Journal of Affective Disorders 263 (2020) 463–471

Contents lists available at ScienceDirect

Journal of Affective Disorders

journal homepage: www.elsevier.com/locate/jad

Research paper

# Mothers' emotions after pediatric burn injury: Longitudinal associations with posttraumatic stress and depressive symptoms 18 months postburn

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ARTICLE INFO

*Keywords:*
PTSD
Trauma
Emotions
Depression

ABSTRACT

*Background:* Various emotions are implicated in posttraumatic stress disorder (PTSD). Longitudinal studies examining temporal associations between emotions and posttraumatic stress may reveal who is at risk of chronic psychological problems. This study examined the longitudinal relationships of mothers' trauma-related emotions with posttraumatic stress and depressive symptoms after pediatric burn injury.

*Methods:* Data from two cohort studies were used ($n$ = 296). Mothers reported the intensity of burn-related emotions within the first month (T1) and 12 months postburn (T2). The Impact of Event Scale (IES) and the Hospital and Anxiety Depression Scale (HADS-D; depression subscale) were administered at T1 and 18 months postburn (T3).

*Results:* Based on two exploratory factor analyses, emotion variables were combined into acute and long-term basic emotions (fear, sadness, horror, anger) and self-conscious emotions (guilt, shame). The path model showed a positive relationship between acute and long-term basic emotions. Higher long-term basic emotions were related to persistence of posttraumatic stress and depressive symptoms. Acute self-conscious emotions showed associations with posttraumatic stress and depressive symptoms at T1 and were longitudinally related to depressive, but not posttraumatic stress, symptoms.

*Limitations:* The posttraumatic stress measure was not based on DSM-5 PTSD criteria and results require replication using these criteria.

*Conclusions:* This study suggests that mothers' acute self-conscious and long-term basic emotions in relation to their child's burn injury are involved in the development of posttraumatic stress and depressive symptoms. Clinically, assessing and monitoring parents' early posttraumatic stress, depressive symptoms and burn-related emotions may be useful to identify parents at risk.

## 1. Introduction

Experiencing a potentially traumatic event may evoke strong emotions and lead to the development of posttraumatic stress disorder (PTSD) symptoms. DSM-IV PTSD criteria (American Psychiatric Association, 1994) included not just exposure to a traumatic event, but also intense peritraumatic emotions of fear, helplessness, and horror (criterion A2). Later studies have shown that a broader range of trauma-related emotions (such as anger, guilt, shame, and disgust) is associated with subsequent symptoms or a diagnosis of PTSD (Andrews et al., 2000; Engelhard et al., 2011; O'Donnell et al., 2010). DSM-5 (American Psychiatric Association, 2013) no longer includes the former A2 criterion, but does acknowledge the wide range of emotions implicated in PTSD.

This enhanced insight, as shown in changed DSM criteria, points at the usefulness of investigating a broader range of peritraumatic (i.e., at the time of the trauma) and posttraumatic emotions, and their development over time. However, most studies that included a range of

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https://doi.org/10.1016/j.jad.2019.11.140
Received 1 July 2019; Received in revised form 30 October 2019; Accepted 29 November 2019
Available online 30 November 2019

trauma-related emotions assessed them only once (Andrews et al., 2000; O'Donnell et al., 2010). Studies including repeated assessments of emotions mainly comprised intervention studies in patients with PTSD (Øktedalen et al., 2015; Resick et al., 2002). However, PTSD or appraisal processes may affect retrospective assessments of trauma-related memory (Engelhard and McNally, 2015), and mechanisms of change in patients do not necessarily mirror the causal mechanism in the etiology of PTSD symptoms. Studies with repeated emotion assessments have shown that pretrauma trait anger is associated with later posttraumatic stress symptoms (Lommen et al., 2014), that feelings of guilt increase intrusive symptoms (Bub and Lommen, 2017), and that the short-term development of emotions varies by trauma type (Amstadter and Vernon, 2008). As a starting point, these studies are informative, but they provide minimal information on the long-term course of trauma-related emotions, because they assessed trait emotions (Lommen et al., 2014), used experimentally induced trauma (Bub and Lommen, 2017), or only assessed emotions in the first days after the traumatic event (Amstadter and Vernon, 2008). To elucidate temporal associations between emotions and posttraumatic stress symptoms, more longitudinal research is needed (McLean and Foa, 2017; Pugh et al., 2015). This may reveal who recovers and who is at risk of chronic posttraumatic stress symptoms. Furthermore, as depressive symptoms often co-occur with posttraumatic stress after trauma (Contractor et al., 2018; O'Donnell et al., 2004), it is relevant to study trauma-related emotions in relation to depressive symptoms as well. The few available studies indicate that sadness, anger, guilt and shame are associated with depressive symptoms after trauma exposure (Kubany et al., 1995; Marx et al., 2010; Rizvi et al., 2008).

Serious burn injury in a child places parents at risk of developing posttraumatic stress (Bakker et al., 2010; De Young et al., 2014) and depressive symptoms (De Young et al., 2014; Phillips and Rumsey, 2008). Although symptom levels typically decrease after the acute phase (De Young et al., 2014), a considerable number of parents experience long-term symptoms (Bakker et al., 2010; Phillips and Rumsey, 2008). Associations between burn severity and parental posttraumatic stress are generally small (De Young et al., 2014; Hawkins et al., 2019). Studies show that it is rather the subjective experience of the injury and medical events that shape the psychological outcome (Kazak et al., 2006). Regarding the subjective experience, qualitative research suggests that parents experience a range of trauma-related emotions such as fear, sadness, anger, and guilt (Egberts et al., 2019; McGarry et al., 2015). Particularly trauma-related guilt is commonly reported by mothers (Bakker et al., 2010) and is associated with concurrent and later posttraumatic stress symptoms (Bakker et al., 2010; De Young et al., 2014; Hawkins et al., 2019). Furthermore, generalized guilt (but not burn-specific guilt) has been related to parental depression cross-sectionally (Sveen and Willebrand, 2018). To our knowledge, no pediatric burn injury studies have repeatedly assessed trauma-related emotions like revulsion or anger, although these emotions are associated with posttraumatic stress after other types of trauma and are resistant to extinction or impede therapy for PTSD (Engelhard et al., 2014; Olatunji et al., 2010). Studying the longitudinal associations between a broader range of burn-related emotions and long-term posttraumatic stress and depressive symptoms may indicate whether different emotions play a differential role in maintaining these symptoms.

Various appraisals of the trauma and its consequences can trigger different trauma-related emotions (Ehlers and Clark, 2000). For example, appraisals regarding responsibility for the trauma may lead to guilt or anger, appraisals about perceived threat to fear, and a perception of loss may trigger sadness. These appraisals and emotions may depend on the type of traumatic event; peri- and posttraumatic emotions have been shown to vary across trauma types (Amstadter and Vernon, 2008; Creamer et al., 2005). Also within the group of parents faced with pediatric burn injury, emotional reactions differ. It is unclear if the child's age affects these reactions (Egberts et al., 2019). Burn events in young children typically concern accidents in or around the house, with a higher likelihood that parents are present (Vloemans et al., 2011). In addition, younger children are generally more dependent on their parents (Scheeringa and Zeanah, 2001) and so parents may perceive more responsibility for their child's safety than parents of older children do. This may lead to differences in intensity and types of parental emotions, such as guilt and sadness, with consequences for long-term psychological outcomes.

The present study examined the intensity of mothers' emotions related to their child's burn injury and its longitudinal associations with symptoms of posttraumatic stress and depression. To increase the sample size and generalizability, the study combines two previous cohorts of young (0–4 years old) and school-aged (8–18 years old) children. The aims of the study were: 1) to examine the presence and intensity of mothers' negative emotions in relation to their child's burn injury within the first month (T1) and at 12 months postburn (T2), as well as potential differences between cohorts, 2) to investigate a potential underlying structure of these emotions, and 3) to examine the relationships between mothers' emotions at T1 and T2 and posttraumatic stress and depressive symptoms 18 months postburn (T3) while controlling for symptoms at T1.

## 2. Methods

### 2.1. Procedure and participant recruitment

The current study is part of a set of studies within a larger project, focusing on parental adjustment after a pediatric burn event. Each study has addressed unique research questions, for example, focusing on the course of parents' posttraumatic stress symptoms (Bakker et al., 2013), child behavioral problems (Bakker et al., 2014), and the interdependence of child and parent posttraumatic stress symptoms (Egberts et al., 2018). In the present study we merged data from two prospective cohort studies. The first cohort concerned children in the age of 8 months to 4 years old, and the second cohort comprised children aged 8 to 18 years old. The study was approved by ethics committees in the Netherlands and Belgium. Between April 2007 and July 2011, families were enrolled in three Dutch and four Belgian burn centers. The current study used data on mothers' emotions, posttraumatic stress, and depressive symptoms, collected within the first month after the burn event (T1), and subsequently at 12 (T2) and 18 months postburn (T3). Families were eligible to participate if their child had been admitted to the hospital for more than 24 h and the child's total body surface area (TBSA) burned was at least 1%. Families were excluded in case of insufficient Dutch language proficiency or child cognitive impairment. During admission, researchers at the burn centers contacted eligible families, explained the study purpose, and offered additional written information. Parents and children (>12 years old) provided written informed consent.

### 2.2. Participants

Of the 515 eligible families, 55 families in the cohort of young children and 22 families in the cohort of school-aged children declined to participate in the study, 26 children (young cohort) and 15 children (school-aged cohort) were already discharged before the family could be approached, and 16 (young cohort) and 19 (school-aged cohort) families were not invited because the researcher deemed their participation too burdensome or inappropriate (e.g., in case of self-inflicted burns, severely ill family members, involvement of child protection services, or severe financial problems). Thirty-two (young cohort) and 34 (school-aged cohort) mothers gave their informed consent to participate but did not complete the emotion measure at T1. In total, data could be used from 296 mothers who completed the emotion measure at T1 ($n$ young cohort = 184, $n$ school-aged cohort = 112). Table 1 displays the characteristics of the two cohorts.

**Table 1**
Mother and child characteristics within the two cohorts.

| | Total | Young cohort | School-aged cohort | | |
|---|---|---|---|---|---|
| | M (SD) | M (SD) | Range | M (SD) | Range |
| Child age (years) | | 1.79 (0.92) | .59 - 4.67 | 12.91 (2.96) | 7.85 - 17.80 |
| Percentage TBSA burned | 8.17 (8.70) | 7.47 (6.52) | 1 - 45 | 9.36 (11.43) | 1 - 72 |
| Length of stay in hospital (in days) | 13.95 (18.90) | 11.18 (10.47) | 1 - 55 | 18.67 (27.35) | 1 - 180 |
| Number of surgeries | .73 (1.65) | .52 (0.85) | 0 - 5 | 1.09 (2.44) | 0 - 16 |
| Mother age (years) | 35.64 (7.40) | 31.85 (5.28) | 20 - 45 | 42.07 (5.89) | 28 - 55 |
| n (%) | | | | | |
| | Total | Young cohort | School-aged cohort | | |
| Child gender (boys/girls) | 198/97 (67/33) | 121/63 (66/34) | 77/34 (70/30) | | |
| Burn type | | | | | |
| Flame/fire | 71 (24.0) | 7 (3.8) | 64 (57.1) | | |
| Scald | 201 (67.9) | 166 (90.2) | 35 (31.3) | | |
| Contact | 15 (5.1) | 9 (4.9) | 6 (5.4) | | |
| Chemical/electrical | 8 (2.7) | 2 (1.1) | 6 (5.4) | | |
| Other | 1 (0.3) | 0 (0) | 1 (0.8) | | |
| Inside or outside site of accident | | | | | |
| At home | 217 (73.3) | 147 (79.9) | 70 (62.5) | | |
| Somewhere else | 79 (26.7) | 37 (20.1) | 42 (37.5) | | |

*Note.* TBSA = Total Body Surface Area.

### 2.3. Measures

#### 2.3.1. Emotions related to the burn event

At T1 and T2, mothers' burn-related emotions were assessed by self-reports with the question "To what extent do the following emotions apply when you think about the accident that caused the burn?". The emotions of fear, sadness, horror, anger, shame, and guilt were used in the current study (to increase comparability with other studies that assessed trauma-related emotions) and comprised single items rated on a 5-point Likert scale (0 = not at all, 1 = a little, 2 = somewhat, 3 = quite a lot, 4 = a lot).

#### 2.3.2. Posttraumatic stress symptoms

The Impact of Event Scale (IES; Horowitz et al., 1979; Sundin and Horowitz, 2002) was used to assess mothers' posttraumatic stress symptoms at T1 and T3. This valid and psychometrically sound 15-item questionnaire assesses two dimensions of traumatic stress: symptoms of intrusion and avoidance. The Dutch version of the IES (Brom and Kleber, 1985) was used. Mothers were asked to rate the frequency of symptoms they had experienced specifically in relation to their child's burn event on a 4-point Likert scale (0-1-3-5). The total potential range is 0–75, with higher scores representing higher levels of stress. A cut-off score of 26 was used to indicate 'clinically relevant stress symptoms' (van der Velden et al., 1992). The IES demonstrated good reliability at both time points, with Cronbach's alpha of 0.85 at T1 and 0.88 at T3 for the Total scale.

#### 2.3.3. Depressive symptoms

The Hospital Anxiety and Depression Scale (HADS; Zigmond and Snaith, 1983) was used to assess mothers' depressive symptoms. The HADS consists of a 7-item subscale for anxiety (HADS-A) and a 7-item subscale for depression (HADS-D). A literature review of the HADS has indicated appropriate sensitivity, specificity and concurrent validity (Bjelland et al., 2002). Mothers' T1 and T3 reports on the validated Dutch version of the HADS-D (Spinhoven et al., 1997) were used for the current study. Items were rated on a 4-point Likert scale (ranging from 0 to 3), with a total possible sum score for depressive symptoms ranging from 0 to 21 and higher scores indicating higher levels of depressive symptoms. A cut-off score of 8 was used to indicate clinically relevant depressive symptoms or 'possible caseness', because it has been shown to achieve an optimal balance between sensitivity and specificity (Bjelland et al., 2002). The Cronbach's alpha of the HADS-D was 0.88 at T1 and 0.85 at T3, indicating good reliability.

#### 2.3.4. Child- and burn characteristics

Characteristics of the child (gender and age) and the burn (percentage TBSA affected, number of skin grafting procedures during initial hospitalization and length of stay in the hospital) were derived from the medical file. Percentage TBSA is the estimated percentage total body surface area affected by partial- or full-thickness burns, providing an estimate of injury severity. Parents provided information on the burn type and the site of the accident at T1.

### 2.4. Data analysis

#### 2.4.1. Drop-out analysis

Of the 296 mothers who completed the emotion measure at T1, 204 (69%) completed all relevant measures at T2 and T3, and they were compared to the 92 mothers with missing data at T2 and/or T3. Mothers with complete data did not differ significantly in terms of posttraumatic stress and depressive symptoms at T1 ($p$ = .21 and $p$ = .74, respectively), or T1 emotions of fear ($p$ = .56), sadness ($p$ = .28), horror ($p$ = .48), shame ($p$ = .63), and guilt ($p$ = .74). However, mothers with missing data reported somewhat higher levels of anger at T1, compared to mothers with complete data: $M_{complete}$ = 1.20, $SD$ = 1.40, $M_{missing}$ = 1.64, $SD$ = 1.51; $t$ (165) = −2.39, $p$ = .02. No differences between the two groups were found in terms of child gender ($p$ = .77), age ($p$ = .15), or burn severity ($p$ = .61).

#### 2.4.2. Statistical analysis

First, presence, intensity, and mean levels of mothers' emotions in relation to the burn event were calculated and compared between T1 and T2. In addition, incidence of clinically relevant levels of posttraumatic stress and depressive symptoms was described, and correlations between the constructs were calculated.

Second, two exploratory factor analyses (EFA), at T1 and T2, respectively, were conducted in SPSS (version 24) to be able to summarize the six emotion items according to their underlying structure. The goal was to reduce correlated emotions to interpretable factors that could be used in further analyses. A direct oblimin (oblique) rotation was used to allow for a correlation between the factors. Determination of the number of factors and the interpretation of the factors was based on eigenvalue criteria (>1), the scree plot, the factor loadings, and

theoretical grounds. Next, for each moment separately, factor scores were saved using the regression procedure. This was done because we assumed no measurement invariance (see also Lommen et al., 2014b). The two assessment moments were expected to elicit substantially different parental experiences. Namely, the first month is characterized by a hectic and demanding hospitalization in which the acute threat of the injury is a central aspect, whereas this threat has disappeared after a year and parents have had time to reflect on, and (re)appraise the injury (Egberts et al., 2019).

Third, the two cohorts were compared in terms of mean levels of mothers' emotions, and posttraumatic stress and depressive symptoms with the use of independent sample *t*-tests.

Fourth, associations between mothers' emotions, posttraumatic stress and depressive symptoms were examined in a path model. T3 posttraumatic stress and depressive symptoms were used as continuous outcome measures. Analyses were conducted in Mplus 7.4 (Muthén and Muthén, 2012). Bayesian estimation with weakly informative priors (based on the possible range of parameter values) was used for both path models, because of the complexity of the models relative to the sample size (van de Schoot et al., 2017). In estimating the models, the steps of the WAMBS-Checklist were followed (Depaoli and van de Schoot, 2017). A detailed report of these steps applied to the current data, including the exact prior specifications, inspection of convergence, and a sensitivity analysis is available through the Open Science Framework. The posterior predictive *p* value (ppp-value) was used to estimate the model fit, with values around 0.50 indicating a well-fitting model. Finally, to examine whether the relationships between the constructs were comparable across cohorts, a multigroup model was estimated. The posterior distributions of each parameter were compared between the two cohorts and based on the overlap of these distributions, comparability was evaluated.

## 3. Results

### 3.1. Descriptive statistics, prevalence, and correlations

Fig. 1 displays the intensity of mothers' emotions at both time points. Sadness and fear were most commonly reported; most mothers reported at least some level ($\geq 1$ on a 0–4 scale) of these emotions at T1 and T2 (Sadness T1: 96%, T2: 88%; Fear T1: 84%, T2: 73%). At least some level of anger, horror, or guilt was reported by approximately 50% of the mothers (Anger T1: 59%, T2: 49%; Horror T1: 52%, T2: 49%; Guilt T1: 65%, T2: 54%). For shame, these percentages were 41% (T1) and 34% (T2). Mean levels (see Table 2) of all emotions decreased from T1 to T2 (all *ps* $<0.036$).

Based on the pre-determined cut-off of the IES, 49% of the mothers reported clinically relevant levels of posttraumatic stress at T1, which decreased to 18% at T3. Based on the HADS-D cut-off, the prevalence of clinically relevant levels of depression was 31% at T1 and 7% at T3. At T1, 24% of the mothers had clinically relevant levels of both posttraumatic stress and depression, which decreased to 6% at T3. The mean levels (see Table 2) of posttraumatic stress and depressive symptoms decreased from T1 to T3 ($p < .001$).

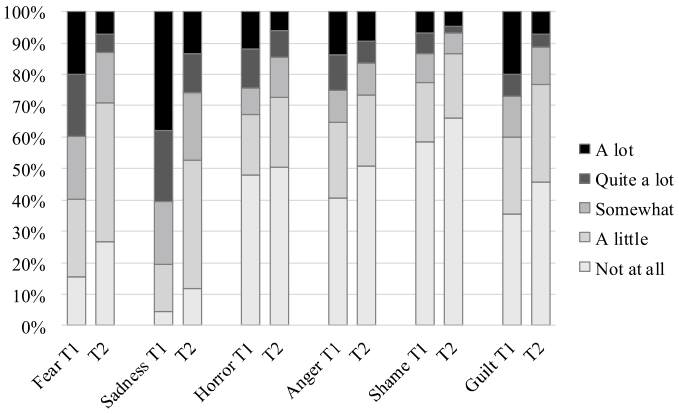


**Fig. 1.** Frequency of mothers' burn-related acute emotions within the first month (T1) and long-term emotions 12 months postburn (T2).

The correlations between symptoms of posttraumatic stress and depression at the same time point were large (0.61 at T1, 0.56 at T3). Table 3 shows the bivariate correlations between mothers' emotions at T1 and T2, and symptoms of posttraumatic stress and depression at T1 and T3. With a few exceptions, both concurrent and longitudinal correlations of emotions with posttraumatic stress and depression were significant. Both concurrently and longitudinally, most emotions showed higher correlations with posttraumatic stress than with depressive symptoms.

### 3.2. Exploratory factor analysis

Based on the scree plot, eigenvalue criteria, and factor loadings resulting from the two EFAs, a two-factor solution was chosen at T1 and T2. Across the two time points, the first factor comprised fear, sadness, horror, and anger. Because the emotion factors at T1 and T2 were computed differently and reflect a different meaning, different labels were given: the first factor was termed 'acute basic emotions' at T1 and 'long-term basic emotions' at T2 (see Tracy and Robins, 2004). This factor explained 34% of the variance at T1 and 43% at T2. Factor loadings ranged from 0.55 to 0.80 at T1 and from 0.64 to 0.83 at T2, and the eigenvalues were 2.06 and 2.60 at T1 and T2, respectively. The second factor included shame and guilt, and was termed 'acute self-conscious emotions' at T1 and 'long-term self-conscious emotions' at T2 (see Tracy and Robins, 2004), and explained 31% of the variance at T1 and 36% at T2. Factor loadings were 0.74 (guilt) and 0.86 (shame) at T1, and 0.99 (guilt) and 0.67 (shame) at T2. Eigenvalues were 1.85 and 2.18 at T1 and T2, respectively. The correlation of the two factors was 0.52 at T1 and 0.48 at T2. A Table displaying all factor loadings of the six emotions at both time points is available through the Open Science Framework.

### 3.3. Differences between the two cohorts

As displayed in Table 2, mothers of younger children reported higher levels of fear at T1, and higher levels of shame and guilt at both time points. This was also found on the factor level, where mothers of young children scored significantly higher on acute basic emotions (T1: $p = .01$), and on both acute and long-term self-conscious emotions, compared to mothers of school-aged children (T1 and T2: $p < .001$), but no significant differences were found for long-term basic emotions (T2: $p = .17$). In addition, no significant differences between the two cohorts were found regarding levels of posttraumatic stress (T1: $p = .43$; T2: $p = .68$) and depressive symptoms (T1: $p = .73$; T2: $p = .31$).

### 3.4. Path analyses

Results of the path model are shown in Fig. 2 and Table 4. The model explained 52% of the variance for T3 posttraumatic stress, and 28% for T3 depressive symptoms.

Regarding *posttraumatic stress symptoms* at T3, strong path coefficients were found relating higher acute (T1) basic emotions and higher initial posttraumatic stress symptoms via higher long-term basic emotions (T2) to more posttraumatic stress symptoms at T3. Moreover, the direct path between posttraumatic stress symptoms at T1 and T3 was strong. Thus, higher acute basic emotions and traumatic stress symptoms were associated with higher long-term posttraumatic stress symptoms, through higher long-term basic emotions. Taking account of other levels and relationships in the model, *higher* acute basic symptoms

**Table 2**
Means (M) and standard deviations (SD) of mothers' emotions, posttraumatic stress, and depressive symptoms for the overall sample and the two cohorts separately.

| | T1 | | | T2 (emotions) or T3 (posttraumatic stress and depressive symptoms) | | |
|---|---|---|---|---|---|---|
| Emotions | Total | Young cohort | School-aged cohort | Total | Young cohort | School-aged cohort |
| Fear | 2.04 (1.37) | 2.16 (1.39)* | 1.84 (1.33)* | 1.22 (1.13) | 1.31 (1.24) | 1.07 (0.89) |
| Sadness | 2.74 (1.23) | 2.81 (1.28) | 2.63 (1.16) | 1.74 (1.22) | 1.86 (1.27) | 1.53 (1.09) |
| Horror | 1.21 (1.45) | 1.27 (1.50) | 1.12 (1.37) | .97 (1.24) | 1.00 (1.30) | .93 (1.12) |
| Anger | 1.34 (1.45) | 1.45 (1.50) | 1.16 (1.34) | 1.02 (1.32) | 1.10 (1.38) | .87 (1.20) |
| Shame | .84 (1.24) | 1.09 (1.34)** | .44 (0.94)** | .59 (1.03) | .78 (1.17)** | .24 (0.60)** |
| Guilt | 1.52 (1.52) | 1.95 (1.54)** | .82 (1.19)** | .96 (1.18) | 1.19 (1.25)** | .55 (0.92)** |
| Posttraumatic stress symptoms | 26.78 (13.97) | 27.28 (14.08) | 25.93 (13.81) | 14.13 (12.29) | 14.40 (12.74) | 13.63 (11.49) |
| Depressive symptoms | 5.27 (4.52) | 5.34 (4.74) | 5.15 (4.14) | 2.19 (3.02) | 2.36 (3.23) | 1.90 (2.59) |

*Note.* T1 = within first month postburn, T2 = 12 months postburn, T3 = 18 months postburn. Asterisks indicate a significant difference between the two cohorts.
* $p < .05$
** $p < .01$. In the total group all emotions, posttraumatic stress symptoms and depressive symptoms significantly decreased from T1 to T2 or T3.

**Table 3**
Pearson correlations between mothers' emotions and symptoms of posttraumatic stress and depression at T1 and T3.

| | Posttraumatic stress | | | | Depression | | | |
|---|---|---|---|---|---|---|---|---|
| | T1 | | T3 | | T1 | | T3 | |
| Emotions | T1 | T2 | T1 | T2 | T1 | T2 | T1 | T2 |
| Fear | .44** | .40** | .30** | .40** | .31** | .27** | .16 | .35** |
| Sadness | .44** | .45** | .31*** | .46** | .36** | .26** | .11 | .13 |
| Horror | .32** | .42** | .16* | .41** | .21** | .22** | .08 | .22** |
| Anger | .43** | .48** | .24** | .52** | .29** | .34** | .19** | .28** |
| Shame | .31** | .37** | .23** | .36** | .18** | .15* | .24** | .26** |
| Guilt | .40** | .37** | .34** | .36** | .26** | .14 | .35** | .20** |
| *n* | 280-285 | 192-193 | 192-194 | 184-185 | 282-287 | 193-195 | 188-190 | 179-180 |

*Note.* T1 = within first month postburn, T2 = 12 months postburn, T3 = 18 months postburn. Total $n = 296$ mothers. The range of the sample sizes ($n$) refers to the number of mothers for whom data was available at each time point.
* $p < .05$
** $p < .01$

at T1 were directly associated with lower posttraumatic stress at T3. For both acute (T1) and long-term (T2) self-conscious emotions, no associations with posttraumatic stress at T3 were found. Within the same time point (T1), posttraumatic stress symptoms showed positive associations with both acute basic- and self-conscious emotions. In addition, higher initial posttraumatic stress (T1) was related to higher long-term basic- and self-conscious emotions (T2).

A similar pattern was observed for the relationship between acute basic emotions and *depressive symptoms*: higher acute basic emotions (T1) were related to more depressive symptoms at T3 via higher long-term basic emotions (T2). Higher depressive symptoms at T1 were related to higher symptoms at T3. Similar to posttraumatic stress, lower acute basic emotions (T1) were directly related to higher depressive symptoms at T3, when taking into account the other relationships. Furthermore, higher acute self-conscious emotions (T1) were longitudinally related to more depressive symptoms at T3, whereas no association was observed between long-term self-conscious emotions (T2) and depressive symptoms at T3. Positive concurrent relationships between the constructs were observed, with higher depressive symptoms at T1 associated with higher acute basic- and self-conscious emotions (T1). Moreover, higher initial depressive symptoms (T1) were related to higher long-term basic emotions (T2).

Posttraumatic stress and depressive symptoms showed positive concurrent associations at T1 and T3. Depressive symptoms at T1 predicted posttraumatic stress symptoms at T3, but posttraumatic stress symptoms at T1 did not predict depressive symptoms at T3.

The results of the multigroup model provided sufficient ground to analyze the two cohorts within the same model (see Open Science Framework for model results). This was indicated by the substantial overlap of the 95% Credibility Intervals (CIs) of the parameters across the cohorts, showing no differences in associations. An exception to this was the effect of basic emotions at T2 to depressive symptoms at T3 ($B_{young} = 1.26$, CI = 0.42 – 2.06; $B_{school\text{-}aged} = -0.17$, CI = −1.59 – 4.90). Although some overlap between the CIs of these parameters was still present, the results indicated the presence of an effect in the young cohort and an absence of this effect in the school-aged cohort. However, for the other parameters, no substantial differences between the cohorts were found regarding associations between the constructs, and therefore comparable relationships between the constructs across cohorts could be assumed.

## 4. Discussion

The current study demonstrated that mothers varied in their experiences of emotions in reaction to their child's trauma. Mothers' emotions related to their child's injury were categorized into acute and long-term basic emotions (fear, sadness, horror, and anger) and acute and long-term self-conscious emotions (guilt and shame). Higher acute basic emotions were related to long-term basic emotions which, in turn, predicted a persistence of posttraumatic stress and depressive symptoms. Acute self-conscious emotions were concurrently related to early posttraumatic stress and depressive symptoms, and longitudinally to depressive symptoms.

Within the first month postburn, 31% of the mothers reported clinically relevant levels of depressive symptoms and 49% reported posttraumatic stress in the clinical range. Eighteen months postburn these rates were 7 and 18%, respectively. Nearly all mothers with long-term depressive symptoms in the clinical range also reported posttraumatic stress symptoms in this range. Consistent with the inclusion of the negative alterations in cognitions and mood cluster in the DSM-5

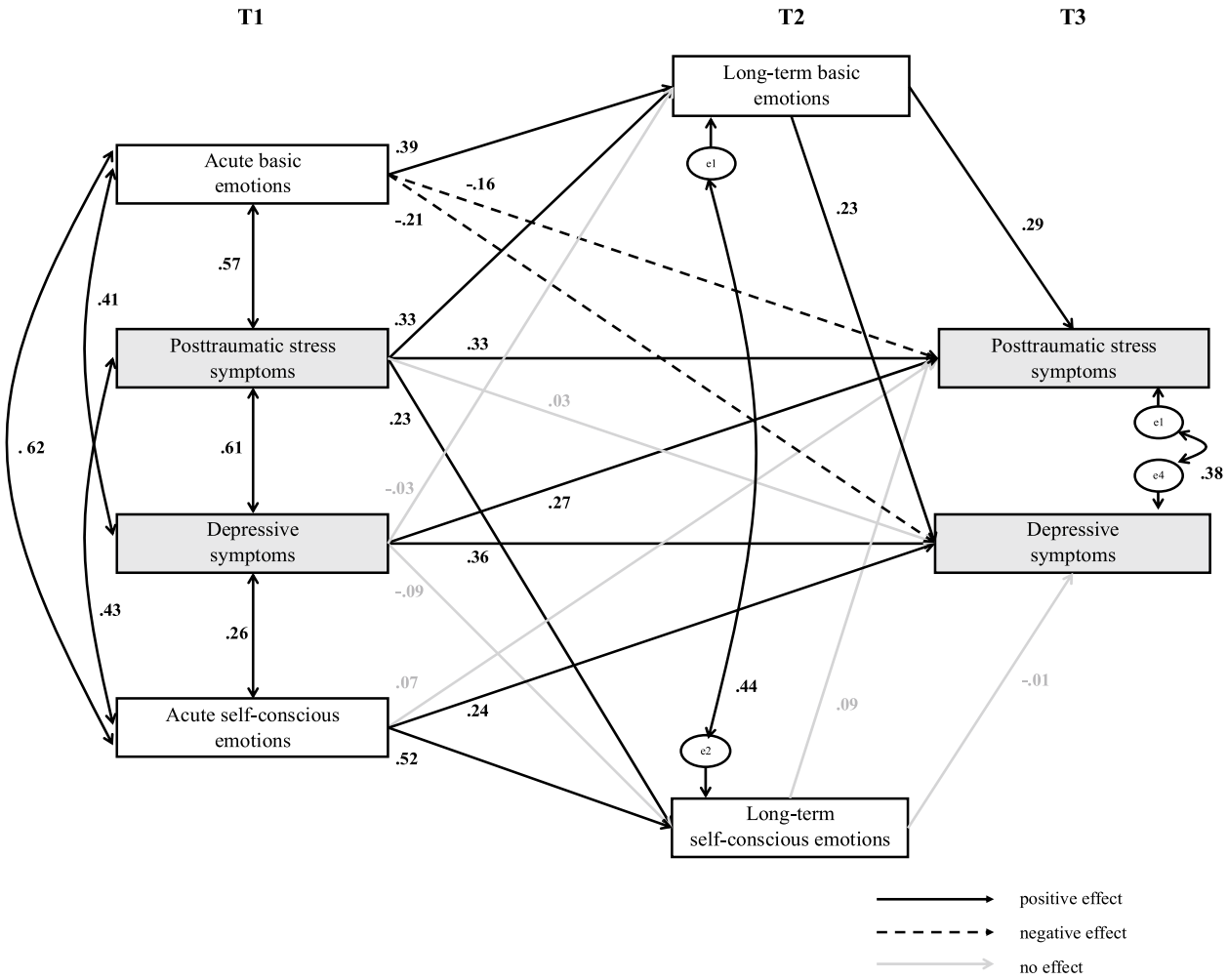


**Fig. 2.** Results of the path model representing the longitudinal associations between the summarizing emotion variables, posttraumatic stress, and depressive symptoms. Standardized coefficients are shown. The shape of the lines indicate the direction of effects. Lines in gray represent parameters for which the 95% Credibility Interval contained the value of zero, indicating no effect. T1 = within the first month postburn, T2 = 12 months postburn, T3 = 18 months postburn (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.) .

PTSD criteria (American Psychiatric Association, 2013), this may indicate that depressive symptoms occurred in the context of posttraumatic stress. On the other hand, the results may reflect a more general chronic traumatic stress reaction that reflects less differentiation between symptoms of posttraumatic stress and depression in the long-term (O'Donnell et al., 2004).

The classification of basic and self-conscious emotions is congruent with theory on human emotions that often proposes such a distinction (Tracy and Robins, 2004). Results showed that shortly after the burn event, sadness (96%) and fear (84%) were almost universal, in line with studies after other types of trauma reporting that sadness was the most dominant trauma-related emotion (Berntsen and Rubin, 2007; Hathaway et al., 2009). Guilt and shame occurred in about half of the mothers in the first month after the injury. Despite an overall decrease of emotion intensity over time, the results highlight the profound long-term emotional impact of child trauma, as indicated by the presence of a subgroup of mothers with persisting high levels of emotions.

The results suggest that particularly persistent heightened basic emotions place mothers at risk of developing chronic symptoms of posttraumatic stress and depression; rather than the occurrence of intense acute emotions as such. In contrast, the level of acute self-conscious emotions appears important, as indicated by the concurrent associations with posttraumatic stress and depressive symptoms within the first month postburn. In addition, the results showed a strong relationship between acute and long-term self-conscious emotions and suggest that the presence of early posttraumatic stress symptoms may influence long-term self-conscious emotions. These longitudinal findings extend previous studies that have shown cross-sectional relations between trauma-related emotions and symptoms of posttraumatic stress and depression, or that have only assessed these emotions once (Andrews et al., 2000; Kubany et al., 1995; Marx et al., 2010; O'Donnell et al., 2010; Rizvi et al., 2008). Whereas high levels of acute self-conscious emotions may already indicate a risk of posttraumatic stress and depressive symptoms, high levels of acute basic emotions may be less indicative of long-term risk. Their predictive role may be limited if emotion intensity dissipates with time, or if emotions occur in the absence of early posttraumatic stress and depressive symptoms. Of course, correlation does not imply causation. Nevertheless, clinically, it may be valuable to assess early symptoms of posttraumatic stress and depression, as well as negative trauma-related emotions. Moreover, the findings suggest that posttraumatic stress and depression should also be monitored at a later time (e.g., after a few months). As the presence of acute self-conscious emotions already appears to indicate risk, further research should evaluate whether early interventions targeting these emotions is helpful and what would be an appropriate time frame for such interventions. For instance, effective interventions that target trauma-related guilt are available (Kubany et al., 1995) but have not specifically been tested after pediatric burn injury.

High levels of acute self-conscious emotions were associated with an increased risk of later depressive symptoms. A qualitative study

**Table 4**
Parameter estimates for the path model.

| | *B* | Posterior *SD* | $CI_B$ | β |
|---|---|---|---|---|
| **Posttraumatic stress T3 predicted by** | | | | |
| Posttraumatic stress T1 | **0.30** | **0.07** | **0.17, 0.43** | **0.33** |
| Depressive symptoms T1 | **0.75** | **0.18** | **0.41, 1.09** | **0.27** |
| Acute basic emotions (T1) | **−2.24** | **1.08** | **−4.33, −0.09** | **−0.16** |
| Long-term basic emotions (T2) | **3.86** | **0.98** | **1.92, 5.78** | **0.29** |
| Acute self-conscious emotions (T1) | 1.00 | 1.02 | −1.00, 3.01 | 0.07 |
| Long-term self-conscious emotions (T2) | 1.14 | 0.94 | −0.69, 2.96 | 0.09 |
| **Depressive symptoms T3 predicted by** | | | | |
| Depressive symptoms T1 | **0.25** | **0.06** | **0.14, 0.36** | **0.36** |
| Posttraumatic stress T1 | 0.01 | 0.02 | −0.04, 0.05 | 0.03 |
| Acute basic emotions (T1) | **−0.75** | **0.34** | **−1.41, −0.07** | **−0.21** |
| Long-term basic emotions (T2) | **0.76** | **0.31** | **0.15, 1.35** | **0.23** |
| Acute self-conscious emotions (T1) | **0.82** | **0.33** | **0.19, 1.46** | **0.24** |
| Long-term self-conscious emotions (T2) | −0.02 | 0.29 | −0.59, 0.55 | −0.01 |
| **Long-term basic emotions (T2) predicted by** | | | | |
| Acute basic emotions (T1) | **0.41** | **0.07** | **0.27, 0.55** | **0.39** |
| Posttraumatic stress T1 | **0.02** | **0.01** | **0.01, 0.03** | **0.33** |
| Depressive symptoms T1 | −0.01 | 0.01 | −0.03, 0.02 | −0.03 |
| **Long-term self-conscious emotions (T2) predicted by** | | | | |
| Acute self-conscious emotions (T1) | **0.56** | **0.06** | **0.43, 0.69** | **0.52** |
| Posttraumatic stress T1 | **0.02** | **0.01** | **0.01, 0.03** | **0.23** |
| Depressive symptoms T1 | −0.02 | 0.02 | −0.05, 0.01 | −0.09 |
| **Within-time associations** | | | | |
| Acute basic emotions (T1) ↔ Posttraumatic stress T1 | **7.21** | **0.90** | **5.61, 9.14** | **0.57** |
| Acute basic emotions (T1) ↔ Depressive symptoms T1 | **1.68** | **0.27** | **1.19, 2.26** | **0.41** |
| Acute self-conscious emotions (T1) ↔ Posttraumatic stress T1 | **5.60** | **0.86** | **4.04, 7.39** | **0.43** |
| Acute self-conscious emotions (T1) ↔ Depressive symptoms T1 | **1.10** | **0.27** | **0.60, 1.65** | **0.26** |
| Posttraumatic stress T1 ↔ Depressive symptoms T1 | **39.70** | **4.66** | **31.42, 49.60** | **0.61** |
| Posttraumatic stress T3 ↔ Depressive symptoms T3 | **9.02** | **1.95** | **5.57, 13.18** | **0.38** |
| Acute basic emotions (T1) ↔ Acute self-conscious emotions (T1) | **0.52** | **0.06** | **0.41, 0.64** | **0.62** |
| Long-term basic emotions (T2) ↔ Long-term self-conscious emotions (T2) | **0.25** | **0.05** | **0.17, 0.35** | **0.44** |

*Note.* CI = 95% Credibility Interval, which indicates the 95% probability that in the population the parameter lies between the two values. Parameters are printed in bold in case zero was not contained in the CI. T1 = within first month postburn, T2 = 12 months postburn, T3 = 18 months postburn. The posterior predictive *p* (ppp)-value of the model is 0.47.

indicated a discrepancy between cognitive and affective components of guilt in parents' reflections on their responsibility for the injury (i.e., parents rationalized they could not be held responsible for their child's injury, but still felt guilty), that may be subject of rumination (Egberts et al., 2019). Rumination (a passive and repetitive focus on symptoms of distress) has consistently been associated with depressive symptoms (Nolen-Hoeksema et al., 2008). Thus, acute self-conscious emotions may induce, fuel or maintain depressive symptoms through rumination. Furthermore, early depressive symptoms were predictive of long-term posttraumatic stress, but early posttraumatic stress did not predict later depressive symptoms. This resembles results of a study in which prolonged grief disorder symptoms predicted later posttraumatic stress, and not vice versa (Djelantik et al., 2018). Also rumination may partly explain the predictive role of early depressive symptoms in relation to long-term posttraumatic stress. More research examining the interplay between rumination, self-conscious emotions, depressive symptoms, and posttraumatic stress is warranted.

In line with previous findings, feelings of guilt and shame were found to be higher for mothers of younger children, which might be explained by a higher perception of responsibility for their young child's safety (Sveen and Willebrand, 2018). This supports the assumption that the developmental period in which child trauma takes place is important to consider when examining family members' psychological responses (Price et al., 2016). However, the results suggest the child's age does not affect incidence and severity of mothers' posttraumatic stress and depressive symptoms and the way in which emotions are related to these symptoms.

The current study included trauma-related emotions as predictors of posttraumatic stress and depressive symptoms, whereas in DSM-5 (American Psychiatric Association, 2013), these constructs together constitute the symptomatology of PTSD. In future research, it would be valuable to further study the longitudinal interplay between symptoms after pediatric burn injury, to identify target symptoms for intervention. Approaches such as (longitudinal) network analyses provide opportunities to explore these interactions (Armour et al., 2017b; Hamaker et al., 2018). Research on PTSD symptom networks already has pointed to the centrality of negative trauma-related emotions (Armour et al., 2017a), and may help to understand the comorbidity between PTSD and depression (Fried et al., 2018). Together with the current results, this highlights the need to take into account a broad spectrum of emotions after trauma. Targeting emotions is a common element in treatments for PTSD. Whereas exposure-based therapies primarily focus on fear, cognitive approaches may take into account a wider range of emotions (Schnyder et al., 2015) and may be more effective to reduce emotions such as guilt, anger, or revulsion. Treatments may be personalized based on certain emotion profiles, although more research is necessary (McLean and Foa, 2017).

A first limitation of this study is that no conclusions can be drawn about aspects of single emotions, such as whom the emotion was directed to. Second, posttraumatic stress and depressive symptoms were assessed by self-report questionnaires instead of diagnostic interviews, which may provide overestimations of trauma-related symptoms (Engelhard et al., 2007). The number of mothers that participated in the current study who met diagnostic criteria for PTSD or Major Depressive Disorder is unknown. In addition, the posttraumatic stress measure only covered two of the four DSM-5 PTSD symptom clusters (American Psychiatric Association, 2013), and did not include the clusters comprising alterations in arousal and reactivity and negative alterations in cognitions and mood (although the HADS-D might have been representative for this last cluster). Therefore, the results should be replicated, preferably using diagnostic interviews based on DSM-5 PTSD criteria. Third, although psychosocial support was available at all burn centers, it was not registered whether participating mothers received psychological treatment and how this potentially affected their

psychological outcomes. Moreover, no information was available regarding specific resilience factors associated with lower posttraumatic stress and depressive symptoms, such as a sense of coherence, perceived social support (Engelhard et al., 2003) and self-compassion (Hawkins et al., 2019). Also, specific risk factors (e.g., mothers' previous trauma exposure) that have been shown important in the development of posttraumatic stress symptoms (De Young et al., 2014; Ozer et al., 2003) were not assessed.

The current study shows the importance of acute self-conscious emotions and long-term basic emotions in relation to early and long-term posttraumatic stress and depressive symptoms after a traumatic event. The results suggest the usefulness of including mothers' trauma-related emotions in monitoring of adverse effects of child burns. The presence of negative emotions may complicate psychological symptoms after trauma, and a decrease of persisting trauma-related emotions can be a complementary goal in the treatment of both posttraumatic stress and depressive symptoms.

## Author statement

**Contributors:** All authors approved the final manuscript and substantially contributed to the article. Author contributions were as follows: Marthe R. Egberts: Conceptualization, Methodology, Formal analysis, Data curation, Writing - original draft. Iris M. Engelhard: Conceptualization, Writing – review & editing. Rens van de Schoot: Methodology, Formal analysis, Writing – review & editing. Anne Bakker: Data curation, Investigation, Project administration, Writing– review & editing. Rinie Geenen: Conceptualization, Writing – review & editing. Peter G.M. van der Heijden: Methodology, Formal analysis, Writing – review & editing. Nancy E.E. van Loey: Conceptualization, Methodology, Investigation, Writing – review & editing, Supervision, Funding acquisition.

**Role of Funding source:** This work was supported by the Dutch Burns Foundation (grant number 07.107 and 07.108). The Netherlands Organization for Scientific Research (NWO) supports the second author (IE) with a VICI grant (453-15-005) and the third author (RvdS) with a VIDI grant (452-14-006). The funding sources had no involvement in the study design, data collection and analysis, interpretation of the data, writing of the report, and in the decision to submit the article for publication.

## Declaration of Competing Interest

The authors have no conflict of interest to declare.

## Acknowledgment

This study represents the collaborative efforts of the Dutch-Belgian psychosocial research group consisting of M. Bremer, G. Bakker, A. Boekelaar, A. van de Steenoven, H. Hofland, L. Braem, A.S. Goemanne, H. Hendrickx, A. Helsen, and E. Vandermeulen, representing the burn centers in Groningen, Beverwijk, Rotterdam, Antwerp, Ghent, Leuven, and Brussels.

## Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jad.2019.11.140.

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