

Firearm injury survivors report extreme high risk for poor physical and mental health outcomes early after hospital discharge necessitating multidisciplinary care

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ABSTRACT

Background Up to 20–40% of survivors of any traumatic injury develop post-traumatic stress disorder (PTSD) or depression after injury. Firearm injury survivors may be at even higher risk for adverse outcomes. We aimed to characterize PTSD and depression risk, pain symptoms, and ongoing functional limitations in firearm injury survivors early after hospital discharge.

Methods Firearm injury survivors seen in the Trauma Quality of Life (TQOL) outpatient follow-up clinic 1–2 weeks after discharge were invited to participate in a survey assessing both mental and physical health outcomes. The survey included the Brief Pain Inventory (BPI), the Injured Trauma Survivor Screen (ITSS), the Beck Depression Inventory (BDI), the PTSD Checklist for DSM-5 (PCL-5), and the 12-item Short Form Survey Physical Health component (SF-12)

Results 306 patients were seen in the TQOL Clinic, and 175 responded to the survey. The mean age was 32 years (SD=12), 81% were male, and 79% were black. On the ITSS, 69% and 48% of patients screened risk positive for PTSD and depression, respectively. Patients reported mild depression symptoms with an average BDI score of 14.3 (SD=11.8) and elevated PTSD symptoms with an average PCL-5 score of 43.8 (SD=12.8). Patients with severe BPI scores were more likely to screen positive for depression and PTSD. Respondents scored >2 SD below the US national average on the SF-12 for physical quality of life (M=28.7). 12% of patients were at risk across all four domains of pain, PTSD, depression, and physical function.

Conclusion Early after discharge, over two-thirds of firearm injury survivors were at risk for the development of PTSD, nearly half were at risk of depression, and physical function was significantly decreased. Trauma centers need to prioritize early, outpatient multidisciplinary care to treat and prevent the development of poor chronic physical and mental health for firearm injury survivors.

Level of evidence III.

INTRODUCTION

In the USA, firearm injury is a public health crisis, and survivors suffer from high rates of long-term mental health consequences and impaired functional recovery.^{1,2} The burden of traumatic injury and firearm-related disease extends far beyond the physical effects of the injury.^{3–5} The need to address

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Patients with firearm injury have high rates of long-term adverse mental health effects and persistent functional limitations after injury. Early mental health symptoms and risk, functional limitations, and continued pain are less understood and may require extensive resources to address.

WHAT THIS STUDY ADDS

⇒ Patients with firearm injury report high rates of mental health risk and symptoms, functional limitations, and ongoing pain early after recovery. Moreover, relationships between these outcomes are closely interconnected.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE, OR POLICY

⇒ A multidisciplinary approach to address pain, mental health, and functional limitations is necessary to promote optimal recovery after firearm injury.

mental health for trauma patients is reflected in the recent American College of Surgeons Committee on Trauma's requirement for Level 1 and 2 trauma centers to screen all survivors of traumatic injury for both depression and post-traumatic stress disorder (PTSD), and to refer patients for further mental health treatment when necessary.⁶

Although long-term mental health and functional outcomes have been described in firearm injury survivors, it is not well understood what symptoms are experienced early after discharge. Prior work has suggested that early PTSD symptoms experienced by firearm injury survivors persist 6 months after injury.⁴ Understanding screening risk rates as well as early physical and mental health symptom patterns can help to inform early multidisciplinary intervention and resource utilization for the firearm injury population to prevent the long-term quality of life issues.

As such, the objective of this study was to describe PTSD and depression screening risk rates and symptoms along with, pain and physical health in firearm injury survivors early after hospital discharge. Additionally, we aimed to characterize interactions between these outcomes to identify

early risk patterns and to begin to describe resources necessary to provide early ambulatory multidisciplinary care.

METHODS

This was a prospective survey-based study at a Midwest Level 1 trauma center. Adult (≥ 18 years old) patients who suffered from a firearm injury, who were discharged from the trauma surgery service, and who followed up in the Trauma Quality of Life (TQoL) Clinic were considered for inclusion in the study. The TQoL Clinic is an outpatient follow-up clinic focused on the multidisciplinary care of firearm injury survivors. All patients with firearm injury discharged from the trauma surgery service are referred to the TQoL Clinic at the time of discharge. During the TQoL Clinic visit, patients are seen by a trauma medical provider, a psychologist, a physical therapist, a social worker, and a hospital responder from the hospital's gun violence intervention program, 414LIFE. All clinic providers are specialized in trauma-informed care of traumatically injured patients, with a particular focus on firearm injury recovery. Ideally, patients are seen 1–2 weeks after discharge from the hospital to promptly identify and address ongoing care needs.⁷ Follow-up at the TQoL Clinic is excellent, with over 80% of patients attending their initial follow-up appointment, and the majority of those who need to reschedule attend their rescheduled appointment.⁸

A convenience sample of candidates was invited to participate in a survey-based interview study at their first TQoL outpatient follow-up appointment by a trained research assistant. For willing participants, the survey was administered in-person via an iPad (Apple Inc., Cupertino, California, 2023). If the patient had limited literacy or if they requested, the survey was read aloud to the participant. The QualtricsSM (Qualtrics, Provo, UT) survey platform was used to manage data collection. The survey was aimed to evaluate various physical and mental health outcomes through validated and reliable measures. The survey measured long-term risk for PTSD and depression, current symptoms of post-traumatic stress and depression, pain, and finally assessed physical and mental quality of life. Demographics, Injury Severity Score (ISS), surgical operations, intensive care unit (ICU) treatment, and engagement with law enforcement were all abstracted from the electronic health record. These clinical variables were collected to determine their impact on the study outcomes. Law enforcement engagement was defined as the patient being placed in custody or under investigation for any period of time. Surgical operations were grouped by primary operation type, which included abdominal, thoracic, vascular, orthopedic, neck, face, washout/debridement, or other.

Survey measures

Brief Pain Inventory (BPI)

The BPI is a self-report tool to measure pain severity and interference. It has been studied in multiple patient populations for acute and chronic pain.^{9–10} The pain severity subscale assesses pain at its “worst,” “least,” “average,” and “now.” The pain interference subscale assesses how pain interferes with a patient's activity, mood, relationships, sleep, and enjoyment of life. Scores range from 0 to 10, with mild pain represented by scores 1–3, moderate pain represented by scores 4–6, and severe pain represented by scores 7–10.^{9–10}

Injured Trauma Survivor Screen (ITSS)

The ITSS is a validated 9-item self-report screening tool for both depression and PTSD. It has been validated for use in inpatient traumatically injured patients with PTSD and depression

subscale sensitivity and specificities of 75% and 79%, and 80% and 66%, respectively.¹¹ It has not yet been validated in the early outpatient setting. Five questions measure the risk for PTSD, five questions measure the risk for depression, with one overlapping item. A score of ≥ 2 in either domain indicates a positive screen for high risk for development of either PTSD, depression, or both at 1- and 6 months after injury.^{12–13}

PTSD Checklist for DSM-5 (PCL-5)

The PCL-5 is a 20-item self-report measure of PTSD symptom severity and detecting probable diagnosis. Respondents indicate the extent to which potential symptoms have been bothering them over the past month using a Likert Scale response ranging from 0 = “not at all” to 4 = “extremely.” The PCL-5 has subscales that evaluate each symptom cluster, including re-experiencing, avoidance, negative alterations in cognition or mood, and hyperarousal. A total score from 0 to 80 is summed to represent a continuous measure of a patient's PTSD symptom burden, with greater scores indicative of greater symptom severity.¹⁴ Prior research has suggested that a cut point of >30 correlates well with the diagnosis of PTSD in a general trauma population, or a cut-off of >34 in the intentional injury population.¹⁵ As criteria for PTSD diagnosis require symptoms to be present for a duration of greater than 1 month,¹⁶ the terminology post-traumatic stress symptoms is used to describe the results.

Beck Depression Inventory (BDI)

The BDI is a 21-item survey assessing the severity of depressive symptoms.¹⁷ Symptoms are rated on a scale of 0–3, with higher scores indicating greater symptom severity. Scores range from 0 to 63, with scores of 0–13 indicating minimal depressive symptoms, 14–19 indicating mild symptoms, 20–28 indicating moderate symptoms, and 29–63 indicating severe symptoms.^{18–19}

Short Form 12 Survey (SF-12)

The SF-12 is a self-report tool to assess comprehensive quality of life. It was developed and validated as an abbreviated version of the Short Form 36 Survey (SF-36) to be applicable in larger-scale health measurement studies. Like the SF-36, it can be divided into physical health components (PCS) and mental health components (MCS) to determine more nuanced results of quality of life.²⁰ Response values vary by question and are weighted according to regression coefficients from a representative US sample. Scores are aggregated for PCS and MCS scales, then standardized for comparison to the general US population where scores range 0–11 with higher scores indicating better quality of life, with the US general population mean of 50 and SD of 10.²¹

Analysis plan

All data analysis was performed using R (R V4.2.1, R Core Team, 2021). Patient demographics and self-report measures are reported with descriptive statistics. Risk outcomes were assessed across all four domains including pain (severe BPI score), PTSD (ITSS positive), depression (ITSS positive), and physical function (< 25 th percentile SF-12 PCS). T-tests were used to compare outcomes between ITSS-positive screen groups for both PTSD and depression risk (two ITSS groups and the five outcomes (BPI severity, BPI interference, BDI, SF-12 MCS, SF-12 PCS)). χ^2 tests were used to compare ITSS PTSD and depression risk across BPI pain levels (mild, moderate, and severe). To adjust for multiple comparisons (16 tests), a Bonferroni correction was applied ($\alpha=0.05/12=0.004$).

Statistical analysis was supplemented by the determination of Area Deprivation Index (ADI) for patients residing in Milwaukee County. Using the patient’s geocoded home address obtained from the electronic health record, ADI rankings were determined using data from the University of Wisconsin Neighborhood Atlas ADI data from 2021.²² ADI rankings nationally range from 1 to 100, with 100 indicating the greatest disadvantage.²² Outcomes were also assessed by ADI (using T-tests) and clinical factors (using χ^2 tests) including need for an operation, need for ICU stay, and law enforcement presence to determine their impact on the survey measures.

RESULTS

A total of 306 patients were seen in the TQoL Clinic from November 2020 through October 2022. Of these, 175 patients participated in some portion of the survey. The majority of patients were male (n=138, 79%) and identified as black (n=134, 77%). The average age was 32.4 years (SD=12.2). Regarding injury severity, 78% of patients had a high ISS, 8% a moderate ISS, and 8% a low ISS. Over this timeframe, there were a total of 782 patients with firearm injury seen by the trauma surgery service, and there were no differences in age, gender, race, or ISS scores compared with the survey participants. The median time from hospital discharge to the TQoL Clinic visit was 10 days (Iinterquartile Range IQI=7; 14), and the median time from injury to completion of the survey was 17 days (IQI=12; 23). Most patients (89%) completed the survey within 30 days of their injury, and 41% completed it within 2 weeks of their injury.

Out of the 176 patients, 149 (84%) were able to be geospatially mapped and associated with an ADI. Reasons for being unable to geocode a patient’s address included living outside of Milwaukee County (n=25), or the address obtained from the electronic health record was invalid (n=2). The mean national ranking was 84.44 (SD=18.08).

Survey descriptive results

For the BPI, the mean pain severity subscore was 5.65 (SD=2.64) indicating moderate pain, and most patients reported moderate (n=70, 40%) to severe (n=60, 34%) pain. The mean pain interference subscore was 5.65 (SD=2.71), also indicating moderate pain interference with activities of daily living.

On the PCL-5, the mean score was 43.81 (SD=12.08), indicating high posttraumatic stress symptom severity. Patients reported high severity across individual symptom clusters of re-experiencing (M=10.77, SD=4.08), negative mood and cognition (M=15.85, SD=5.06), and hyperarousal (M=13.07, SD=4.06). Similarly, 69% (n=121) of patients screened risk positive for PTSD on the ITSS.

For depressive symptoms, the mean score on the BDI was 14.33 (SD=11.76), indicating mild mood disturbance. Using the ITSS screen, 48% (n=84) screened risk positive for depression.

For the SF-12, the average score on the Mental Health Component Score (MCS) was 45.62 (SD=13.03), which is approximately at the 25th percentile compared with the US general population. For the Physical Health Component (PCS), SF-12 scores had a mean of 28.73 (SD=15.51), well below the 25th percentile score of 46.5 in the US general population. The majority of patients had scores below the 25th percentile for the SF-12 in both physical health (n=105, 90%) and Mental Health Component (n=63, 53%) (tables 1 and 2).

Overall, 86% of patients met criteria for at least one risk domain. 12% of patients (n=21) met criteria in all four outcome domains.

Table 1 Demographic and survey descriptives of the cohort

	Number	Percentage	Number missing
Total	175	100%	
Male sex	138	79%	8
Race			8
Black	134	77%	
White	13	7%	
Hispanic	7	<5%	
Other	10	6%	
American Indian or Alaska Native	<5	<5%	
Unknown	<5	<5%	
ISS			10
Low (<9)	15	8%	
Moderate (9–15)	14	8%	
High (16–24)	136	78%	
Risk-positive ITSS PTSD	121	69%	
Risk-positive ITSS depression	84	48%	
	Mean	SD	Number missing
Age	32.4	12.2	8
PCL-5 total	43.81	12.08	25
Re-experience	10.77	4.08	
Avoidance	4.13	2.35	
Negative cognition/mood	15.85	5.06	
Hyperarousal	13.07	4.06	
ITSS total	4.21	2.54	19
Depression	1.92	1.48	
PTSD	2.96	1.62	
BDI total	14.33	11.76	38
BPI severity	5.65	2.64	4
BPI interference	5.65	2.71	4
SF-12 mental health	45.62	12.03	58
SF-12 physical function	28.73	15.51	58

Values <5 suppressed for patient confidentiality.
BDI, Beck Depression Inventory; BPI, Brief Pain Inventory; ISS, Injury Severity Score; ITSS, Injured Trauma Survivor Screen; PCL-5, PTSD Checklist for DSM-5; PTSD, post-traumatic stress disorder; SF-12, Short Form 12.

Association between measures of mental health

Compared with those who were ITSS PTSD risk-negative, patients who were PTSD risk-positive on the ITSS had significantly higher pain scores on the BPI (Severity t=3.22, p<0.001; Interference t=5.82, p<0.001), higher depression symptoms on

Table 2 Brief Pain Inventory and SF-12 by severity level

Measure	Level	n (%)
BPI	Mild	41 (23%)
	Moderate	70 (40%)
	Severe	60 (34%)
SF-12 PCS	<25th percentile	105 (90%)
	26–50th percentile	5 (4%)
	51–75th percentile	5 (4%)
	>75th percentile	1 (<1%)
SF-12 MCS	<25th percentile	63 (53%)
	26–50th percentile	18 (15%)
	51–75th percentile	8 (7%)
	>75th percentile	28 (23%)

BPI, Brief Pain Inventory; SF-12 MCS, Short Form 12 Mental Health Component; SF-12 PCS, Short Form 12 Physical Health Component.

Table 3 Associations between mental health screens and pain, depression scores, and SF-12 mental health and physical function scores

Risk domain	BPI severity	BPI interference	BDI	SF-12 MCS	SF-12 PCS
ITSS PTSD					
Risk negative	4.25	3.40	4.44	56.55	35.15
Risk positive	5.87*	6.23*	16.59*	42.67*	26.75
ITSS depression					
Risk negative	4.84	4.42	7.27	52.22	32.43
Risk positive	6.07*	6.59*	19.72*	39.86*	25.14

Values reported are column means for each risk domain group. T-tests were conducted within each risk domain for each measure. Lower scores on the SF-12 MCS and PCS indicate worse mental and physical health. ** $p < 0.04$ after Bonferroni correction.

BDI, Beck Depression Inventory; BPI, Brief Pain Inventory; ITSS, Injured Trauma Survivor Screen; PCL-5, Post-traumatic Stress Disorder Checklist for DSM-5; PTSD, post-traumatic stress disorder; SF-12 MCS, Short-Form 12 Mental Health Component; SF-12 PCS, Short-Form 12 Physical Health Component.

the BDI ($t = 5.48$, $p < 0.001$), and lower quality of life scores on the SF-12 MCS ($t = -5.15$, $p < 0.001$) (table 3). Similarly, those who screened at risk for depression on the ITSS had significantly higher pain scores on the BPI (Severity $t = 2.91$, $p = 0.004$; Interference $t = 5.25$, $p < 0.001$), significantly higher depression symptoms on the BDI ($t = 7.17$, $p < 0.001$), and lower function on the SF-12 MCS ($t = -5.44$, $p < 0.001$) compared with those who were ITSS depression risk negative (table 3).

Association between pain scores and mental health measures

Those in the BPI moderate and severe pain groups were more likely to screen positive on the ITSS for PTSD (moderate = 81%, severe = 88%; $\chi^2 = 12.37$, $p < 0.001$) (figure 1). Those in the moderate and severe pain groups were more likely to score below the 25th percentile on the MCS (Mild $p = 0.18$; Moderate and Severe p 's < 0.01).

Association between clinical care factors and survey measures

There were no differences between those who did ($n = 97$, 55%) or did not ($n = 78$, 45%) require an operation in ITSS screen risk, SF-12 scores, or BPI scores. Similarly, there were no differences in these outcomes by hospital length of stay, by ISS severity group (p 's > 0.08), or for those who required an ICU stay ($n = 66$, 37%). Patients who were engaged with law enforcement ($n = 43$, 24%) were more likely to screen positive for depression ($\chi^2 = 4.65$, $p < 0.01$).

Association between ADI and survey measures

The mean ADI was 84.44 (SD = 18.08) for the group. ADI was significantly higher in the ITSS depression risk-positive group compared with the ITSS depression risk negative group ($t = 2.60$, $p = 0.01$), and in the BPI severe group compared with the BPI mild group ($t = 2.38$, $p = 0.01$). There were otherwise no differences in ADI by ITSS PTSD risk ($p = 0.27$), SF-12 MCS percentile groups (p 's > 0.12), SF-12 PCS percentile groups (p 's > 0.64), or BDI total score ($p = 0.16$).

DISCUSSION

The purpose of this study was to document the acute physical and mental quality of life issues experienced by firearm-injured survivors hospitalized at an urban Level 1 trauma center. Our

prospective study demonstrated that firearm injury survivors are at high risk for adverse mental health outcomes, development of chronic pain, and lower quality of life early after hospital discharge for their injury. In addition to screening risk-positive for the development of PTSD and depression according to the ITSS (> 1 month after injury), our patients are already experiencing significant post-traumatic stress symptoms early in their recovery, which may be a risk for future development of PTSD.^{4,23-25} In spite of the acute psychopathology, ongoing pain, and functional limitations having the potential to develop into chronic problems, the majority of traumatic injury post-discharge care does not specifically address these complex needs.²⁶ This highlights the need for an early multidisciplinary approach to pain, physical function, and mental health to promote optimal recovery after firearm injury.⁵

The American College of Surgeons Committee on Trauma has now mandated that trauma centers screen and refer patients for PTSD and depression, further demonstrating the national recognition that mental healthcare is necessary for comprehensive recovery after injury.⁶ Based on the present study, it is clear that patients with firearm injury are at particular risk for poor mental health outcomes, and it is important for trauma centers that treat a high rate of patients with firearm injury to understand the needs of this population so appropriate resource planning and allocation of treatment can be determined.

The concept that pain may influence functional recovery is well-established in trauma care. In patients with mild traumatic brain injury 3 months after injury, pain interference, but not cognition, was associated with functional outcomes.²⁷ In a group of patients with moderate to severe traumatic injuries, 46% reported pain that influenced their daily activities at 6–12 months after injury, and those with ongoing pain were more likely to report functional limitations and not to have returned to work.²⁸ The influence of clinical factors on the development of chronic pain is less understood. Patients with traumatic brain injury are recognized to be at risk for chronic pain²⁸ as well as length of hospital stay,²⁸⁻³⁰ but data regarding the influence of injury severity is more mixed.²⁸⁻³³ While we studied pain early in recovery, we did not identify any clinical care factors that influenced the severity of pain at first follow-up, including need for an operation, need for ICU stay, hospital length of stay, or ISS score. It should be noted that this may be simply that there may be an expected level of pain approximately 2 weeks after firearm injury, and the majority of our patients reported moderate to severe pain at this time. Further longitudinal work is necessary to explore these relationships in patients with firearm injury.

The association between chronic pain and mental health disorders is also complex. While pain is a risk factor for mental health disorders,³⁴ the reverse is also true,³⁵ highlighting the importance of multidisciplinary teams addressing holistic needs. This relationship was evident early after traumatic injury in our firearm injury survivors, as those in the moderate to severe BPI pain groups were more likely to screen positive for PTSD and to report mental and physical quality of life at or below the 25th percentile for the US national average on the SF-12 PCS and SF-12 MCS assessments. It is worth noting that our firearm injury survivors reported extreme quality of life deficits, as 90% fell below the 25th percentile for the US national average on the SF-12 PCS, and just over 50% fell below the 25th percentile on the SF-12 MCS. In a study evaluating injured patients, the average SF-12 PCS was 32 and SF-12 MCS Score was 47 at 1 month.³⁶ Our patients with firearm injury still reported worse quality of life compared with this injured population, with an average SF-12 PCS Score of 28.7 and SF-12 MCS Score of 45.6.

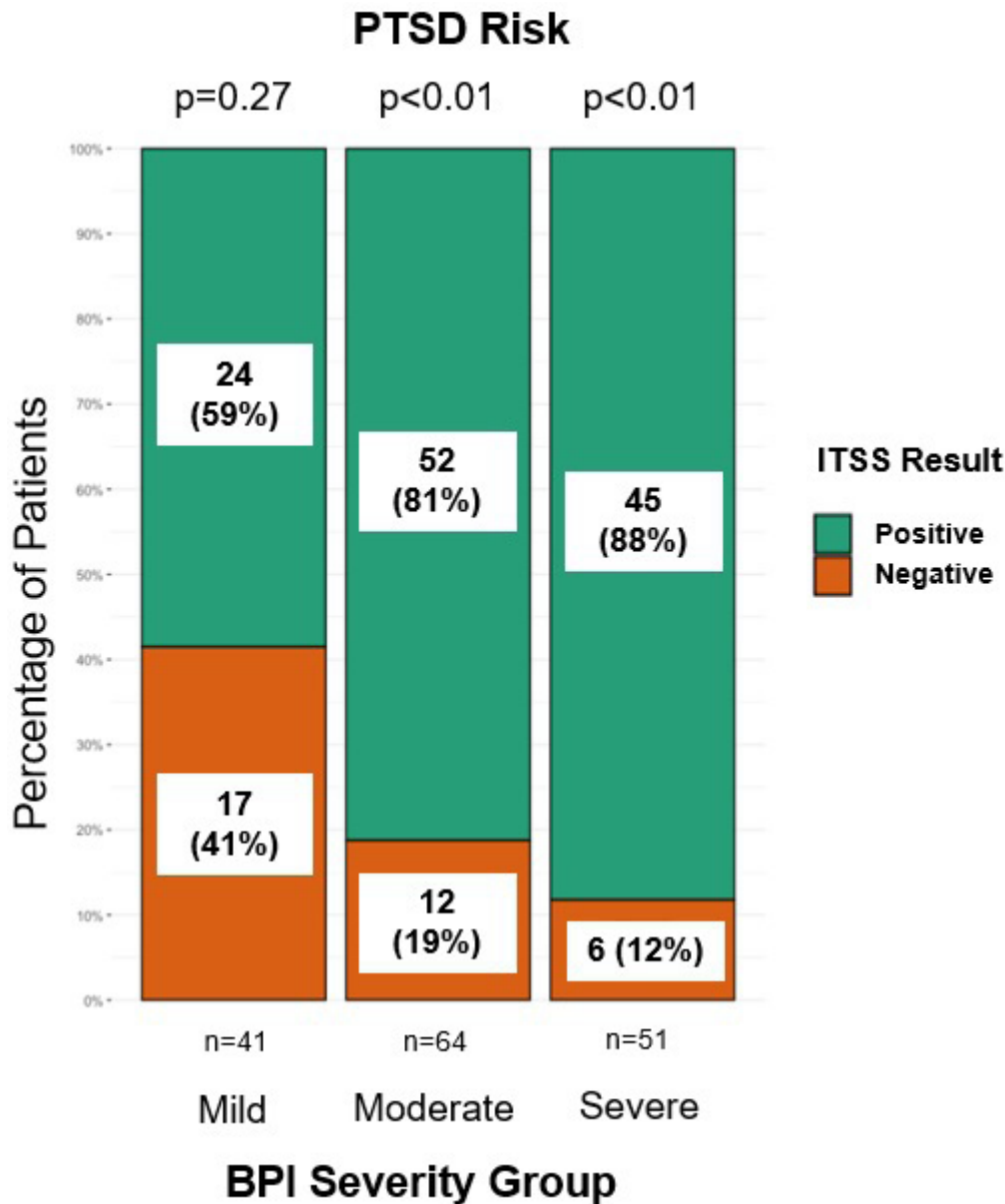


Figure 1 Injured Trauma Survivor Screen (ITSS) results in relation to BPI pain severity scoring groups. Groups were based on scores of 1–3=mild, 4–6=moderate, and 7–10=severe. Those in the BPI moderate and severe pain groups were more likely to screen positive on the ITSS for PTSD ($\chi^2=12.37$, $p<0.001$). BPI, Brief Pain Inventory; PTSD, post-traumatic stress disorder.

These are startling numbers, and the high proportion of patients reporting poor functional quality of life made determining nuanced relationships and risk patterns between quality of life and pain difficult to elucidate as nearly all patients fell into the highest symptom group for functional deficits. Nevertheless, it is important for providers to recognize that acute pain treatment is necessary to promote functional recovery and to mitigate the development of future chronic pain. The cornerstone of strategies to mitigate risk involve multimodal pain therapies with the addition of opioid analgesics if necessary.³⁷

Our study suggests that 69% and 48% of patients are at risk for PTSD and depression. Long-term patient-reported mental health and functional outcomes have also been described in firearm injury survivors. Greenspan *et al*'s work demonstrated that at 8 months after injury, approximately 40% of firearm injury survivors have symptoms of PTSD as well as decreased SF-36 scores across all domains, notably physical function, social functioning,

bodily pain, health perception, and vitality scores.² More recently, Vella *et al* performed a prospective evaluation of various mental health outcomes using the Patient-Reported Outcomes Measurement Information System instruments at a median of 5.9 years after firearm injury and found that compared with the US general population, participants had worse scores in the domains of Global Physical Health, Global Mental Health, Pain Intensity, and Alcohol and Severity of Substance Use. Patients who were more than 5 years from their injury had worsened Global Physical Health but improved screening rates for PTSD (43% vs 60% for less than 5 years). This suggests patient's perception of their physical function may continue to worsen, but PTSD symptoms improve with time.¹ Yet, all of these studies convey that about half of the patient sample had or was at risk for PTSD, which is substantial. These studies did not evaluate if patients had received mental health treatment, but these data would indicate the crucial need for early mental health intervention as a part of trauma care.

Unsurprisingly, patients with firearm injury report worsened long-term health compared with the general population. Herrera-Escobar *et al* compared patients with firearm injury to a population of patients with motor vehicle collision (MVC)-injury at 6–12 months after injury. Patients with firearm injury had significantly higher rates of daily pain (68% vs 57%) and positive screens for PTSD (53% vs 23%) compared with patients injured in an MVC. Although patients with firearm injury had higher adjusted odds of new functional limitations (OR 2.26, 95% CI 0.95 to 5.42), the differences in functional limitations and return to work were not statistically significant between the groups.³⁸

Despite over 20 years since the Greenspan *et al* article,² more recent literature^{1,4,38} and our results would suggest that patients with firearm injury are still at extreme high risk for adverse mental and physical health outcomes. The current study also underscores the complex relationships between pain, physical function, and mental health early after hospital discharge in firearm injury survivors. Multidisciplinary outpatient care models have been recently introduced and are an opportunity to provide early, comprehensive care to the patient.^{7,39,40} Notably, the TQoL Clinic is established as a full clinic embedded in the trauma division specifically for patients with firearm injury, where they are automatically scheduled to see all providers.⁷ The TQoL Clinic includes a trauma medical provider, physical therapist, psychologist, social worker, and a hospital-based violence interrupter who is a credible community member with direct access to community support and resources. The objective of the clinic is to address as many patient-identified biopsychosocial needs as possible at the same time in a single clinic space to improve access to these resources. This is important as patients in the study came from highly disadvantaged neighborhoods with the average ADI in the eighth decile of disadvantage. Consistent with other work identifying that gun violence is most prevalent in disadvantaged neighborhoods,⁴¹ these findings highlight the need for a social worker and for strong connections to community resources as the social resource needs of this population are great.

Other multidisciplinary models do exist. For example, the Center for Trauma Survivorship uses a referral process in which trauma patients who are critically ill see a nurse practitioner, healthcare navigator, and social worker as well as a trauma psychiatrist and trauma surgeon as needed.^{39,40} Importantly, both TQoL and the Center for Trauma Survivorship have providers who address pain, physical function, and mental health. These early interventions are crucial, as patients who receive some form of mental health intervention early in the post-traumatic period have evidence for improved symptoms and PTSD prevention.^{42,43} These multidisciplinary models and clinics are key examples of comprehensive trauma care.

Of note, our findings must be interpreted within the context of institutional resources. This study was performed at an institution with a robust multidisciplinary care team including an inpatient to outpatient trauma psychology program. At our institution, early multidisciplinary interventions and mental healthcare can be provided immediately after clinical stability. In a less-resourced center, it is possible that there could be even worse risk for these outcomes. Historically, the majority of patients seen for firearm injury are black Americans who are disproportionately affected by low socioeconomic status and who have reduced access to care.^{41,44} Trauma centers, particularly those that serve communities with high rates of firearm-related violence, have the potential to improve health equity by making a significant impact on enhancing access to mental healthcare

and other forms of multidisciplinary care. Moving forward, it is imperative for trauma centers to implement these practices to address the complex recovery needs of patients.

This study was limited in that patients were surveyed based on research assistant availability and on a volunteer basis without monetary incentive. Therefore, there may be a selection bias in patients who chose to respond to the surveys; however, the demographics of this group are similar to those seen in the overall clinic. Additionally, our sample was limited to patients eligible for the TQoL Clinic (ie, those discharged from the trauma surgery service), thus this sample does not capture all patients with firearm injury treated at our institution, most notably those discharged from the emergency room or those who had single system injuries that were treated by and discharged from surgical specialty services. For the same reason regarding a lack of incentive, there was also missing data for some of the measures which can contribute to additional bias. Although the purpose of this study was to gather baseline data, the study would be strengthened by follow-up data to determine the trajectory of recovery after injury. This is an area of future work for our team.

Overall, our study demonstrated the high risk for adverse mental health outcomes, and significant pain and functional symptoms that patients with firearm injury experience early after recovery. Extensive resources are necessary to support the comprehensive recovery of these patients. Trauma centers that serve a large population of patients with firearm injury should implement multidisciplinary care models which are specifically aimed to address these needs.

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