



Youth, poverty, and interpersonal violence: a recipe for PTSD

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INTRODUCTION

Substantial efforts have focused on physical rehabilitation to help speed the recovery process post-trauma. Despite intensive physical therapy, many trauma patients never return to their pre-injury status. This finding suggests there are various psychosocial factors playing a substantial role in the recovery of these patients. Several studies have found that trauma patients suffer from significant mental health-related issues, especially post-traumatic stress disorder (PTSD), after their traumatic event.¹ PTSD has been shown to decrease quality of life, with many patients unable to hold jobs and maintain personal relationships after a major trauma. These patients are at high risk of substance abuse, suicide, and psychological disturbances, and are more likely to suffer from chronic pain.² Trauma patients with PTSD have worse functional outcomes and increased social disintegration, contributing to substantial healthcare, economic, and personal costs.¹ Thus, identifying and treating PTSD early has the potential to mitigate the negative impact of the disease by improving quality of life coupled with decreasing the socioeconomic cost to both the patient and society. We hypothesized that specific factors related to the patient and their trauma would be predictive of PTSD. The purpose of this study was to identify PTSD in patients post-injury and determine which risk factors could predict its subsequent development.

METHODS

Identification of patients

A prospective quality improvement project was undertaken in response to previous work performed at our institution. Consecutive patients admitted to the trauma service for >48 hours with planned follow-up in the outpatient trauma clinic between August 2019 and January 2020 were eligible for participation in the study and offered the opportunity for inclusion. Data were collected following introduction of a discharge information form and discharge teaching. Using a detailed five-question survey at their first follow-up visit post-discharge, patients were screened prospectively for PTSD. Only those patients completing all five questions comprising the survey were included in the analysis.

Data collection and comparison

Patient demographics, education level, income data, injuries and operations, mechanism of injury,

severity of injury (as measured by admission injury severity score (ISS) and Glasgow Coma Scale), severity of shock (as measured by admission base excess and 24-hour transfusion requirements), and PTSD screen result were recorded. Three or more affirmative responses on the five-question survey constituted a positive screen for PTSD. Outcomes including ventilator days, and ICU and hospital length of stay were also recorded. Patients were then stratified by screen result and compared.

Statistical analysis

All data were analyzed using SAS V.9.4 (SAS Institute, Cary, NC). Normally distributed continuous variables were analyzed using the Student t-test, while nonparametric continuous variables were analyzed using the Wilcoxon rank-sum test. Categorical data were analyzed with a χ^2 analysis or Fischer's exact test where appropriate. Differences were considered statistically significant at $p < 0.05$. Multivariable logistic regression was then performed to determine variables significantly associated with the development of PTSD in the study population. Variables exhibiting a significance less than 0.2 on univariable analysis were considered for inclusion in the full multiple regression model. The final multivariable model was constructed in a backwards stepwise fashion to identify independent predictors for the development of PTSD. Differences were considered significant at $p < 0.05$. The area under the receiver operating curve was reported with 95% CIs.

RESULTS

Study population

Of the 153 surveys distributed, 145 (95%) were returned and comprised the study population. The mean time from discharge to follow-up was 15 days. The majority (71%) of the patients were male, with a median age and ISS of 32 and 14, respectively. Forty-two percent of patients suffered penetrating injuries. Of the 145 patients, 59% reported annual household incomes of <US\$25,000 and 67% had an education level of high school diploma or less. Overall, 41% of the patients surveyed screened positive for PTSD.

Comparison

Table 1 demonstrates the comparison between patients stratified by their PTSD screen result.

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Table 1 Comparison of characteristics of patients with and without PTSD

| Characteristics | No PTSD | PTSD | P value |
|----------------------|-------------|-------------|---------|
| n | 86 | 59 | |
| Age | 37 (26, 55) | 29 (24, 36) | 0.011 |
| Male (%) | 72 | 66 | 0.477 |
| Penetrating (%) | 40 | 60 | 0.0001 |
| Income (%)* | 43 | 71 | 0.001 |
| Education (%)* | 45 | 54 | 0.234 |
| GCS | 15 (15, 15) | 15 (15, 15) | 0.704 |
| ISS | 14 (10, 20) | 17 (10, 22) | 0.376 |
| 24-hour transfusions | 0 (0, 1.5) | 2.5 (0, 5) | 0.027 |
| BE | -3.1 (5.4) | -4.0 (6.5) | 0.371 |
| Lactate | 3.6 (3.5) | 3.7 (3.4) | 0.833 |
| SBP | 127 (27) | 126 (30) | 0.844 |
| HR | 99 (26) | 101 (22) | 0.624 |
| Ventilator days | 0 (0, 1.5) | 2 (0, 4) | 0.191 |
| ICU LOS (days) | 2 (0, 6) | 3 (0, 7) | 0.814 |
| Hospital LOS (days) | 5 (8.5, 17) | 8 (4, 16) | 0.743 |

*Income and education—the most common income level was <US\$25,000 annually for both groups and the most common level of education was high school or equivalent for both groups, and these were compared.

BE, base excess; GCS, Glasgow Coma Scale; HR, heart rate; ICU, intensive care unit; ISS, injury severity score; LOS, length of stay; PTSD, post-traumatic stress disorder; SBP, systolic blood pressure.

Fifty-nine patients (41%) screened positive for PTSD and comprised the PTSD group. Eighty-six patients (59%) screened negative for PTSD and comprised the no PTSD group. Both groups were comparable in terms of gender, education, severity of injury, ventilator days, and ICU and hospital length of stay. Patients screening positive for PTSD were more likely to come from a lower annual income household, suffer a penetrating injury, and require more transfusions within the first 24 hours post-injury compared with those patients who screened negative.

PTSD prediction

A multivariable logistic regression model was then developed using the database to identify potential predictors for the development of PTSD in patients post-injury. After adjusting for age, penetrating mechanism, income, severity of shock (24-hour transfusions), and ventilator days, multivariable logistic regression found both lower income (OR 2.70; 95% CI 1.21 to 6.01) and penetrating mechanism (OR 2.84; 95% CI 1.32 to 6.12) to be significantly associated with the development of PTSD (table 2).

Table 2 PTSD prediction

| | Adjusted OR | 95% CI | P value |
|----------------------|-------------|----------------|---------|
| Age | 1.024 | 0.998 to 1.043 | 0.0557 |
| Penetrating | 2.837 | 1.315 to 6.123 | 0.0079 |
| Income | 2.701 | 1.213 to 6.010 | 0.0149 |
| 24-hour transfusions | 1.063 | 0.977 to 1.157 | 0.1552 |
| Ventilator days | 0.979 | 0.938 to 1.021 | 0.3128 |

OR for age is presented for decreasing age.

OR for income is presented for <US\$25,000 annually compared with >US\$25,000 annually.

PTSD, post-traumatic stress disorder.

Furthermore, backwards stepwise elimination identified younger age (OR 1.02; 95% CI 1.0 to 1.05, $p=0.049$), lower income (OR 2.43; 95% CI 1.12 to 5.29 $p=0.025$), and penetrating mechanism (OR 2.97; 95% CI 1.40 to 6.29, $p=0.004$) as the only independent predictors for the development of PTSD in patients post-injury ($c=0.91$, 95% CI 0.89 to 0.99).

DISCUSSION

Trauma patients often suffer significant mental health-related issues, especially PTSD, following their traumatic event.³ While the general population has a PTSD rate between 2% and 4%, it can be as high as 35% at 4 months post-trauma and up to 32% at 1 year out, with one in four trauma patients suffering from chronic PTSD.^{3,4} In our current analysis of patients post-trauma, we identified PTSD in 41% of our patients at their first post-discharge follow-up visit and found that the development of PTSD was related to the patient's age, income level, and mechanism of injury.

Physical recovery post-trauma takes time, with patients unable to work, often for the duration of the recovery process, while still requiring continued healthcare. The related economic burden is significant with associated healthcare and productivity costs nearing US\$671 billion per year.⁵ PTSD only adds to those costs. Patients suffering from PTSD are often unable to maintain employment despite successfully completing their physical rehabilitation. These patients are at increased risk of substance abuse, suicide, psychological disturbances, more likely to suffer from chronic pain, and have worse functional outcomes, contributing to already substantial healthcare and economic costs.⁶

In addition to its obvious healthcare and economic burdens, PTSD carries a significant personal cost for the trauma patient. Although difficult to quantify, this personal cost remains high and is, in part, attributed to an associated decrease in quality of life. deRoon-Cassini *et al*⁴ evaluated quality of life post-trauma using the Health-Related Quality of Life (HRQoL) scale—a questionnaire that allows researchers to quantify otherwise subjective perceptions of physical and mental health and gauge a patient's available social support by evaluating a subject's functional, health, and socioeconomic status.^{1,2} Building on this work, further studies identified an association between traumatic injury and subsequent decline in HRQoL scores.⁴ Using the Trauma Quality-of-Life (T-QoL) scale, researchers have demonstrated HRQoL after trauma is related to and influenced by post-traumatic psychological distress.⁴ In fact, a diagnosis of PTSD remains one of the strongest predictors of poor post-trauma HRQoL when compared with trauma patients without PTSD.⁴

In the present study, multivariable logistic regression analysis identified younger age, lower income, and penetrating injury as independent predictors of the development of PTSD post-trauma. Younger patients were found to have an increased risk for PTSD following traumatic injury. While our study found younger age as an independent predictor of PTSD, not much evidence exists evaluating PTSD in youths. However, one such study by Herringa assessed the effects of PTSD at the structural and functional level of the brain between the pediatric and adult patient. The study found that pediatric PTSD and adult patients with PTSD have similar brain abnormalities, yet youth with PTSD display overt and developmental irregularities in the frontolimbic circuits of the brain.⁷ Because of these abnormal circuits, youth with PTSD may have increased threat reactivity and decreased emotional regulation capacity leading to decreased coping mechanisms for stressful and traumatic events in life.⁷ It stands to reason with

a decreased coping mechanism, not only are youth with PTSD at risk for chronic PTSD and the life-long negative effects that follow, they are also at risk for subsequent PTSD following any new trauma or stressful event. These patients are more likely to experience significant injuries while lacking both the necessary psychological as well as economic support system needed to properly manage their recovery.⁸

In fact, patients with an annual income of less than US\$25,000 had greater than two times the risk of developing PTSD compared with patients with higher income in the current study. This finding is supported by previous studies in which income inequality was identified as a risk factor for PTSD in New York survivors of the September 11 attacks.⁹ These studies demonstrated that income inequality was associated with higher scores on a scale of depressive symptoms and was strongest among individuals with the lowest household incomes. In addition, patients in areas with high income inequality were significantly more likely to develop PTSD.⁹ In the absence of outside support, social services in low-income communities are limited by the constraints of their financial resources.⁹ By supplementing a community's resources, the overall cost to society potentially could be mitigated, decreasing PTSD rates, and quickening returns to the work force.

Finally, we also found that patients suffering a penetrating injury were nearly three times more likely to develop PTSD compared with blunt-injured patients. This observation is consistent with previous work by Gillikin *et al*¹⁰ in which researchers evaluated trauma exposure and PTSD rates within an inner city population. They found that nearly 90% of urban, low-income residents of an inner city have suffered a violent trauma with a lifetime PTSD prevalence of at least 40%. They also identified a prior history of trauma or PTSD as predictors of subsequent violence, thus creating a vicious cycle.¹⁰ As a result, treating PTSD has the potential to improve recovery and also to prevent future violence.²

The American College of Surgeons Committee on Trauma recommends PTSD and depression risk screening for hospitalized trauma patients be part of comprehensive rehabilitative trauma center care.⁴ Given the results of our study, we are recommending early targeted PTSD screening for younger, low-income patients who have suffered a penetrating injury. Early treatment of PTSD post-trauma has been shown to prevent the subsequent development of many of the complications (alcohol abuse, substance abuse, and chronic pain) associated with the disease and improve physical recovery, social functioning, and quality of life.⁶ Patients who were treated early (almost directly after their trauma) with trauma-focused cognitive-behavioral therapy exhibited a reduction in PTSD-related symptoms and the risk of PTSD was prevented or significantly reduced by treatment starting in the first 2 weeks post-trauma.⁶ These suggestions along with our study's findings of younger age, lower income, and penetrating injury as independent predictors of PTSD again highlight the need for early intervention and treatment of PTSD in young patients, as well as continued studies in the youth trauma population.

Unfortunately, there is not one simple answer for all patients because not all critically injured patients are created physiologically or psychologically equal. However, what we do know is that early identification of PTSD allows for the prompt initiation of appropriate therapeutic interventions thereby speeding recovery, preventing future violence, and potentially disrupting a vicious and destructive cycle.

Limitations

There are several inherent limitations to this study. First, not all patients during the time period of the study agreed to participate.

The impact of this finding is twofold: (1) the small number of patients certainly weakens any conclusions from the data and (2) perhaps those who chose to participate were more motivated to improve their overall health, potentially limiting the impact of the intervention in less-motivated patients. Second, because the data were collected over a relatively short time period in a single outpatient setting at a well-established trauma center, the findings may not be generalizable. Finally, some patients discharged during this time period were lost to follow-up (never showed up for their outpatient visit) and, as a result, we cannot be sure that the study population is truly representative of the entire population.

CONCLUSIONS

PTSD remains relatively common in patients following traumatic injury. The greatest risk was observed in younger, low-income patients who have sustained penetrating injuries. With this information, trauma centers may be able to better allocate already limited resources for those patients at greatest risk for developing PTSD. Targeted screening and intervention programs introduced immediately post-injury can significantly improve symptoms from PTSD and thus increase quality of life post-trauma and improve the trauma patient's overall recovery. This early identification and treatment of PTSD may also allow for strengthening of social support, thus lessening the impact of PTSD and also decreasing the risk of continued violence.

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REFERENCES

- Herrera-Escobar JP, deRoon-Cassini T, Brasel K, Nehra D, Al Rafai SS, Toppo A, Kasotakis G, Velmahos G, Salim A, Haider AH. Development and validation of a revised trauma-specific quality of life instrument. *J Trauma Acute Care Surg* 2020;88:501–7.
- Qi W, Gevonden M, Shalev A. Prevention of post-traumatic stress disorder after trauma: current evidence and future directions. *Curr Psychiatry Rep* 2016;18:20.
- Haagsma JA, Ringburg AN, van Lieshout EM, van Beeck EF, Patka P, Schipper IB, Polinder S. Prevalence rate, predictors and long-term course of probable posttraumatic stress disorder after major trauma: a prospective cohort study. *BMC Psychiatry* 2012;12:236.
- deRoon-Cassini TA, Hunt JC, Geier TJ, Warren AM, Ruggiero KJ, Scott K, George J, Halling M, Jurkovich G, Fakhry SM, *et al*. Screening and treating hospitalized trauma survivors for posttraumatic stress disorder and depression. *J Trauma Acute Care Surg* 2019;87:440–50.



- 5 Florence C, Haegerich T, Simon T, Zhou C, Luo F. Estimated lifetime medical and work-loss costs of emergency department-treated nonfatal injuries — United States, 2013. *MMWR Morb Mortal Wkly Rep* 2015;64:1078–82.
- 6 Visser E, Gosens T, Den Oudsten BL, De Vries J. The course, prediction, and treatment of acute and posttraumatic stress in trauma patients: a systematic review. *J Trauma Acute Care Surg* 2017;82:1158–83.
- 7 Herringa RJ. Trauma, PTSD, and the developing brain. *Curr Psychiatry Rep* 2017;19:69.
- 8 Nehra D, Herrera-Escobar JP, Al Rafai SS, Havens J, Askari R, Nitzschke S, Velmahos G, Kasotakis G, Brasel KJ, Levy-Carrick N, et al. Resilience and long-term outcomes after trauma: an opportunity for early intervention? *J Trauma Acute Care Surg* 2019;87:782–9.
- 9 Pabayo R, Fuller D, Goldstein RB, Kawachi I, Gilman SE. Income inequality among American states and the conditional risk of post-traumatic stress disorder. *Soc Psychiatry Psychiatr Epidemiol* 2017;52:1195–204.
- 10 Gillikin C, Habib L, Evces M, Bradley B, Ressler KJ, Sanders J. Trauma exposure and PTSD symptoms associate with violence in inner city civilians. *J Psychiatr Res* 2016;83:1–7.