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Original Research Article

# Prevalence and risk factors for acute stress disorder and posttraumatic stress disorder after burn injury

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ABSTRACT

*Background:* Psychological consequences of burn injury can be profound. Acute stress disorder (ASD) and posttraumatic stress disorder (PTSD) are known sequelae, but routine identification is challenging. This study aims to identify patient characteristics associated with outpatient positive screens.
*Methods:* The Primary Care Posttraumatic Stress Disorder questionnaire (PC-PTSD-4) was administered at initial outpatient Burn Center visits between 5/2018–12/2018. Demographics, injury mechanism, and total body surface area (TBSA) were recorded. Those with ≥3 affirmative answers were considered positive. Patients with positive and negative screens were compared.
*Results:* Of 307 surveys collected, 292 (median TBSA 1.5 %, IQR 0.5–4.0 %) remained for analysis after exclusions. Of those, 24.0 % screened positive. Positive screens were associated with presence of a deep component of the injury, injury mechanism, upper extremity involvement, ICU admission, and prolonged hospital length of stay.
*Conclusions:* Numerous factors distinguish burn injury from other traumatic mechanisms and contribute to disproportionate rates of traumatic stress disorders. Optimization of burn-oriented ASD and PTSD screening protocols can enable earlier intervention.



## 1. Introduction

It is well understood that traumatic injury can result in psychological distress consistent with diagnoses of acute stress disorder (ASD) and post-traumatic stress disorder (PTSD).[1,2] Following Boston's Cocoanut Grove nightclub fire in 1942 researchers reported experiences of nightmares, insomnia, generalized nervousness, and anxiety in burn survivors.[3] It was found that the only protective factor to these sequelae was loss of consciousness during the trauma, particularly if the loss of consciousness was prolonged.[4] One of the earliest formal reports of PTSD prevalence in burn patients closely followed the release of the DSM-3 in 1980 and noted that even minor burn injuries could be associated with significant and persistent psychologic trauma.[5]

Thermally and chemically injured patients are particularly susceptible as the triggering trauma often extends beyond the scope of the injury itself.[6–8] Treatment of burn injuries can entail multiple surgical interventions and may require prolonged hospital and intensive care unit stays with significant potential for readmissions.[9–11] Patients may have protracted periods of pain, physical disability, and inability to maintain employment.[12] Additionally, reintegration into society can be particularly troubling given the unique challenges of disfigurement and cosmesis, which may require ongoing adjustment, understanding, and acceptance of a new body image.[2,13–16]

ASD and PTSD have been newly classified as Trauma- and Stressor-Related Disorders in the fifth edition of the Diagnostic and

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Statistical Manual of Mental Disorders (DSM-5).[17] Both conditions encompass a spectrum of 20 symptoms categorized into four categories: intrusion symptoms, persistent avoidance of stimuli associated with the traumatic event, negative alterations in mood and cognition, and marked alterations in arousal and reactivity. Dissociative symptoms of depersonalization and derealization may also be noted. The primary distinguishing feature between the disorders is their temporal relation to the trauma – ASD is applicable to symptoms experienced between three days and one month after the inciting incident while PTSD is applicable only beyond the 30-day mark. In many cases patients with ASD will have persistent symptoms, and studies have shown that the presence of ASD often predicts subsequent diagnosis of PTSD.[11]

The 2013 American Burn Association (ABA) Consensus Statement on Psychological Outcomes emphasized the need for defined metrics with which to evaluate for symptoms of ASD and PTSD, recognizing both the prevalence of these disorders and their profound impact on all aspects of burn care and quality of life.[18] There is marked variability in reported rates of ASD and PTSD in burn survivors largely due to the number of measurement and screening tools utilized as well as the variety of post-injury time points assessed.[11,19–21] Reported rates of ASD range from 6 to 33 %, while PTSD rates may be as high as 24–40 % and 15–45 % when measured at six and twelve months post-injury respectively. International variability has also been observed. Although these issues are pervasive, formalized mental health screening and incorporation of dedicated mental health professionals into the multidisciplinary care team are not yet commonplace.[22,23] Recognizing the importance of this facet of patient care, our institution has recently been working to establish a formal screening protocol. Preliminarily a short, validated screening questionnaire was distributed to all burn patients evaluated at their first post-injury clinic visit. A chart review and retrospective analysis of these surveys was performed in order to gain understanding of the patterns and prevalence of post-traumatic disorders in our patients. We hypothesized that high rates of both ASD and PTSD would be detected in our study population. We additionally aimed to gain insight into factors associated with increased risk in order to inform the ongoing development of our clinical practice with regard to timing and frequency of screening.

## 2. Methods

After obtaining institutional IRB approval we performed a cross-sectional study of patients presenting for initial outpatient clinic visits at a large regional Burn Center between May 2018 and December 2018.

### 2.1. Survey tool

The Primary Care Posttraumatic Stress Disorder (PC-PTSD-4) screening tool is a validated four-item questionnaire aimed at detection of clinically concerning PTSD symptoms which warrant further evaluation in a primary care environment.[24] It was selected for use given its brevity and ease of distribution. The questions specifically target symptoms of intrusion, avoidance, hypervigilance and dissociation. Patients are asked:

Because of your recent trauma, in the past month, have you …

1. Have had nightmares about it or thought about it when you did not want to?
2. Tried hard not to think about it or went out of your way to avoid situations that reminded you of it?
3. Were constantly on guard, watchful, or easily startled?
4. Felt numb or detached from others, activities, or your surroundings?

Surveys were administered to all Burn Center patients by a physician or mid-level provider at the time of their first outpatient visit following their injury. English and Spanish versions of the survey were available. Based on the original questionnaire design, a cutoff of three out of four affirmative responses was designated a positive screen. Patients with positive screens were subsequently referred for further behavioral assessment.

### 2.2. Data collection

All patients completing questionnaires within the study timeframe were included. Patients being evaluated for non-burn dermatologic disorders or those with a known history of PTSD prior to their burn injury were excluded. If a patient completed the survey at two different time points, the results of the repeat questionnaire were also excluded. Patients initially presenting to clinic one year or more following their injury were also excluded, as visits were for assessment of long-term persistent issues such as scar contractures rather than for acute or subacute management of the burn.

Data obtained by chart review included patient demographics, injury mechanism and circumstances, specifics of affected body region and total burn surface area (TBSA). Burns were considered to have a deep component if at least some portion of the injury was documented as being full thickness. Concurrent trauma denoted any non-burn injury which was sustained at the time the patient was burned. Injuries were designated as work-related if they took place performing duties associated with their employment, regardless of their physical location at the time. Hospital and intensive care unit (ICU) lengths of stay were limited to the index hospital admission, whether at our own institution or elsewhere.

### 2.3. Statistical analysis

Patient characteristics were described using frequencies and percentages for categorical variables. As all continuous variables studied were determined to have non-normal distributions by a Kolmogorov-Smirnov test, continuous variables were described by median values and interquartile ranges. Multiple group comparisons were performed, using Chi-square tests for categorical variables and the Mann-Whitney *U* test for continuous variables. These analyses subdivided the patient population by duration of time from injury to survey ($<30$ vs $\geq 30$ days, delineating acute stress disorder from PTSD), whether or not they were admitted to the hospital and whether or not they required ICU admission. Comparison was also performed between patients who required operation during their index hospitalization and those who did not.

Further univariate analysis was performed to identify factors associated with positive screens and factors associated with surveys with four affirmative responses. Binary logistic regression was performed in both of these cases to assess for independent predictors.

In all analyses, $p \leq 0.05$ were considered statistically significant. All statistical analyses were performed using the Statistical Package for Social Sciences (SPSS Mac ©), version 26.0 (IBM Corp.).

## 3. Results

A total of 307 questionnaires were completed during the study period, with time of completion ranging from 1 to 128 days post-injury (median 13.0 days, IQR 9.0–19.0 days). 560 new-to-clinic burn patients were seen during that period, ranging from new

referrals to first outpatient visits after inpatient discharge. After exclusions, 292 patients remained for analysis. The patient population was 53.4 % male, with a median age of 41.0 years (IQR 29.0–53.0 years, Table 1). A prior psychiatric history was documented in 35 (12.0 %) of patients.

Affected TBSA ranged from 0.1 % to 58.0 %, but the majority of the burns were small (median 1.5 %, IQR 0.5–4.0 %). A deep component was reported in 63 (21.6 %) cases. The most common injury mechanisms noted were scald (27.4 %) and flame (24.7 %). Injuries were designated as work-related in 69 (23.6 %). Nearly one quarter of patients were seen at our facility after transfer from an outside institution. Concurrent traumatic injury was seen in 17 (5.8 %), primarily in patients who had sustained friction burns, with rates not differing significantly between those with positive and negative screens.

Approximately half of the study patients required inpatient admission, with a median hospital length of stay of 5.0 days (IQR 2.0–10.0 days, Table 2). Those with concurrent trauma were more likely to be admitted (8.8 % vs 2.8 %, $p = 0.043$), while patients injured at work were less likely to be admitted (15.0 % vs 32.4 %, $p = 0.001$). Admitted patients had bigger burns (3.5 % vs. 0.8 %, $p < 0.001$) which were more likely to have a deep component (40.1 % vs 2.8 %, $p < 0.001$).

While patients with concurrent traumatic injury were significantly more likely to be admitted to the hospital (76.5 % vs. 48.7 %, $p = 0.43$), the presence of traumatic injuries did not have a significant impact on hospital length of stay among admitted patients. Presence of a prior psychiatric history had no impact on likelihood of admission, nor did it have a significant effect on hospital length of stay of patients requiring inpatient care for their burn injuries.

A total of 70 (24.0 %) patients screened positive. 42 patients answered affirmatively to all questionnaire items, representing 14.4 % of all study patients and 60 % of those with positive screens (Table 3). Avoidance (Question 2) was the issue most commonly identified by patients (111, 38.0 %). Within both the entire patient population and the subgroup of patients screening positive, dissociation (Question 4) was the least frequently reported issue.

On univariate analysis of patient and injury factors associated with positive screens the presence of a deep component, injury mechanism, and upper extremity involvement were statistically significant (Table 1). Positive screens were significantly more likely to be present in patients with longer hospital stays and ICU admission. Higher rates of positive screens were noted in patients requiring operative intervention and longer ICU stays, but findings were not statistically significant. Binary logistic regression was performed incorporating variables significant on univariate analysis and other variables felt to be clinically relevant including the most common injury mechanisms (TBSA, presence of deep injury, upper extremity involvement, flame, scald, and grease mechanisms, concurrent trauma, hospital length of stay, ICU admission, and operative intervention). Only increased hospital length of stay independently predicted a positive screen result (odds ratio 1.04, $p = 0.019$).

The 264 (90.4 %) patients answering questionnaires within the first thirty days after injury were designated as ASD screens, while the 28 (9.6 %) responding at thirty days and beyond were counted as PTSD screens (Table 4). Both patient subgroups had similar demographics, with no significant difference in age, gender distribution or psychiatric history. On univariate analysis no significant difference was noted for ASD as opposed to PTSD screens with regard to rates of concurrent trauma and injury mechanism. PTSD screens had significantly larger TBSA involvement (4.0 % vs. 1.3 %, $p = 0.025$) and were more likely to have a deep component of their burn (57.1 % vs 21.6 %, $p < 0.001$). Patients undergoing screening beyond 30 days from injury were significantly more likely to have required inpatient care, more likely to require an operation, and had longer hospital and ICU lengths of stay. Screen positive rates were significantly higher in this population (57.1 % vs. 18.2 %), as was the likelihood of responding affirmatively to all questionnaire items (46.4 % vs. 11.0 %, $p < 0.001$).

Of the 147 patients admitted to inpatient care, 34 (23.1 %) were admitted to the ICU at some point in their hospital course, with a

**Table 1**
Patient demographics and injury characteristics.

| Variable | All n = 292 | Positive screens n = 70 | Negative screens n = 222 | p |
|---|---|---|---|---|
| Age (years) | 41.0 (29.0–53.0) | 39.0 (30.0–50.3) | 41.0 (27.0–54.0) | 0.892 |
| Gender (male) | 156 (53.4 %) | 32 (45.7 %) | 124 (55.9 %) | 0.169 |
| Psychiatric history | 35 (12.0 %) | 8 (19.0 %) | 27 (10.8 %) | 0.130 |
| TBSA % | 1.5 (0.5–4.0) | 1.8 (0.5–4.1) | 1.0 (0.5–4.0) | 0.121 |
| Deep component | 63 (21.6 %) | 22 (31.4 %) | 41 (18.5 %) | 0.030 |
| Work related | 69 (23.6 %) | 21 (30.0 %) | 48 (21.6 %) | 0.151 |
| Concurrent trauma | 17 (5.8 %) | 6 (8.6 %) | 11 (5.0 %) | 0.253 |
| Mechanism | | | | 0.026 |
| Flame | 72 (24.7 %) | 17 (24.3 %) | 55 (24.8 %) | |
| Flash | 18 (6.2 %) | 5 (7.1 %) | 13 (5.9 %) | |
| Scald | 80 (27.4 %) | 15 (21.4 %) | 65 (29.3 %) | |
| Grease | 56 (19.2 %) | 9 (12.9 %) | 47 (21.2 %) | |
| Contact | 24 (8.2 %) | 5 (7.1 %) | 19 (8.6 %) | |
| Chemical | 13 (4.5 %) | 6 (8.6 %) | 7 (3.2 %) | |
| Friction | 13 (4.5 %) | 4 (5.7 %) | 9 (4.1 %) | |
| Electrical | 11 (3.8 %) | 7 (10.0 %) | 4 (1.8 %) | |
| Other/unknown | 5 (1.7 %) | 2 (2.9 %) | 3 (1.4 %) | |
| Anatomic distribution | | | | |
| Head and neck | 61 (20.9 %) | 17 (24.3 %) | 44 (19.8 %) | 0.500 |
| Anterior trunk | 33 (11.3 %) | 10 (14.3 %) | 23 (10.4 %) | 0.388 |
| Back | 17 (5.8 %) | 6 (8.6 %) | 11 (5.0 %) | 0.253 |
| Upper extremity | 104 (35.6 %) | 33 (47.1 %) | 71 (32.0 %) | 0.023 |
| Hands | 104 (35.6 %) | 18 (25.7 %) | 86 (38.7 %) | 0.062 |
| Lower extremity | 95 (32.5 %) | 27 (38.6 %) | 68 (30.6 %) | 0.243 |
| Feet | 38 (13.0 %) | 11 (15.7 %) | 27 (12.2 %) | 0.422 |
| Genitals/perineum | 13 (4.5 %) | 4 (5.7 %) | 9 (4.1 %) | 0.519 |
| Buttocks | 16 (5.5 %) | 4 (5.7 %) | 12 (5.4 %) | 1.000 |

TBSA, total body surface area; LOS, length of stay; ICU, intensive care unit.

**Table 2**
Hospital stay characteristics.

| Variable | All n = 292 | Positive screens n = 70 | Negative screens n = 222 | p |
|---|---|---|---|---|
| Inpatient care | 147 (50.3 %) | 37 (52.9 %) | 110 (49.5 %) | 0.682 |
| Hospital LOS (days) | 5.0 (2.0–10.0) | 8.0 (3.0–15.5) | 4.0 (1.0–8.0) | 0.008 |
| Operation | 93 (31.8 %) | 28 (40.0 %) | 65 (29.3 %) | 0.106 |
| ICU admission | 34 (23.1 %) | 14 (37.8 %) | 20 (18.2 %) | 0.023 |
| ICU LOS (days) | 3.0 (1.0–11.0) | 4.5 (1.0–12.8) | 2.0 (1.0–9.0) | 0.377 |
| Intubation | 12 (35.3 %) | 6 (42.9 %) | 6 (30.0 %) | 0.487 |
| Ventilator days | 0.0 (0.0–1.0) | 0.0 (0.0–1.8) | 0.0 (0.0–1.0) | 0.616 |
| Readmission | 15 (5.1 %) | 5 (7.1 %) | 10 (4.5 %) | 0.364 |

*LOS, length of stay; ICU, intensive care unit.*
Hospital LOS analyzed for patients admitted to the hospital only; ICU LOS and ventilator days analyzed only for patients with ICU admission.

**Table 3**
Primary Care Posttraumatic Stress Disorder questionnaire (PC-PTSD-4) responses.

| Variable | All patients n = 292 | Patients with positive screens n = 70 |
|---|---|---|
| Question 1 (Intrusion) | 89 (30.5 %) | 61 (87.1 %) |
| Question 2 (Avoidance) | 111 (38.0 %) | 69 (98.6 %) |
| Question 3 (Hypervigilance) | 94 (32.2 %) | 69 (98.6 %) |
| Question 4 (Dissociation) | 62 (21.2 %) | 53 (75.7 %) |
| Four items affirmative | 42 (14.4 %) | 42 (60.0 %) |

**Table 4**
Characteristics of ASD vs PTSD screens.

| Variable | All patients n = 292 | ASD Screen n = 264 | PTSD screen n = 28 | p |
|---|---|---|---|---|
| Inpatient care | 147 (50.3 %) | 126 (47.7 %) | 21 (75.0 %) | 0.009 |
| Hospital LOS (days) | 5.0 (2.0–10.0) | 4.0 (1.0–8.0) | 22.0 (8.0–31.0) | < 0.001 |
| Operation | 93 (31.8 %) | 73 (27.7 %) | 20 (71.4 %) | < 0.001 |
| ICU admission | 34 (21.1 %) | 24 (19.0 %) | 10 (47.6 %) | 0.009 |
| ICU LOS (days) | 3.0 (1.0–11.0) | 2.0 (1.0–4.0) | 19.0 (4.8–33.8) | 0.002 |
| Intubation | 12 (35.3 %) | 9 (37.5 %) | 3 (30.0 %) | 1.000 |
| Ventilator days | 0.0 (0.0–1.0) | 0.0 (0.0–1.0) | 0.0 (0.0–6.8) | 0.956 |
| Readmission | 15 (5.1 %) | 8 (3.0 %) | 7 (25.0 %) | < 0.001 |
| Question 1 (intrusion) | 89 (30.5 %) | 71 (26.9 %) | 18 (64.3 %) | < 0.001 |
| Question 2 (avoidance) | 111 (38.0 %) | 92 (34.8 %) | 19 (67.9 %) | 0.001 |
| Question 3 (hypervigilance) | 94 (32.2 %) | 75 (28.4 %) | 19 (67.9 %) | < 0.001 |
| Question 4 (dissociation) | 62 (21.2 %) | 48 (18.2 %) | 14 (50.0 %) | < 0.001 |
| Screen positive | 70 (24.0 %) | 54 (18.2 %) | 16 (57.1 %) | < 0.001 |
| Four items affirmative | 42 (14.4 %) | 29 (11.0 %) | 13 (46.4 %) | < 0.001 |

*ASD, acute stress disorder; PTSD, post-traumatic stress disorder; LOS, length of stay; ICU, intensive care unit.*
Hospital LOS analyzed for patients admitted to the hospital only; ICU LOS and ventilator days analyzed only for patients with ICU admission.

median ICU length of stay of 3.0 days (IQR 1.0–11.0 days) for those admitted to the ICU. Patients requiring ICU care were primarily injured by a flame mechanism (61.8 %) and had significantly larger (13.0 % vs. 2.5 %, $p < 0.001$) and deeper (61.8 % vs 33.6 %, $P = 0.005$) burns than non-ICU admitted patients. Patients requiring ICU had significantly longer HLOS (13.5 vs. 4.0 days, $p < 0.001$) and were more likely to have required an operation (85.3 % vs 55.8 %). Twelve patients (35.3 %) required intubation outside of any immediate perioperative period.

Screen positive rates were significantly higher in patients admitted to the ICU than non-ICU patients (37.8 % vs. 18.2 %, $p = 0.023$). ICU patients reported higher rates of hypervigilance (47.1 % vs 24.8 %, $p = 0.018$) and dissociation (44.1 % vs 16.8 %, $p = 0.002$), but no difference in rates of intrusion or avoidance. Patients requiring ICU admission were significantly more likely to respond affirmatively to all four questionnaire items than patients not requiring ICU admission (32.4 % vs 11.5 %, $p = 0.007$).

At least one operative intervention was performed in 93 (31.8 %) of patients during their index admission. Patients requiring operative intervention had bigger burns (4.5 % vs. 1.0 %, $p < 0.001$) and were more likely to have a deep component (54.8 % vs 6.0 % $p < 0.001$) than those who did not undergo an operation. Rates of concurrent trauma did not significantly differ between the groups. Patients undergoing operations had significantly longer hospital stays (12.0 vs 1.0 days, $p < 0.001$) and were more likely to require ICU admission (31.5 % vs 9.1 %, $p = 0.002$). Screen positive rates did not differ between patients who underwent operations and those who did not, however patients requiring an operation were significantly more likely to respond affirmatively to all four questionnaire items (20.4 % vs 11.6 %, $p = 0.050$).

## 4. Discussion

The term “trauma” translates literally from the Greek “wound”. According to the Trauma and Justice Strategic Initiative of the Substance Abuse and Mental Health Services Administration (SAMHSA) “trauma results from an event, series of events, or set of circumstances that is experienced by an individual as physically or emotionally harmful or threatening and that has long-lasting adverse effects on the individual's functioning and physical, social, emotional, or spiritual well-being.”[25] Failure to identify symptoms of traumatic stress disorders early has prolonged and potentially fatal consequences. Several studies have correlated distress levels with extended recovery.[9] PTSD has been strongly

linked to the development of depression and poses a significant associated suicide risk. The presence of uncontrolled acute or chronic pain is closely linked to the psychiatric symptoms and further increases risk for suicide within the burn survivor population.[2]

Documented rates of ASD and PTSD vary widely in the literature but are unsurprisingly high. The screen positive rate for our study population was 24.0 %, with a measured ASD screen rate of 18.2 % and a measured PTSD screen rate of 57.1 %. The majority of patients in our study were screened prior the thirty day mark. Given that the screening was performed during patients' initial clinic visits as opposed to a set timeframe after injury, patients being evaluated within the first month after injury tended to be less severely injured, with smaller and more superficial burns requiring fewer hospital admissions, shorter hospital lengths of stay for those admitted, fewer operations and fewer critical care needs.

A variety of validated evaluations are available. Low et al. found that the Burn Specific Health Scale-Brief item "I have nightmares" was useful in confirming and ruling out symptoms consistent with PTSD.[26] The Structured Clinical Interview for DSM-4 Axis I Disorders (SCID-I) tool was previously used to assess the presence of psychiatric illness but is now outdated as it is linked to the DSM-4. Also in use are the Posttraumatic Stress Disorder Checklist for DSM-5 (PCL-5) and the Clinical Administration PTSD Scale (CAPS-5) which align with the DSM-5 ASD and PTSD diagnoses. Considerations for selection of an appropriate tool include tool availability, patient factors such as age, literacy level and language barrier, and factors associated with the setting of tool administration including time needed for screening and availability of qualified staff.

An updated PC-PTSD-5 is now in use.[27] The PC-PTSD-4 was chosen for use in our clinic because of its short length, ease of administration and emphasis on symptomatology. Currently the PC-PTSD-5 is being used at all initial clinic visits. We are also exploring use of the Injured Trauma Survivor Screen (ITSS) in our patient population as it has been validated to screen for both PTSD and depression in hospitalized survivors of major traumatic injury.[28,29]

Although not all patients with ASD develop PTSD, ASD remains one of the strongest predictors for PTSD development. In their assessment of data from the Burn Model Systems project Fauerbach et al. noted that patients exhibited clinically significant psychological distress not only while hospitalized, but also persisted long after discharge.[2] In contrast, Patterson et al. identified a 29.6 % rate of stress disorder symptoms in hospitalized burn patients but felt that most resolved spontaneously prior to discharge.[30] Our ability to evaluate the link between ASD and PTSD development in our study population was limited by the fact that repeat screening in the clinic setting was not performed. All additional screening, diagnosis, and management were performed following outpatient referral to mental health providers.

Data regarding identification of risk factors for ASD and PTSD in the burn population do not yield clear or consistent demographic markers or injury characteristics.[6,19,20,31,32] Many have hypothesized about links to hyperarousal responses as well as cognitive factors affecting perception and memory. Personality traits such as neuroticism have been thought to be possible risk factors for PTSD development.[33,34] The impact of pre-injury psychiatric disorders on ASD and PTSD development is not well defined.[35] In our study population, patients with positive screens were more likely to have a prior psychiatric history than those with negative screens, but the difference was not found to be statistically significant.

In this study positive screens were associated with presence of a deep component of the injury, injury mechanism, upper extremity involvement, ICU admission, and prolonged hospital length of stay. While hospital length of stay was the only variable independently predictive of a positive screen, all other notable factors have the commonality of likely contributing to prolonged trauma associated with emotional distress. We had anticipated but did not find that anatomic injury distribution to the head and face would increase ASD and PTSD risk. The association of upper extremity involvement speaks to concerns for function as well as cosmesis. The most common injury mechanisms of flame and scald had similar rates in both patient cohorts. A higher incidence of electrical and chemical injuries were reported in patients screening positive and a higher incidence of grease burns were seen in patients screening negative. Given the low incidence of these injury mechanisms, however, it is difficult to determine what level of risk for ASD and PTSD these mechanisms represent.

Perceived threat to life, poor socioeconomic status, lifestyle factors and overall satisfaction of medical care received may also play a role. Patterson et al. found that patients feeling not responsible for the incident was also associated with higher PTSD risk.[30] The difficulty of identifying predictive factors has been repeatedly demonstrated throughout the literature and is accordingly reflected in systematic reviews and meta-analyses.

Ultimately it remains difficult to accurately predict who will develop ASD or PTSD such that the best diagnostic approach is broad, early and frequent screening.[34] Current ABA recommendations include screening of all inpatients for symptoms of ASD and depression within 48 h of becoming evaluable at least one time prior to discharge and additional screening for depression and symptoms of ASD/PTSD at the first post-discharge clinic visit.[18] Integration of mental health specialists into the multidisciplinary treatment team can also facilitate identification of at-risk patients and connection to psychological resources.[36] Beyond this, burn centers should have a system in place to facilitate referral to mental health services for patients who screen positive for symptoms of depression, ASD or PTSD.

### 4.1. Limitations

A number of potentially clinically significant findings, including the relationship of positive screens with prior psychiatric history, operative intervention, and intubation, were not found to be statistically significant. It is possible that a larger sample size would have detected a statistically significant relationship. While data were collected prospectively, the study was retrospective. As such, timing and frequency of screening were established by clinical criteria and may not have been optimal standardization from a research perspective. Additional insight into additional screening, diagnosis, and management of these patients was performed by mental health professionals and was not available to this study, which may have provided further insight into the study findings. Finally, the study is limited as a single-center evaluation and may not be generalizable to other burn centers or facilities caring for burn patients.

## 5. Conclusions

PTSD and ASD are highly prevalent in our patient population, with rates commensurate with other studies. Improvements in holistic clinical care may be achieved with integration of behavioral health specialists to engage in structured clinical interviews addressing current and past psychosocial risk factors and perform full scale trauma-symptoms inventories. Further opportunities for screening exist, both during hospitalizations and on repeat evaluations in the outpatient setting. Further investigation comparing various screening tools for this patient population are needed in order to identify those which are most sensitive in an early phase.

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## Declaration of competing interest

The authors of this manuscript have no conflicts of interest to declare.

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