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RESEARCH ARTICLE

Impact of posttraumatic stress disorder and depressive symptoms on quality of life in adolescents after general traumatic injury

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Abstract

Posttraumatic stress disorder (PTSD) and depressive symptoms have been associated with poorer health-related quality of life in adolescents after general traumatic injuries; few studies have examined the broader construct of postinjury quality of life (QOL). We evaluated the impact of traumatic injury on adolescent QOL and examined factors that potentially contribute to poorer outcomes, using the Youth Quality of Life Instrument–Research Version as the outcome measure. Data were collected within 30 days postinjury and 2, 5, and 12 months postinjury. Mixed-model regression (MMR) was used for the main analyses. Participants ($N = 204$) were drawn from a prospective cohort study of 12–18-year-olds admitted to a Level 1 trauma center ($n = 108$) and healthy participants from a local cross-sectional study ($n = 116$); study group participants were significantly older. The initial MMR indicated that female adolescents had significantly lower QOL, $B = -2.69$, 95% CI [−4.68, −0.70], and were more likely to score above the cutoffs for PTSD (19.1% vs. 2.0%), $\chi^2(1, N = 381) = 34.6$, $p < .001$, or depression (32.8% vs. 14.0%), $\chi^2(1, N = 381) = 18.7$, $p < .001$, on post hoc analyses. Adolescents with mental health conditions in the year postinjury had significant QOL deficits without predicted improvements toward baseline, PTSD: $B = -10.05$, 95% CI [−15.29, −4.81]; depression: $B = -18.00$, 95% CI [−21.69, −14.31]. These findings highlight the importance of ongoing mental health monitoring and care for adolescents, particularly female adolescents, following traumatic injury even when physical recovery appears complete.

Unintentional injury is the leading cause of death among children aged 1–18 years in the United States (WHOQOL Group, 1995). In 2018 alone, approximately 2,500,000 children between 12 and 18 years of age experienced a nonfatal unintentional or intentional injury (Centers for Disease Control & Prevention, 2018). Advances in acute and critical care have led to improved survival and a growing focus on the long-term health-related quality of life (HRQOL), functional status, and emotional well-being of trauma survivors. Research has shown a negative impact of general traumatic injury on HRQOL in children and adolescents, with female adolescents exhibiting poorer HRQOL than their male counterparts. Improvements commonly occur over the first 1–2 years postinjury, but functioning may not return to baseline (Bisegger et al., 2005; Daviss et al., 2000; Karimi & Brazier, 2016; Martin-Herz et al., 2012).

Quality of life (QOL) relates to an individual's self-perceived life status, inclusive of their culture, value system, goals, expectations, and concerns (WHOQOL Group, 1995). Unlike HRQOL, QOL considers both external (e.g., sociocultural, geographic, and geopolitical) and internal (e.g., lifestyle, illness behavior, motivation, and values) factors and is particularly useful when assessing environments or issues outside direct health care (Karimi & Brazier, 2016). Knowledge of the impact of pediatric traumatic injury on QOL is very limited, highlighting a gap of concern in adolescence, a time when these broader factors are particularly important.

Posttraumatic stress disorder (PTSD) or significant PTSD symptoms are common in children and adolescents following traumatic injury, ranging from 12% to as high as 45% in some samples (Kassam-Adams et al., 2015; Martin-Herz et al., 2012; Schneeberg et al., 2016; van Meijel et al., 2019). Significant PTSD symptoms have been shown to continue in 17%–27% of adolescents 12–18 months after injury (Holbrook et al., 2005; Jurkovich et al., 2008; Landolt et al., 2005), and symptoms may start within the first year, even in children without significant acute stress symptoms (Landolt et al., 2005). Additionally, 17%–20% of children and adolescents show significant depressive symptoms in the first few weeks after a traumatic injury (Jurkovich et al., 2008; Kassam-Adams et al., 2015; Schneeberg et al., 2016; van Meijel et al., 2019; Zatzick et al., 2006). Children who screen positive for PTSD or depressive symptoms following an injury have been shown to exhibit poorer HRQOL up to 12 months postinjury (Holbrook et al., 2007; Jurkovich et al., 2008; Kassam-Adams et al., 2015; Landolt et al., 2007; Schneeberg et al., 2016); we did not find any studies of the impact of PTSD symptoms or depressive symptoms on QOL.

The current study aimed to evaluate the impact of general traumatic injury on adolescent QOL and investigate the contribution of demographic factors, injury variables, and adolescent mental health to this outcome. We hypothesized that (a) compared with a healthy sample, adolescents who experienced a traumatic injury would report similar retrospective recall of preinjury QOL and (b) report poorer postinjury QOL, with improvements toward baseline in the year after injury and a negative impact of ongoing mental health conditions.

METHOD

Participants

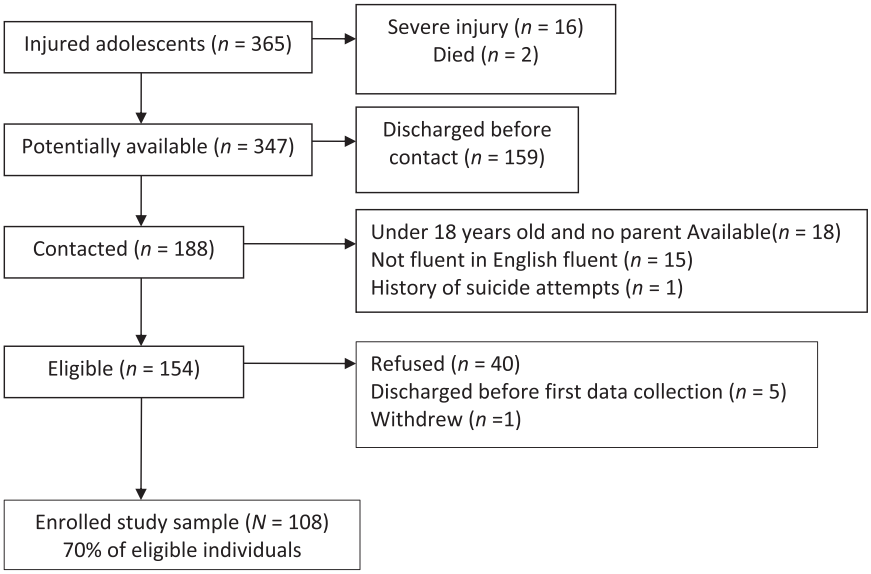
The study sample was drawn from a prospective cohort study with a population-based sampling frame. Data were collected at four assessments: baseline (i.e., within 30 days of injury) and 2 months, 5 months, and 12 months postinjury. A comparison sample consisted of the healthy subsample from a cross-sectional cohort study, with data collected at a single assessment point.

The study sample included 108 adolescents (age range: 12–18 years) recruited from a regional Level 1 trauma center following a general traumatic injury. Inclusion criteria were an injury requiring inpatient admission, English fluency in the patient and one parent, a Glasgow Coma Scale score of 15 (Teasdale & Jennett, 1974), and a score of at least 7 out of 10 on the "orientation to location" and "date" items on the Mini-Mental State Examination (Folstein et al., 1975). The latter two criteria were included to assure the patient was alert and oriented with clear sensorium. Exclusion criteria included self-inflicted injury or a level of injury severity that prevented participation due to extended hospitalization or inpatient rehabilitation (e.g., severe traumatic brain injury, spinal cord injury, large burn injury). Reimbursement was $10–$15 (USD) each session, up to a maximum of $50. Parental consent and adolescent consent or assent were required. Participants were enrolled between July 2002 and August 2003.

The comparison sample consisted of 116 age-matched, noninjured, typically developing adolescents, with data provided by the Seattle Quality of Life Group at the University of Washington. Inclusion criteria were the ability to read at the sixth-grade level and no chronic medical conditions, disability, attention-deficit/hyperactivity disorder, depression, or other mental health challenges. Recruitment was community-based in the same geographical region as the trauma center. Parental consent and adolescent consent or assent were required. Adolescents received $20 for participation. Data collection was completed between August 1999 and July 2000.

The final samples consisted of 108 study participants and 116 comparison participants. The study flow is depicted in Figure 1. At baseline, interviews occurred an average of

FIGURE 1 Study recruitment flow chart



11.7 days ($SD = 12.1$) days postinjury; the average elapsed time since the injury was 51 days ($SD = 17.8$) at 2-month follow-up, 154.7 days ($SD = 23.2$) days at 5 months, and 367.3 days ($SD = 34.0$) at 12 months. Retention rates were 97.2% ($n = 105$) at baseline, 87.0% ($n = 94$) at 2 months, 83.3% ($n = 90$) at 5 months, and 82.4% ($n = 89$) at 12 months postinjury.

On average, participants in the study group were significantly older than those in the comparison group ($M = 15.89$ years, $SD = 1.89$ vs. $M = 14.90$ years, $SD = 1.71$), $t(222) = 4.12$, $p < .001$. There were no significant differences in gender, with 36 (33.3%) female adolescents in the study group versus 47 (40.5%) in the comparison group, $\chi^2(1, N = 224) = 1.238$, $p = .266$, nor were there differences in dichotomous race (i.e., White non-Hispanic vs. "other;" study group: $n = 79$, 73.1% White non-Hispanic; comparison group: $n = 87$, 75.0% White non-Hispanic), $\chi^2(1, N = 224) = 0.1$, $p = .752$. Table 1 shows additional study sample demographic characteristics, injury variables, predictors, and outcome variables for the study sample.

Procedure

Adolescents were interviewed in a confidential space separate from their parents. Adolescents' symptoms were evaluated using self-report tools. Injury characteristics were obtained from the trauma registry information system. Baseline interviews were conducted in person within 30 days of injury either during hospitalization or by telephone. All follow-up interviews were conducted by telephone and completed 2, 5, and 12 months after the initial injury. Interview reliability was monitored in 5% of cases. For the comparison sample, data were collected by telephone via a parent interview for demographic data and a separate adolescent interview for the Youth Quality of Life Instrument–Research Version (YQOL-R; Edwards et al., 2002; Patrick et al., 2002; Topolski et al., 2002).

For the study sample, full Institutional Review Board (IRB) approval was obtained at the University of Washington for the parent study. Informed consent was obtained from adolescent participants 18 years of age or older and one parent, and participants under 18 years of age provided assent and one parent provided consent. For the comparison sample, full IRB approvals from the University of Washington and Children's Hospital and Regional Medical Center (now Seattle Children's Hospital) were obtained for the parent study. Approval for secondary data analysis was additionally obtained from the University of California San Francisco.

Measures

Demographic variables

Study sample demographic variables included age, gender, race, and household income. Age, gender, and race were available for the comparison sample.

Injury characteristics

The Injury Severity Score (ISS; Baker et al., 1974) was used to assess injury severity. The ISS was developed to describe overall injury severity when more than one body region is involved and includes ratings of injuries to the head or neck, face, chest, pelvis or abdomen, and extremities, as

TABLE 1 Demographic characteristics and injury, predictor, and outcome variables

	M	SD	n	%	*Mdn*	Range
Adolescent age (years)	15.89	1.89			16	12–18
Adolescent gender						
Male			72	66.7		
Female			36	33.3		
Adolescent race/ethnicity						
White, non-Hispanic			79	73.1		
Other race/ethnicity			29	26.9		
Parent age (years)	43.82	7.36			43	31–73
Parent gender						
Male			22	22.2		
Female			77	77.8		
Household income (USD)						
$0–$29,999			14	17.3		
$30,000–$59,999			25	30.9		
$60,000–$89,999			24	29.6		
≥ $90,000			18	22.2		
Injury variables						
Injury Severity Score	9.71	6.54			9	1–29
Length of hospital stay (days)	5.33	6.23			3	1–44
Admitted to ICU			28	29.2		
Time in ICU (days)	0.69	2.24			0	0–16
Psychosocial variables						
Baseline						
Adolescent PTSD symptoms	20.78	12.94			18	0–52
Adolescent depressive symptoms	17.47	11.10			16	0–45
Traumatic life events	2.46	1.76			2	0–6
2-month follow-up						
Adolescent PTSD symptoms	18.62	13.75			15	0–60
Adolescent depressive symptoms	11.69	11.26			9	0–53
5-month follow-up						
Adolescent PTSD symptoms	15.93	12.79			13	0–52
Adolescent depressive symptoms	9.23	10.65			6	0–45
12-month follow-up						
Adolescent PTSD Symptoms	14.58	11.52			12	0–56
Adolescent Depressive Symptoms	9.36	9.53			6	0–41
QOL outcome measure						
Baseline	83.31	14.67			87.33	27–99
2-month	81.70	16.11			85.64	32–99
5-month	85.56	14.30			89.18	25–100
12-month	83.88	14.23			87.68	45–99

Note: ICU = intensive care unit; PTSD = posttraumatic stress disorder; QOL = quality of life.

well as external injuries. Each region is given a score based on the severity of the injuries to that region. The ISS was calculated as the sum of squares of the highest abbreviated injury scale grade for the three body areas with the most severe injuries. Injury intent was gathered from the medical record and noted as accidental versus nonaccidental or assaultive.

PTSD symptoms

PTSD symptoms were investigated using the adolescent version of the UCLA PTSD Reaction Index (PTSD-RI; Steinberg et al., 2004), with participants asked to rate items using the event in which they were injured as their reference traumatic experience. The PTSD-RI has demonstrated good convergent validity with PTSD diagnosis, good internal consistency (e.g., Cronbach's α = .90),

and good–to–excellent test–retest reliability. When a dichotomous evaluation is desired, a cutoff score of 38 has a reported sensitivity of 0.93 and specificity of 0.87 for the diagnosis of PTSD by a clinician-administered measure (Steinberg et al., 2004). In the present sample, the PTSD-RI demonstrated adequate internal consistency across the four assessment points, Cronbach's αa = .89–.92.

Depressive symptoms

Adolescents' depressive symptoms were evaluated using the Center for Epidemiological Studies Depression Scale (CES-D; Radloff, 1977), a 20-item self-report measure. The CES-D has demonstrated excellent internal consistency and convergent validity (Radloff, 1977) and has been extensively used in adolescent samples (Wight et al., 2004). Cutoff scores for adolescents have ranged from 12, for male adolescents only, to 28 (Garrison et al., 1991; Roberts et al., 1991; Yang et al., 2004; Zatzick et al., 2008), with optimal cutoffs for major depression in adolescents reported to be 12−22 for boys and 22−24 for girls (Garrison et al., 1991; Roberts et al., 1991); for the present study, we operationalized a cutoff of 22. In the current sample, the internal consistency of the CES-D was adequate across the four assessment points, Cronbach's αs = .70–.78.

Trauma history

A modified version of the PTSD-RI trauma history screen (Steinberg et al., 2004) was used to assess participants' history of traumatic life events that occurred before the index traumatic injury. This screening tool was used to capture lifetime exposure to natural disasters, motor vehicle crashes, war zones, physical assault, witnessing violence or death, the sudden unexpected loss of a loved one, and life-threatening medical conditions. Each item was assigned equal weight for event severity, as research with this and other measures of life events demonstrates little to no benefit of using differential weights (Swearingen & Cohen, 1985). Because trauma history scales do not assess an overall construct, psychometric properties are typically not calculated nor presented either from tool development or this specific sample.

QOL

The YQOL-R served as the study outcome measure. It is a self-report measure designed with the World Health Organization QOL measurement recommendations in mind (Edwards et al., 2002; Patrick et al., 2002; Topolski et al., 2002). The measure is used to assess QOL across four domains: sense of self, social relationships, environment, and general QOL. The composite total QOL was the outcome measure for the current study. The maximum score is 100, with higher scores indicating higher levels of QOL. The YQOL-R has demonstrated adequate internal consistency (Cronbach's αs = .77–.96) and test–retest reliability (intraclass correlation coefficients = .74–.85) as well as acceptable content and discriminant validity. Baseline QOL was queried retrospectively as "statements that you might have made about yourself before the event in which you were injured;" at all other assessment points, items were anchored by "statements that you might have made about yourself since your injury." For the current study, Cronbach's alpha values ranged from .95 to .96 across the four assessment points, showing excellent internal consistency.

Data analysis

A total of five participants had some missing data at baseline, 14 had missing data at 2 months, 18 had missing data at 5 months, and 20 were missing data at 12 months postinjury. We did not detect any patterns that might explain the missing data. If fewer than 50% of items were missing on a YQOL-R subscale, missing values were imputed by substituting the average of available items for each subscale for the missing item. The total QOL was then recalculated from the updated subscale scores per YQOL scoring protocols. This procedure is recommended for the MOS SF-36, a commonly used adult HRQOL measure (Ware et al., 2000), and was chosen for that reason. Data for one participant at baseline, two participants at 2 months, one participant at 5 months, and one participant at 12 months were amenable to imputation by mean substitution. Because we planned to control for baseline YQOL-R scores in the final analyses, the four participants with missing baseline YQOL-R data would have been dropped from subsequent analyses due to their missing status on this one measure. Thus, we used multiple imputation (i.e., multivariate normal regression) to calculate missing subscale totals for these four participants using adolescent age, gender, baseline PTSD symptom score, and baseline depressive symptom score in the model. A total of 20 imputations were taken. Relative efficiency numbers were all greater than 0.99, suggesting that this was a sufficient number of imputations. Total QOL scores were then calculated as usual from these values. For the time-varying variables, mixed-model regression retains all participants who have missing data; we specifically chose this method for this longitudinal dataset because of the risk for missingness. Thus, individuals with missing YQOL-R ratings at 2-, 5-, and 12-month

follow-up and those with missing values for key predictor variables (i.e., PTSD-RI and CES-D) were included in subsequent analyses. For this reason, imputation was not completed for these variables. There were no missing data for the time-invariant predictor variables of age, gender, or race/ethnicity. Household income was imputed for 15 participants by ordered logistic regression, the method for ordinal data. Ten imputations were undertaken with parent gender, age, and PCLC scores utilized in the model.

To improve interpretation of the model intercept, age was centered on 12(i.e., the youngest participant age), and adolescent PTSD symptoms, depressive symptoms, and baseline QOL were all centered on their median value at baseline data collection, so the intercept could be interpreted as the average value at the youngest age and median of other covariates. The outcome YQOL-R data was not centered.

Analyses were conducted using SPSS (Version 26; IBM Corp., 2018) and Stata (Version 13.1; StataCorp, 2013). We compared demographic variables of the study and comparison samples. QOL from the comparison sample was compared to study sample QOL from each assessment point using independent samples *t* tests and a Holm-Bonferroni correction for multiple comparisons (Gaetano, 2013). An analysis of variance (ANOVA) with a post hoc Tukey test for pairwise comparisons was then calculated to compare three groups: (a) study sample adolescents with PTSD or depressive symptom scores that fell above the established cutoffs, (b) study sample adolescents with PTSD or depressive symptom scores that fell below the established cutoffs, and (c) the comparison sample. We again used a Holm-Bonferroni correction for multiple comparisons to adjust for multiple comparisons (Gaetano, 2013).

Further analysis of the study sample included mixed-model regression (MMR) to investigate trends in QOL over the year following traumatic injury. Adjustment was made for age, gender, dichotomous race, household income, ISS, and injury intent. A second set of MMRs was conducted to evaluated contributors to QOL over time. These included the fixed effects of gender; age; dichotomous race; household income; baseline QOL score; baseline continuous PTSD symptoms or depressive symptoms, respectively; and the number of adolescent preinjury traumatic life events. Two different models of time-varying effects were investigated, with YQOL-R total score as the dependent variable. The first model included adolescent PTSD, defined as a PTSD-RI score of 38 or higher, as the only time-varying predictor. The second model included adolescent depression, defined as a CES-D score of 22 or higher, as the only time-varying predictor.

RESULTS

An MMR of the study sample that adjusted for baseline total QOL, age, gender, dichotomous race (i.e., White, non-Hispanic vs. other race/ethnicity), household income, injury severity, and injury intent (i.e., accidental vs. assault), revealed no significant trend in QOL over the 12 months postinjury. Female gender was associated with significantly poorer QOL, averaging 2.7 points lower than male adolescents, $B = -2.69$, 95% CI [−4.68 - −0.70], $z = -2.64$, $p = .008$. Injury variables were not significantly related to QOL and were not included in subsequent analyses. A simple linear regression on the one time point for the comparison sample did not reveal differences in QOL by available demographic variables.

There was no significant difference in QOL, using the Holm-Bonferroni correction, for multiple comparisons between the full study sample and the comparison group at baseline ($M = 83.30$, $SD = 13.13$ vs. $M = 79.93$, $SD = 1.22$), $t(216) = -1.78$, $p = .154$; 2-month follow-up, ($M = 81.70$, $SD = 16.11$ vs. $M = 79.93$, $SD = 13.13$), $t(207) = -0.88$, $p = .383$; or 12 months postinjury, ($M = 83.88$, $SD = 14.23$ vs. $M = 79.93$, $SD = 13.13$), $t(201) = -2.05$, $p = .126$. At 5-months postinjury, participants in the study sample reported significantly higher QOL scores compared with the comparison sample ($M = 85.56$, $SD = 14.30$ vs. $M = 79.93$, $SD = 13.13$), $t(203) = 2.93$, $p = .004$. Given these findings, we further compared QOL scores at each time point for participants with and without probable PTSD and participants in the comparison group as well as for participants with and without probable depression and participants the comparison group (Figures 2 and 3). One-way ANOVAs revealed significant differences across the three groups at the three follow-up time points for PTSD, Baseline: $F(2, 215) = 1.89$, $p = .154$; 2-month follow-up, $F(2, 206) = 11.29$, $p < .001$; 5-month follow-up, $F(2, 202) = 10.46$, $p < .001$; 12-month follow-up, $F(2, 200) = 10.31$, $p < .001$, and at all time points for depression, Baseline: $F(2, 215) = 13.87$, $p < .001$; 2-month follow-up, $F(2, 206) = 30.64$, $p < .001$; 5-month follow-up, $F(2, 202) = 36.41$, $p < .001$; 12-month follow-up $F(2, 200) = 32.18$, $p < .001$). Means and standard deviations, with 95% confidence intervals, are presented in Supplemental TableS1. The significance of pairwise comparisons is shown in Figures 2 and 3, with a Holm-Bonferroni correction used for multiple comparisons.

The final analyses investigated the impact of PTSD symptoms and depressive symptoms on QOL over time. PTSD symptoms and depressive symptoms showed significant multicollinearity, *r*s = .77–.89, by time point, and, thus, were analyzed separately. All reported beta coefficients are unstandardized. For PTSD symptoms, an initial MMR with continuous PTSD symptoms revealed a signifi-

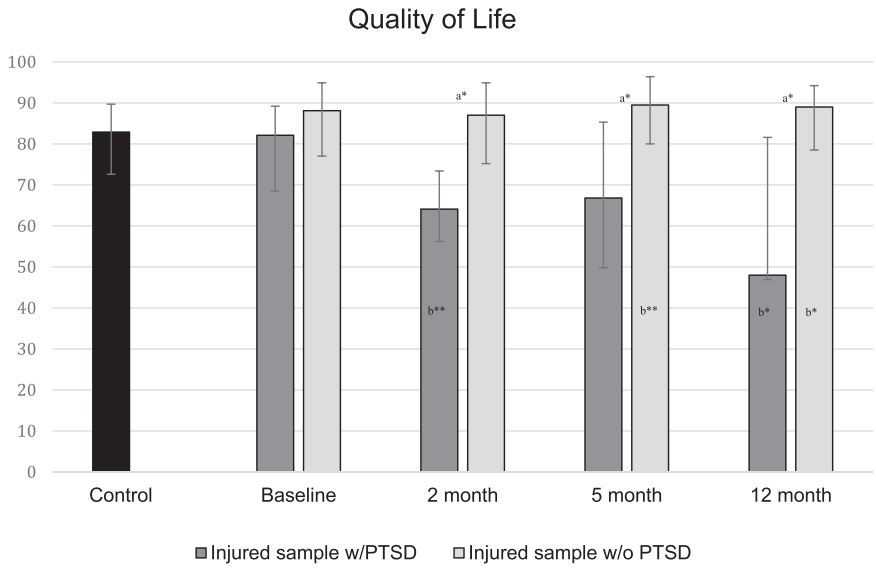


FIGURE 2 Quality of life median, 25th, and 75th percentiles, by posttraumatic stress disorder (PTSD) symptom status. Note: A Holm–Bonferroni correction was made for multiple comparisons
[a]PTSD versus no PTSD: $^{*}p < .01$. [b]Significant difference from comparison group: $^{*}p < .05$; $^{**}p < .01$.

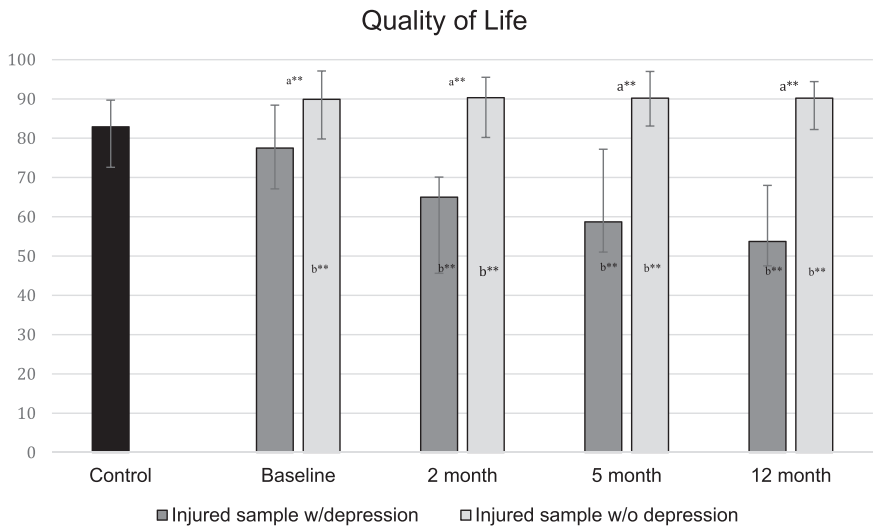


FIGURE 3 Quality of life median, 25th, and 75th percentiles, by depressive symptoms. Note: A Holm–Bonferroni correction was made for multiple comparisons
[a]Depression versus no depression: $^{**}p < .01$. [b]Significant difference from comparison group: $^{**}p < .01$.

cant effect of baseline YQOL-R total score, $B = 0.62$, 95% CI [0.52, 0.72], $t(73.79) = 12.24$, $p < .001$, and adolescent continuous PTSD symptoms, $B = -0.55$, 95% CI [−0.67, −0.43], $t(73.79) = -8.88$, $p < .001$, on the dependent variable. Nine adolescents (8.3%) at baseline, 10 (9.3%) at 2 months, six (5.6%) at 5 months, and five (4.6%) at 12 months scored at or above the threshold score of 38 on the PTSD-RI. A second regression with time-varying dichotomized PTSD revealed an overall QOL score 10 points lower for individuals with PTSD than those without PTSD (Table 2). Similar analyses were completed for depressive symptoms. An initial MMR that included continuous depressive symptoms showed a significant effect of baseline YQOL-R total score, $B = 0.53$, 95% CI [0.44, 0.62], $t(73.79) = 11.65$, $p < .001$, and adolescent continuous depressive symptoms, $B = -0.86$, 95% CI [−0.98, −0.76], $t(73.79) = -15.28$, $p < .001$. At baseline, 38 adolescents (35.2%) scored at or above the cutoff of 22 on the CES-D; at 2-, 5-, and 12-, months, the numbers of participants who scored at or above the threshold were 17 (15.7%), 12 (11.1%), and 11 (10.2%), respectively. A second MMR, with dichotomized depressive symptoms, revealed QOL scores an average of 18 points lower among adolescents with significant depressive symptoms compared with those without significant symptoms (Table 3).

DISCUSSION

It is well documented that adolescents experience HRQOL deficits in the initial months and, potentially, years after a general traumatic injury. In contrast, when investigating the broader concept of QOL, the current study found overall normative or better-than-normative QOL in the full sample, with no notable change over the year following injury. Findings were similar for participants who did not meet the established cutoff for PTSD symptoms at each of

TABLE 2 Mixed-model regression for total quality of life (QOL) and posttraumatic stress disorder (PTSD) symptom scores

Variable	*B*	*SE*	*t* (73.79)	95% CI
Baseline total QOL	0.74	0.05	13.71*	[0.63, 0.84]
Baseline PTSD symptoms	−0.16	0.06	−2.76*	[−0.28, −0.05]
Gender: female	−1.16	1.44	−0.80	[−3.99, 1.69]
Age	−0.01	0.33	0.97	[−0.66, 0.64]
Race: non-White/non-Hispanic	−1.92	1.58	−1.21	[−5.02, 1.18]
Household income (USD)[a]				
$0 –$29,999	−6.18			
$30,000–$59,999	0.17			
$60,000–$89,999	1.38			
≥ $90,000	−2.38			
Assessment time				
2-months	Ref.			
5-months	2.28	1.31	1.74	[−0.29, 4.85]
12-months	0.42	1.42	0.29	[−2.37, 3.20]
PTSD: Yes	−10.05	2.67	−3.76*	[−15.29, −4.81]
Preinjury TLE	−0.33	0.40	−0.83	[−1.11, 0.45]

Note: Ref. = reference; TLE = traumatic life events.
[a]χ^2 (4, N = 98) = 12.75*.
*$p < .05$; **$p < .01$; ***$p < .001$.

TABLE 3 Mixed-model regression for total quality of life (QOL) and depressive symptoms

Variable	*B*	*SE*	*t*(73.79)	95% CI
Baseline total QOL	0.59	0.05	10.94*	[0.48, 0.69]
Baseline depressive symptoms	−0.01	0.07	−0.20	[−0.15, 0.12]
Gender: female	−1.55	1.24	−1.25	[−3.98, 0.88]
Age	0.16	0.29	0.54	[−0.42, 0.74]
Race: non-White/non-Hispanic	−3.17	1.39	−2.29*	[−5.89, −0.46]
Household income[a] (USD)				
$0 –$29,999	−2.05			
$30,000–$59,999	0.93			
$60,000–$89,999	0.63			
≥ $90,000	−1.19			
Assessment time				
2-month	Ref			
5-month	1.64	1.20	1.37	[−0.72, 4.00]
12-month	−0.46	1.25	−0.04	[−2.51, 2.42]
Depression: Yes	−18.00	1.88	−9.56*	[−21.69, −14.31]
Preinjury TLE	−0.02	0.41	−0.37	[−0.96, 0.66]

Note: PTSD = posttraumatic stress disorder; TLE = traumatic life events; Ref = reference.
[a]χ^2 (4, N = 98) = 3.24.
*$p < .05$; **$p < .01$; ***$p < .001$.

the three follow-up assessments and for those who did not meet the cutoff for depressive symptoms at all visits. Similar findings in at least two studies of HRQOL or QOL after injury suggest the current findings are not likely spurious (Pope et al., 2007; Watson et al., 2007). In a study specifically investigating the validity of retrospective recall of preinjury HRQOL in adults, baseline retrospective recall of HRQOL was shown to be consistently higher than national norms in the injured sample and remained similarly high 12 months postinjury in the subgroup of individuals who fully recovered from their injuries (Watson et al., 2007). Individuals who did not recover, however, reported significantly poorer HRQOL 12 months postinjury compared with HRQOL assessed at baseline. The investigators suggested that adults who experience injury may, in fact, rate themselves differently than the general population even before they experience an injury and may form a different subsample of the population for whom baseline retrospective recall of HRQOL is a more appropriate comparison measure than national norms (Watson et al., 2007). It is certainly possible that the current sample, with primarily mild-to-moderate injury severity, contained a predominance of participants who were fully recovered by 12 months and could fit this pattern. A second study investigated QOL outcomes in 36 children an average of 11 years, 9 months after a burn injury. The study utilized the same QOL measure as we used for the current study and similarly found that the sample with burn injuries reported higher levels of overall QOL than an uninjured school-based sample (Pope et al., 2007). However, the study had some significant limitations, including a very small sample size and low response rate (i.e., 37% for the study sample, 24% for the comparison sample), as well as a much longer time since injury.

Two potential explanations are postulated for why injured adolescents reported similar or higher QOL than those in a comparison sample of adolescents without

disability, chronic medical conditions, or chronic mental health concerns. First, injured teens may have differed in self-perceived QOL from typical peers even before they were injured. In support of this explanation, Scholten et al. (2017) found higher-than-normative HRQOL scores for the physical component, mental component, or both in nine of the 12 studies they included in a systematic review examining preinjury HRQOL in adults. Alternatively, injured adolescents may have a postinjury change in their self-perceived QOL, either through posttraumatic growth (PTG) or because of a shift in how they interpret their own QOL. Small but significant associations between PTG and QOL have been documented (Alisic et al., 2008; Clay et al., 2009). The concept of PTG is gaining support both in the adult and pediatric literature (Alisic et al., 2008; Clay et al., 2009): Several studies have noted a positive association between PTSD symptoms and PTG, with individuals who experience PTSD symptoms demonstrating more significant experiences of PTG (Alisic et al., 2008; Barakat et al., 2006; Kamibeppu et al., 2010; Salter & Stallard, 2004). Although, on the surface, these findings may make PTG seem to be a less likely reason for improved QOL in individuals without PTSD, recent data suggest that the association between PTSD symptoms and PTG may be curvilinear, with individuals at the low and high ends of PTSD symptom severity showing less PTG than those with more moderate symptoms (Levine et al., 2008). Exploratory analyses of relevant YQOL-R subscales did not support such an association in the current data. Finally, injured adolescents may have experienced a response shift in which their internal standard for HRQOL was "reset" at the time of injury, and this new standard was maintained throughout the study period. Response shift is thought to be either a change in values or in the conceptualization of the construct—in this case, QOL—and may be precipitated by a traumatic event (Watson et al., 2007). Further investigation of this area for adolescent QOL seems warranted.

Notably, the findings differed for children with and without elevated PTSD or depressive symptoms, with significantly poorer QOL reported among those with elevated PTSD or depressive symptoms and no recovery over time for those with symptoms at later time points (Figure 2). Importantly, these differences (i.e., 10%–18% of the overall scale range, or 100 points) are likely to impact adolescent functioning. These findings parallel those for HRQOL outcomes but differ in that they reflect the impact of significant mental health symptoms over time as opposed to those reported at the time of injury (Kassam-Adams et al., 2015; Zatzick et al., 2008). They provide new information about factors that contribute to QOL outcomes in adolescents after traumatic injury and highlight important targets for screening and intervention. Finally, given that injuries in this sample were in the mild-to-moderate range, with full physical recovery likely for many, these findings highlight the need for close mental health monitoring in this population, even if physical recovery has occurred (Kassam-Adams et al., 2013). A growing number of studies focus on risk factors for poor mental health outcomes in children and adolescents after traumatic injuries, including avoidant coping strategies and injury-related fear or perceived life threat. Such work will be important in identifying higher-risk children and developing interventions (Cox et al., 2008; Kassam-Adams et al., 2013; Marsac et al., 2016, 2017; Trickey et al., 2012).

Overall, 15.7% and 37.0% of participants, respectively, reported PTSD or depressive symptoms that met or exceeded the clinical cutoff at one or more assessment points. These rates were highest in the first 2 months postinjury, reaching a maximum of 9.3% of the sample for PTSD symptoms at 2 months and 35.2% of the sample for depressive symptoms at baseline. These findings suggest the present sample may have exhibited more early depressive symptoms than previous samples, although cutoff scores for the CES-D in adolescents have varied. Although both male and female adolescents with PTSD and depressive symptoms demonstrated decreased QOL, only female gender was significantly associated with poorer QOL over time for the full study sample. Post hoc analyses showed that female adolescents had significantly higher PTSD ($M = 24.39$, $SD = 15.38$ vs. $M = 14.12$, $SD = 9.85$), $t(187.39) = 6.93$, $p < .001$, and depressive symptoms ($M = 16.59$, $SD = 13.26$ vs. $M = 9.91$, $SD = 9.16$), $t(196.68) = 5.16$, $p < .001$, than male adolescents and were significantly more likely to score above the symptom cutoff for both variables, 19.1% vs. 2.0%, $\chi^2(1, N = 381)$, $p < .001$, for PTSD (32.8% vs. 14.0%), $\chi^2(1, N = 381)$, $p < .001$, for depression. These findings are consistent with limited research from both adults and adolescents and highlight female adolescents as a high-risk group following injury, demonstrating the need to pay particular attention to their postinjury mental health (Asbridge et al., 2014; Holbrook & Hoyt, 2004; Holbrook et al., 2002). In addition to mental health findings, there are several other potential reasons female adolescents experience poorer QOL after general traumatic injuries than their male counterparts. First, there is a self-esteem gender gap among adolescents, with young female adolescents reporting significantly lower self-esteem than male adolescents, which likely contributes to worsening QOL after injury (Helwig & Ruprecht, 2017). Additionally, several authors have noted that girls and boys may differ in coping mechanisms, with female adolescents tending to adopt more emotion-based versus problem-solving coping styles (Flannery et al., 2018; Kelly et al., 2008). If female adolescents adopt more avoidant coping, the previously cited literature would suggest a higher risk for poor mental health outcomes (Kassam-Adams et al., 2013). Intersectional variables such as gender, race/ethnicity, and socioeconomic status could also be important determinants of

child and adolescent well-being (Turan et al., 2019), and investigations of related potential health disparities could prove beneficial for future child and adolescent care.

The present study had several limitations, most notably its relatively small sample size, which limited the type and extent of the analyses and generalizability of findings. Although the population-based sampling frame could improve generalizability, future research will benefit from a larger sample to allow consideration of additional factors in full analyses. The use of retrospective recall at baseline for ratings of preinjury QOL may also be considered a limitation. Similarly, preinjury adolescent mental health and other diagnoses, such as attention-deficit/hyperactivity disorder or chronic illness, were also unknown, although we did assess participants' mental health at the time of injury. This lack of preinjury data collection is an issue that impacts the field of posttrauma research in general: Both negativity bias and positive response shift have been noted as possible, and preinjury data collection is not easily addressed outside of large epidemiologic samples (Naragon-Gainey et al., 2012; Patterson et al., 2003; Sato & Kawahara, 2011; Watson et al., 2007). Nonetheless, there is a potential to improve future postinjury and injury prevention research through the review of preinjury medical records and medication use (e.g., stimulant medication for ADHD) or the additional study of the accuracy of retrospective recall of preinjury mental health. The present study also did not investigate the participants' subjective experience of the injury event or query how many of the assaultive injuries (i.e., 10.2% of the reported injuries) were abusive. These factors will be important to consider in future work. In addition, the datasets we utilized in this secondary analysis were older, and, as such, participants' QOL self-assessment may have differed from how current adolescents would respond. Importantly, data for both the injured cohort and healthy controls were collected close together; thus, time is unlikely to have been a factor in the similarities and differences observed. There continues to be a large knowledge gap regarding the broader construct of QOL, making these data still relevant and contributory to the field. Additionally, data from only one assessment point were available for the comparison group, and it is possible that QOL may have shifted over time for this healthy sample without mental health conditions, although we did not observe significant change over time in the injured sample. Future work would benefit from a noninjured longitudinal comparison sample. Finally, this study followed participants for 1 year after injury. Although physical recovery is likely to have occurred for many, the mental health consequences of major traumatic injuries suggest that longer-term investigation of QOL outcomes after adolescent injury will be important.

As the first known study to investigate the impact of adolescent general traumatic injury on QOL, this project adds to the important field of postinjury pediatric outcomes. In contrast to our predictions, these findings suggest that adolescents who do not experience significant PTSD or depressive symptoms have no QOL deficits, whereas adolescents with these mental health conditions in the year after an injury have significant QOL deficits without the predicted improvement toward baseline. We identified poorer QOL outcomes, as well as higher rates of PTSD and depression symptoms, in female adolescents compared to their male counterparts. Overall, the present findings emphasize the importance of ongoing mental health monitoring and care for adolescents who experience traumatic injury, particularly female adolescents, even when physical recovery appears complete.

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REFERENCES

Alisic, E., van der Schoot, T. A. W., van Ginkle, J. R., & Kleber, R. J. (2008). Looking beyond posttraumatic stress disorder in children: Posttraumatic stress reactions, posttraumatic growth, and quality of life in a general population sample. *The Journal of Clinical Psychiatry*, *69*(9), 1455–1461. https://doi.org/10.4088/JCP.v69n0913

Asbridge, M., Azagba, S., Langille, D. B., & Rasic, D. (2014). Elevated depressive symptoms and adolescent injury: Examining associations by injury frequency, injury type, and gender. *BMC Public Health*, *14*(1), 190. https://doi.org/10.1186/1471-2458-14-190

Baker, S. P., O'Neill, B., Haddon, W., & Long, W. B. (1974). The Injury Severity Score: A method for describing patients with multiple injuries and evaluating emergency care. *The Journal of Trauma*, *14*(3), 187–196. https://doi.org/10.1097/00005373-197403000-00001

Barakat, L. P., Alderfer, M. A., & Kazak, A. E. (2006). Posttraumatic growth in adolescent survivors of cancer and their mothers and fathers. *Journal of Pediatric Psychology*, *31*(4), 413–419. https://doi.org/10.1093/jpepsy/jsj058

Bisegger, C., Cloetta, B., von Bisegger, U., Abel, T., & Ravens-Sieberer, U., & The European Kidscreen Group. (2005). Health-related quality of life: Gender differences in childhood and adolescence. *Sozial- Und Präventivmedizin SPM*, *50*(5), 281–291. https://doi.org/10.1007/s00038-005-4094-2

Centers for Disease Control and Prevention. (2018). *Web-based injury statistics query and reporting system (WISQARS)*. https://www.cdc.gov/injury/wisqars/index.html

Clay, R., Knibbs, J., & Joseph, S. (2009). Measurement of posttraumatic growth in young people: A review. *Clinical Child Psychology and Psychiatry*, *14*(3), 411–422. https://doi.org/10.1177/1359104509104049

Cox, C. M., Kenardy, J. A., & Hendrikz, J. K. (2008). A meta-analysis of risk factors that predict psychopathology following accidental trauma. *Journal for Specialists in Pediatric Nursing*, *13*(2), 98–110. https://doi.org/10.1111/j.1744-6155.2008.00141.x

Daviss, W. B., Mooney, D., Racusin, R., Ford, J. D., Fleischer, A., & McHugo, G. J. (2000). Predicting posttraumatic stress after hospitalization for pediatric injury. *Journal of the American Academy of Child & Adolescent Psychiatry*, *39*(5), 576–583. https://doi.org/10.1097/00004583-200005000-00011

Edwards, T. C., Huebner, C. E., Connell, F. A., & Patrick, D. L. (2002). Adolescent quality of life, Part I: Conceptual and measurement model. *Journal of Adolescence*, *25*(3), 275–286. https://doi.org/10.1006/jado.2002.0470

Flannery, K. M., Vannucci, A., & Ohannessian, C. M. (2018). Using time-varying effect modeling to examine age-varying gender differences in coping throughout adolescence and emerging adulthood. *Journal of Adolescent Health*, *62*(3), S27–S34. https://doi.org/10.1016/j.jadohealth.2017.09.027

Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). Mini-mental state. *Journal of Psychiatric Research*, *12*(3), 189–198. https://doi.org/10.1016/0022-3956(75)90026-6

Gaetano, J. (2013). *Holm-Bonferroni sequential correction: An EXCEL calculator*. https://doi.org/10.13140/RG.2.1.4466.9927

Garrison, C. Z., Addy, C. L., Jackson, K. L., McKeown, R. E., & Waller, J. L. (1991). The CES-D as a screen for depression and other psychiatric disorders in adolescents. *Journal of the American Academy of Child & Adolescent Psychiatry*, *30*(4), 636–641. https://doi.org/10.1097/00004583-199107000-00017

Helwig, N. E., & Ruprecht, M. R. (2017). Age, gender, and self-esteem: A sociocultural look through a nonparametric lens. *Archives of Scientific Psychology*, *5*(1), 19–31. https://doi.org/10.1037/arc0000032

Holbrook, T. L., & Hoyt, D. B. (2004). The impact of major trauma: Quality-of-life outcomes are worse in women than in men, independent of mechanism and injury severity. *The Journal of Trauma: Injury, Infection, and Critical Care*, *56*(2), 284–290. https://doi.org/10.1097/01.TA.0000109758.75406.F8

Holbrook, T. L., Hoyt, D. B., Coimbra, R., Potenza, B., Sise, M., & Anderson, J. P. (2005). Long-term posttraumatic stress disorder persists after major trauma in adolescents: New data on risk factors and functional outcome. *The Journal of Trauma: Injury, Infection, and Critical Care*, *58*(4), 764–771. https://doi.org/10.1097/01.TA.0000159247.48547.7D

Holbrook, T. L., Hoyt, D. B., Coimbra, R., Potenza, B., Sise, M. J., Sack, D. I., & Anderson, J. P. (2007). Trauma in adolescents causes long-term marked deficits in quality of life: Adolescent children do not recover preinjury quality of life or function up to two years postinjury compared to national norms. *The Journal of Trauma: Injury, Infection, and Critical Care*, *62*(3), 577–583. https://doi.org/10.1097/TA.0b013e318031aa97

Holbrook, T. L., Hoyt, D. B., Stein, M. B., & Sieber, W. J. (2002). Gender differences in long-term posttraumatic stress disorder outcomes after major trauma: Women are at higher risk of adverse outcomes than men. *The Journal of Trauma: Injury, Infection, and Critical Care*, *53*(5), 882–888. https://doi.org/10.1097/00005373-200211000-00012

IBM Corp. (2018). *IBM SPSS Statistics for Macintosh* (Version 26.0). IBM Corp.

Jurkovich, G. J., Fan, M.-Y., Grossman, D., Russo, J., Katon, W., & Rivara, F. P. (2008). Association between posttraumatic stress and depressive symptoms and functional outcomes in adolescents followed up longitudinally after injury hospitalization. *Archives of Pediatrics & Adolescent Medicine*, *162*(7), 642. https://doi.org/10.1001/archpedi.162.7.642

Kamibeppu, K., Sato, I., Honda, M., Ozono, S., Sakamoto, N., Iwai, T., Okamura, J., Asami, K., Maeda, N., Inada, H., Kakee, N., Horibe, K., & Ishida, Y. (2010). Mental health among young adult survivors of childhood cancer and their siblings including posttraumatic growth. *Journal of Cancer Survivorship*, *4*(4), 303–312. https://doi.org/10.1007/s11764-010-0124-z

Karimi, M., & Brazier. (2016). Health, health-related quality of life, and quality of life: What is the difference? *Pharmacoeconomics*, *34*(7), 645–649. https://doi.org/10.1007/s40273-016-0389-9

Kassam-Adams, N., Marsac, M. L., García-España, J. F., & Winston, F. (2015). Evaluating predictive screening for children's post-injury mental health: New data and a replication. *European Journal of Psychotraumatology*, *6*(1), 29313. https://doi.org/10.3402/ejpt.v6.29313

Kassam-Adams, N., Marsac, M. L., Hildenbrand, A., & Winston, F. (2013). Posttraumatic stress following pediatric injury: Update on diagnosis, risk factors, and intervention. *JAMA Pediatrics*, *167*(12), 1158. https://doi.org/10.1001/jamapediatrics.2013.2741

Kelly, M. M., Tyrka, A. R., Price, L. H., & Carpenter, L. L. (2008). Sex differences in the use of coping strategies: Predictors of anxiety and depressive symptoms. *Depression and Anxiety*, *25*(10), 839–846. https://doi.org/10.1002/da.20341

Landolt, M. A., Buehlmann, C., Maag, T., & Schiestl, C. (2007). Brief report: Quality of life is impaired in pediatric burn survivors with posttraumatic stress disorder. *Journal of Pediatric Psychology*, *34*(1), 14–21. https://doi.org/10.1093/jpepsy/jsm088

Landolt, M. A., Vollrath, M., Timm, K., Gnehm, H. E., & Sennhauser, F. H. (2005). Predicting posttraumatic stress symptoms in children after road traffic accidents. *Journal of the American Academy of Child & Adolescent Psychiatry*, *44*(12), 1276–1283. https://doi.org/10.1097/01.chi.0000181045.13960.67

Levine, S. Z., Laufer, A., Hamama-Raz, Y., Stein, E., & Solomon, Z. (2008). Posttraumatic growth in adolescence: Examining its components and relationship with PTSD. *Journal of Traumatic Stress*, *21*(5), 492–496. https://doi.org/10.1002/jts.20361

Marsac, M. L., Ciesla, J., Barakat, L. P., Hildenbrand, A. K., Delahanty, D. L., Widaman, K., Winston, F. K., & Kassam-Adams, N. (2016). The role of appraisals and coping in predicting posttraumatic stress following pediatric injury. *Psychological Trauma: Theory, Research, Practice, and Policy*, *8*(4), 495–503. https://doi.org/10.1037/tra0000116

Marsac, M. L., Kassam-Adams, N., Delahanty, D. L., Ciesla, J., Weiss, D., Widaman, K. F., & Barakat, L. P. (2017). An initial application of a biopsychosocial framework to predict posttraumatic stress following pediatric injury. *Health Psychology*, *36*(8), 787–796. https://doi.org/10.1037/hea0000508

Martin-Herz, S. P., Zatzick, D. F., & McMahon, R. J. (2012). Health-related quality of life in children and adolescents following traumatic injury: A review. *Clinical Child and Family Psychology Review*, *15*(3), 192–214. https://doi.org/10.1007/s10567-012-0115-x

Naragon-Gainey, K., Simpson, T. L., Moore, S. A., Varra, A. A., & Kaysen, D. L. (2012). The correspondence of daily and retrospective PTSD reports among female victims of sexual assault. *Psychological Assessment*, *24*(4), 1041–1047. https://doi.org/10.1037/a0028518

Patrick, D. L., Edwards, T. C., & Topolski, T. D. (2002). Adolescent quality of life, Part II: Initial validation of a new instrument. *Journal of Adolescence*, *25*(3), 287–300. https://doi.org/10.1006/jado.2002.0471

Patterson, D. R., Finch, C. P., Wiechman, S. A., Bonsack, R., Gibran, N., & Heimbach, D. (2003). Premorbid mental health status of adult burn patients: Comparison with a normative sample. *Journal of Burn Care & Rehabilitation*, *24*(5), 347–350. https://doi.org/10.1097/01.BCR.0000086070.91033.7F

Pope, S. J., Solomons, W. R., Done, D. J., Cohn, N., & Possamai, A. M. (2007). Body image, mood, and quality of life in young burn survivors. *Burns*, *33*(6), 747–755. https://doi.org/10.1016/j.burns.2006.10.387

Radloff, L. S. (1977). The CES-D Scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement*, *1*(3), 385–401. https://doi.org/10.1177/014662167700100306

Roberts, R. E., Lewinsohn, P. M., & Seeley, J. R. (1991). Screening for adolescent depression: A comparison of depression scales. *Journal of the American Academy of Child & Adolescent Psychiatry*, *30*(1), 58–66. https://doi.org/10.1097/00004583-199101000-00009

Salter, E., & Stallard, P. (2004). Posttraumatic growth in child survivors of a road traffic accident. *Journal of Traumatic Stress*, *17*(4), 335–340. https://doi.org/10.1023/B:JOTS.0000038482.53911.01

Sato, H., & Kawahara, J. (2011). Selective bias in retrospective self-reports of negative mood states. *Anxiety, Stress & Coping*, *24*(4), 359–367. https://doi.org/10.1080/10615806.2010.543132

Schneeberg, A., Ishikawa, T., Kruse, S., Zallen, E., Mitton, C., Bettinger, J. A., & Brussoni, M. (2016). A longitudinal study on quality of life after injury in children. *Health and Quality of Life Outcomes*, *14*(1), 120. https://doi.org/10.1186/s12955-016-0523-6

Scholten, A. C., Haagsma, J. A., Steyerberg, E. W., van Beeck, E. F., & Polinder, S. (2017). Assessment of pre-injury health-related quality of life: A systematic review. *Population Health Metrics*, *15*(1), 10. https://doi.org/10.1186/s12963-017-0127-3

StataCorp. (2013). *Stata statistical software* (Release 13). StataCorp LP.

Steinberg, A. M., Brymer, M. J., Decker, K. B., & Pynoos, R. S. (2004). The University of California at Los Angeles posttraumatic stress disorder reaction index. *Current Psychiatry Reports*, *6*(2), 96–100. https://doi.org/10.1007/s11920-004-0048-2

Swearingen, E. M., & Cohen, L. H. (1985). Measurement of adolescents' life events: The junior high life experiences survey. *American Journal of Community Psychology*, *13*(1), 69–85. https://doi.org/10.1007/BF00923260

Teasdale, G., & Jennett, B. (1974). Assessment of coma and impaired consciousness. *The Lancet*, *304*(7872), 81–84. https://doi.org/10.1016/S0140-6736(74)91639-0

Topolski, T. D., Edwards, T. C., & Patrick, D. L. (2002). *Youth Quality of Life Instruments–U.S. Version: User manual and interpretation guide*. University of Washington, Department of Health Services.

Trickey, D., Siddaway, A. P., Meiser-Stedman, R., Serpell, L., & Field, A. P. (2012). A meta-analysis of risk factors for post-traumatic stress disorder in children and adolescents. *Clinical Psychology Review*, *32*(2), 122–138. https://doi.org/10.1016/j.cpr.2011.12.001

Turan, J. M., Elafros, M. A., Logie, C. H., Banik, S., Turan, B., Crockett, K. B., Pescosolido, B., & Murray, S. M. (2019). Challenges and opportunities in examining and addressing intersectional stigma and health. *BMC Medicine*, *17*(1), 7. https://doi.org/10.1186/s12916-018-1246-9

van Meijel, E. P. M., Gigengack, M. R., Verlinden, E., van der Steeg, A. F. W., Goslings, J. C., Bloemers, F. W., Luitse, J. S. K., Boer, F., Grootenhuis, M. A., & Lindauer, R. J. L. (2019). The association between acute pain and posttraumatic stress symptoms in children and adolescents 3 months after accidental injury. *Journal of Clinical Psychology in Medical Settings*, *26*(1), 88–96. https://doi.org/10.1007/s10880-018-9567-6

Ware, J. E., Kosinski, M., & Dewey, J. E. (2002). *How to score Version 2 of the SF-36 Health Survey* (3rd ed.). QualMetric.

Watson, W. L., Ozanne-Smith, J., & Richardson, J. (2007). Retrospective baseline measurement of self-reported health status and health-related quality of life versus population norms in the evaluation of post-injury losses. *Injury Prevention*, *13*(1), 45–50. https://doi.org/10.1136/ip.2005.010157

WHOQOL Group. (1995). *The World Health Organization Quality of Life assessment (WHOQOL): Position paper from the World Health Organization*., *41*, 1403–1409.

Wight, R., Sepulveda, J., & Aneshensel, C. (2004). Depressive symptoms: How do adolescents compare with adults? *Journal of Adolescent Health*, *34*(4), 314–323. https://doi.org/10.1016/S1054-139X(03)00275-1

Yang, H., Soong, W.-T., Kuo, P.-H., Hsueh-Ling, C., & Chen, W. J. (2004). Using the CES-D in a two-phase survey for depressive disorders among nonreferred adolescents in Taipei: A stratum-specific likelihood ratio analysis. *Journal of Affective Disorders*, *82*(3), 419–430. https://doi.org/10.1016/j.jad.2004.04.008

Zatzick, D. F., Jurkovich, G. J., Fan, M.-Y., Grossman, D., Russo, J., Katon, W., & Rivara, F. P. (2008). Association between posttraumatic stress and depressive symptoms and functional outcomes in adolescents followed up longitudinally after injury hospitalization. *Archives of Pediatrics & Adolescent Medicine*, *162*(7), 642. https://doi.org/10.1001/archpedi.162.7.642

Zatzick, D., Russo, J., Grossman, D. C., Jurkovich, G., Sabin, J., Berliner, L., & Rivara, F. (2006). Posttraumatic stress and depressive symptoms, alcohol use, and recurrent traumatic life events in a representative sample of hospitalized injured adolescents and their parents. *Journal of Pediatric Psychology*, *31*(4), 377–387. https://doi.org/10.1093/jpepsy/jsj056

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