a 20-item self-report measure with adequate psychometric properties (Bovin et al., 2016). Total scores range from 0 to 80, with responses ranging from 0 ("Not at all") to 4 ("Extremely"). Higher scores indicate greater severity of PTSD, with cutoff scores ranging from 31 to 33 indicative of probable PTSD (Bovin et al., 2016). Participants were instructed to rate symptoms in response

to their ED index trauma — **assessed at all measurement timepoints (rather than only at baseline as with the other assessments above**).

2.2.6. PTSD diagnosis

A probable diagnosis of PTSD was assessed via The Clinician-Administered PTSD Scale for DSM-5 (CAPS-5; Weathers et al., 2018). The CAPS consists of 30 items that assess PTSD symptoms and associated impairment over the past month. For the current study, the CAPS scoring algorithm (based on criteria for PTSD in DSM-5) was used to determine probable diagnosis of PTSD **assessed at three months after the ED-presenting trauma** (according to DSM-5, PTSD cannot be diagnosed until at least one month after the trauma, so we did not administer the CAPS at baseline).

2.3. Data analysis

We used R v.4.0.2 (R Core Team, 2019) to clean and pre-process data, and for preliminary analyses. We used the following R packages: *careless* (for inattentive responding), *dplyr* (data cleaning), *mice* (missing data imputation), *corrplot* (correlations), *fmsb* (internal consistency), and *sjstats* (ANOVA effects). For inclusion in the present analysis, participants must have taken the PCL-5 at two or more (≥50% of) timepoints. Participants with only one PCL-5 timepoint were excluded. For remaining participants, we imputed missing item-level data using maximum likelihood procedures (via the *mice* R package); we subsequently imputed variables with missing data (see Fig. 2) using full-information maximum likelihood procedures.

Data were analyzed using bivariate correlations, and ANOVA to compare PCL-5 scores by sex and index trauma type. Index trauma type was first coded as MVA = 1, assault = 2, and other trauma type = 3. Instances of "other trauma type" (e.g., animal bite, fall, bicycle accident) were infrequent and accounted for approximately 2% of traumatic events experienced in our sample. Then an MVA trauma type variable (MVA = 1, assault/other = 0) and assault trauma type variable (assault = 1, MVA/other = 0) were dummy coded and used in our analyses. Additionally, ANOVA was used to compare individuals who met criteria for PTSD (PTSD group = 1) and those who did not (non-PTSD group = 0) at the 3-month timepoint based on the scoring algorithm for the CAPS.

Growth curve modeling analysis was conducted using Mplus v.8.1 (Muthén and Muthén, 1998-2020) to examine changes in PTSD symptom severity over time. Age, sex, state anxiety, trait anxiety, emotion dysregulation, depression, PTSD diagnosis and trauma type were included as covariates to examine their relative contributions to PTSD symptom severity at baseline and change in severity across repeated measures. We used maximum likelihood estimation with robust standard errors as the estimator.

3. Results

We present descriptive statistics in Table 1 and bivariate correlations for variables of interest in Fig. 2. On a bivariate basis, depression, state and trait anxiety, and emotion dysregulation were positively correlated with PCL-5 scores at all timepoints. Approximately 36%[1] of this trauma-exposed sample met the cutoff (CAPS-5 score of >30) for probable PTSD diagnosis at the 3-month timepoint.

Inferential statistics are summarized in Table 2. At baseline, significant differences in PCL-5 scores existed between individuals reporting an index trauma of MVA ($M = 52.97$) vs. those without MVA index trauma ($M = 47.68$), $p = 0.03$; and between individuals with an assault-related ($M = 53.08$) vs. non-assault-related index trauma ($M = 47.85$), $p = 0.036$. At three months, significant differences in PCL-5 scores existed between males ($M = 40.16$) and females ($M = 33.40$), $p = 0.034$, and between those who experienced a MVA ($M = 41.35$) and those who did not ($M = 35.19$), $p = 0.041$. No significant differences existed at the third time point. At twelve months, a significant difference in PCL-5 scores existed between those who experienced a MVA ($M = 33.62$) and those who did not ($M = 27.56$), $p = 0.04$. Effect sizes were small ($\eta^2 \leq 0.03$) throughout.

We tested an unconditional linear growth model, first assessing change in PCL-5 scores across time without covariates, $\chi^2(5, N = 147) = 34.09$, $p < 0.001$. The intercept's variance (138.86, $p < 0.001$) was significant, supporting the use of random effects in subsequent analysis. The slope's variance (1.88, $p = 0.66$) was not significant, and was fixed at 0 in the conditional model. The slope's mean was significant, $\beta = -1.594$, SE = 0294, $p < 0.001$, indicating that PCL-5 scores significantly decreased over the 12-month period (see Fig. 3, separated by trauma type). Slope and intercept were significantly inversely correlated, $\beta = -0.582$, SE = 0.135, $p < 0.001$, demonstrating that individuals with higher initial PCL-5 scores had steeper symptom declines over time. Adding a quadratic effect to the model resulted in statistical convergence issues, indicating a linear rather than non-linear change in PCL-5 scores across the 12-month period. Accordingly, subsequent analyses model a linear slope.

Next, we tested a conditional model adding the covariates from Table 3, $\chi^2(25, N = 147) = 110.551$, $p < 0.001$. We present standardized regression coefficients for covariates predicting the intercept and slope in Table 3. Depression, state anxiety, emotion dysregulation, and PTSD diagnosis were positively associated with the PCL-5's intercept, suggesting individuals experiencing greater severity depression, anxiety, emotion dysregulation, and PTSD diagnosis had higher PCL-5 scores at baseline. Regarding the PCL-5's slope, depression and state anxiety were inversely associated with PTSD severity over time.[2] This finding indicates that individuals who experienced greater symptoms of depression and higher state anxiety showed steeper decreases in PCL-5 scores across time.[3]

4. Discussion

The current study examined PTSD symptoms prospectively in trauma victims using demographic and psychopathology covariates via growth modeling. Consistent with previous studies (Farhood et al., 2016; Demir et al., 2020; Norr et al., 2016) and our hypothesis (H1), we found that baseline PTSD symptom severity was positively associated with state (but not trait) anxiety, depression, and emotion dysregulation. Although not included in our hypotheses, baseline PTSD severity was also positively associated with PTSD diagnosis.

In addition to examining covariates of baseline PTSD severity, growth modeling revealed significant associations with PTSD symptom change over time. State anxiety and depression were inversely related to PTSD severity over time. That is, greater state anxiety and depression symptoms at baseline were associated with steeper declines in PTSD symptoms over time. Our significant finding for depression confirms previous evidence that depression symptoms influence PTSD pathology (Backholm and Björkqvist, 2012); however, not in the expected direction. Perhaps the decline in PTSD symptoms despite high initial depression symptoms is reflective of stronger initial psychological reactions to traumatic exposure due to pre-existing psychopathology.

[1] A total of 139 participants completed the CAPS-5 at the 3-month timepoint and 50 (35.95%) scored 31 or greater on the CAPS-5 suggesting a probable diagnosis of PTSD.

[2] Additionally, we computed the conditional model with interactions between depression with PTSD diagnosis and anxiety with PTSD diagnosis. The interaction of depression with PTSD was negatively related to the intercept, $\beta = -0.937$, SE = 0.236, $z = -3.969$, $p < 0.001$. Remaining interactions with the intercept and slope were not significant.

[3] We also computed the conditional model without PTSD diagnosis as a covariate, $\chi^2(23, N = 147) = 53.929$, $p < 0.001$. Results remained the same, except emotion dysregulation was no longer related to the intercept.

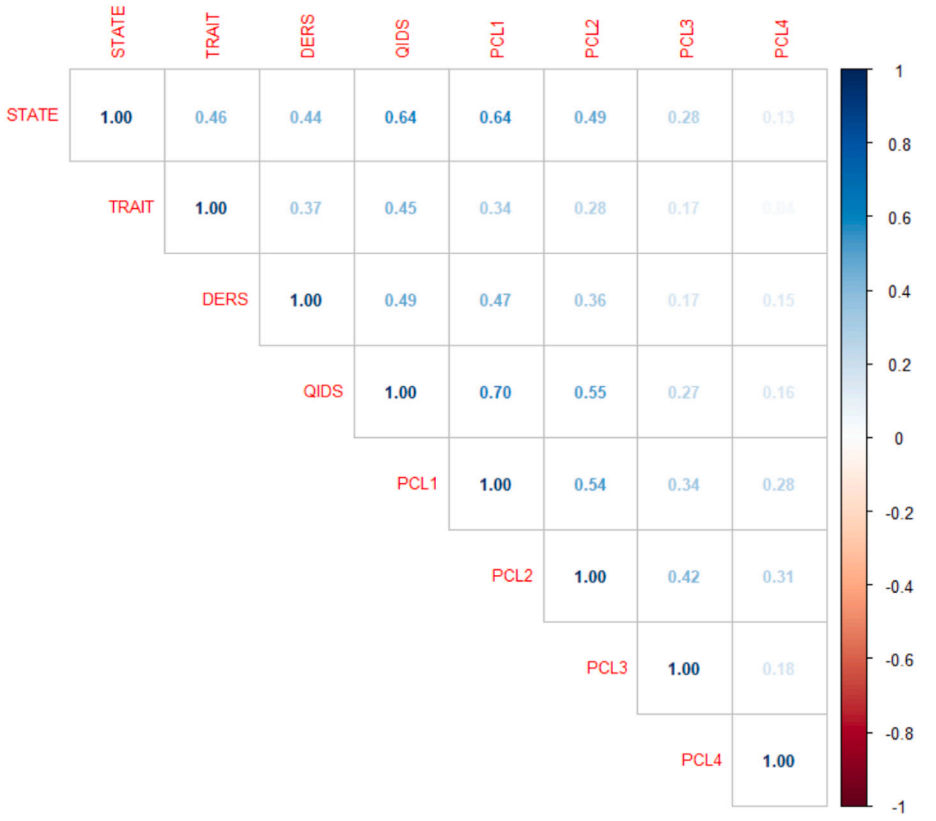

Fig. 2. Bivariate correlation heatmap for variables of interest.
Notes: STATE = state anxiety; TRAIT = trait anxiety; QIDS = depression; DERS = emotion dysregulation; PCL = PTSD symptom severity whereby PCL1 = 2-week assessment, PCL2 = 3-month assessment, PCL3 = 6- to 9-month assessment, PCL4 = 12-month assessment. Correlations >0.16 in size were significant at $p < 0.05$, and correlations >0.21 were significant at $p < 0.01$.

Table 2
Inferential statistics for baseline psychological variables and repeated PCL-5 measurements.

	Sex			MVA			Assault		
	Male *M*(*SD*)	Female *M*(*SD*)	$p(\eta^2)$	Yes *M*(*SD*)	No *M*(*SD*)	$p(\eta^2)$	Yes *M*(*SD*)	No *M*(*SD*)	$p(\eta^2)$
PCL5-1	50.24(14.83)	49.67(16.30)	0.84(0.00)	52.97(14.03)	47.68(15.90)	0.03(0.03)	53.08(13.67)	47.85(16.06)	0.04(0.03)
PCL5-2	40.16(16.99)	33.40(19.98)	0.05(0.03)	41.35(19.05)	35.19(17.16)	0.04(0.03)	40.55(18.99)	36.06(17.53)	0.14(0.02)
PCL5-3	36.62(15.58)	35.00(17.41)	0.59(0.00)	37.67(15.27)	34.80(16.83)	0.28(0.00)	37.76(15.05)	34.87(16.90)	0.28(0.00)
PCL5-4	31.05(18.00)	28.69(17.67)	0.45(0.00)	33.62(19.42)	27.56(16.10)	0.04(0.03)	33.29(19.56)	28.08(16.29)	0.09(0.02)

Notes: PCL-5-1 = 2-week assessment, PCL-5-2 = 3-month assessment, PCL5-3 = 6-to 9-month assessment, PCL-5-4 = 12-month assessment.

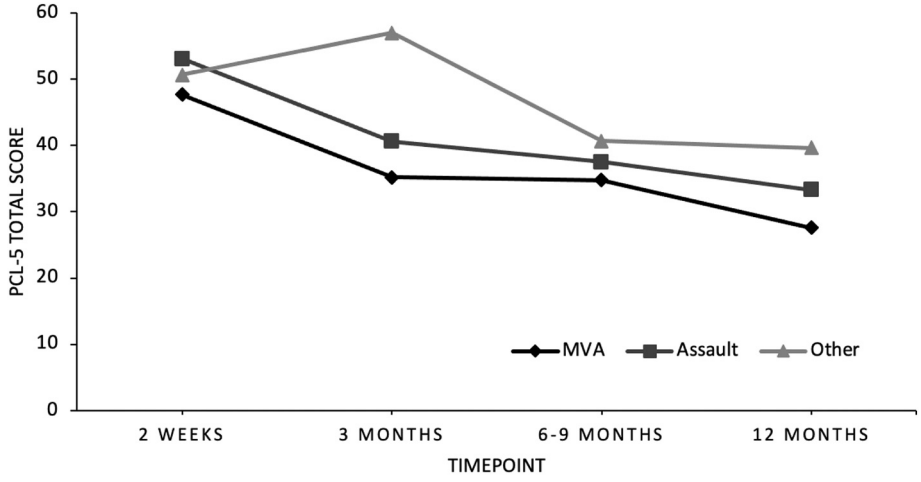

Fig. 3. Changes in PTSD symptom severity over time by index trauma type.

Table 3
Standardized covariate regression coefficients for the intercept and slope (for PCL-5 repeated measurements) in the linear growth model.

Covariate	Intercept β (SE)	z	Slope β (SE)	z
Age	−0.019 (0.063)	−0.299	0.113 (0.145)	0.781
Sex	0.020 (0.065)	0.331	−0.075 (0.138)	−0.542
PTSD diagnosis	0.22 0 (0.072)	3.048**	0.180 (0.167)	1.073
State anxiety	0.353 (0.072)	4.873**	−0.413 (0.171)	−2.421*
Trait anxiety	−0.115 (0.068)	−1.705	−0.016 (0.215)	−0.073
Emotion dysregulation	0.161 (0.065)	2.479*	−0.054 (0.180)	−0.299
Depression	0.519 (0.071)	7.349**	−0.706 (0.145)	−4.877**
Trauma — MVA	−0.131 (0.227)	−0.580	−0.547 (0.364)	−1.506
Trauma — assault	−0.107 (0.229)	−0.469	−0.499 (0.379)	−1.316

* Indicates $p < 0.05$.
** Indicates $p < 0.01$.

Individuals with greater depression symptoms may have experienced a greater initial spike in PTSD symptoms thus having a higher baseline (more room) from which to experience a decrease in PTSD symptoms. Our finding may also reflect evidence that depression and PTSD symptoms are independent sequelae of traumatic events (Shalev et al., 1998). It may be that, over time, participants' PTSD symptoms remitted; however, depression symptoms may have remained. Because the current study did not analyze depression symptoms over time, further research is needed to explain this finding. Additionally, participants with greater depression symptoms may have been more motivated to seek treatment subsequently resulting in steeper declines of symptoms overall. Finally, our finding may reflect spontaneous remission rates seen with PTSD diagnoses (Morina et al., 2014).

Our finding with state anxiety has little precedence in the literature. To the authors' knowledge, this is the first study of its kind to examine baseline state anxiety and change in PTSD severity in adults. One possible reason state anxiety significantly influenced PTSD severity may be that a temporary and, thus, changing emotional state may better account for the variance in PCL-5 scores rather than a stable personality disposition, like trait anxiety. However, the inclusion of state anxiety in future prospective studies of PTSD is necessary to confirm this finding.

Contrary to hypotheses, female sex was not significantly associated with either baseline PTSD symptom severity (H2) or change in PTSD symptom severity (H4). This was a surprising finding given the substantial evidence in the literature demonstrating female sex as a risk factor for PTSD (Christiansen and Berke, 2020). Yet our sample was predominately male (approximately 67%), and a more equal distribution of sex may have revealed different results. In addition to sex, trait anxiety and emotion dysregulation were not associated with change in PTSD severity (H3). Given that baseline emotion dysregulation was associated with baseline PTSD severity and greater baseline state anxiety was associated with steeper declines in PTSD severity over time, how an individual emotionally processes trauma (emotion regulation) shortly after the event may play an important role in initial PTSD severity while an individual's affective state (state anxiety) may contribute to PTSD's course. A somewhat perplexing finding counter to our hypothesis was that assault and MVA trauma were not significantly associated with change in PTSD severity (H5). There is substantial evidence in the literature suggesting interpersonal trauma (physical/sexual assault) is associated with greater PTSD symptom severity (Guina et al., 2018; Kelley et al., 2009). Thus, we would expect to see an increase in PTSD symptom severity (as hypothesized) or less steep declines over time in individuals who experienced assault trauma. This finding may again reflect our predominately male sample. There are noted sex differences associated with vulnerability to specific trauma types and emotional response to trauma (Irish et al., 2011; Neria et al., 2010). Thus, if our sample reflected a more equal distribution of sex, our results may have been different.

4.1. Limitations

There are limitations with the current study that are important to consider. First, data were collected at only four timepoints over the course of 12-months. Results may be different with more measurement points over longer periods (e.g., 5 years). Another potential limitation was the use of a dichotomous (diagnosis vs. no diagnosis) PTSD diagnosis variable which does not reflect variation of severity of PTSD diagnosis. We found that PTSD diagnosis was not significantly associated with change in PTSD symptom severity; using a continuous variable for PTSD diagnosis, such as a CAPS score, may have yielded different results. Another important consideration is the low frequency of "other" trauma types (approximately 2%) included in our analysis. Due to the low frequency of "other" trauma types, and the method for coding MVA and assault trauma types, the proportions of participants for the MVA/other variable and the assault/other variable were similar and thus produced similar findings (Table 3). Results may have been different with a greater frequency of other trauma types. Finally, we did not examine post-traumatic factors associated with PTSD severity such as social support (Sareen, 2014) or whether participants were receiving treatment for PTSD. The inclusion of pre-, peri- and post-trauma risk factors would allow for a more comprehensive examination of PTSD pathology.

4.2. Conclusion

Understanding risk factors for PTSD pathology can help with assessment of trauma victims when they present to the ED. Our study demonstrates risk factors such as sex, trauma type, state anxiety, depression, and emotion dysregulation deserve further attention; and longitudinal research is necessary to understand their impact on PTSD symptom severity over time. Considering the functional impairment (comorbidity, suicidality) associated with PTSD prognosis, providing trauma victims psychoeducation on potential short- and long-term implications of traumatic exposure and, when indicated, information on trauma-focused treatments will hopefully alleviate the negative impact of the same.

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Availability of data and material

Data and survey materials will be made available upon request.

CRediT authorship contribution statement

Emily A. Rooney: Writing – original draft, Visualization, Data curation, Validation. **Caleb J. Hallauer:** Formal analysis, Data curation, Visualization, Validation. **Hong Xie:** Investigation, Writing – review & editing, Data curation, Validation. **Chia-Hao Shih:** Writing – review & editing, Data curation, Validation. **Daniel Rapport:** Writing – review & editing, Data curation, Validation. **Jon D. Elhai:** Supervision, Writing – review & editing, Data curation, Validation. **Xin Wang:** Investigation, Writing – review & editing, Data curation, Validation.

Declaration of competing interest

The authors report no conflicts of interest with this paper's study. Outside the scope of the present paper…

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