

# Health-Related Quality of Life After Polytrauma: A Systematic Review

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## ABSTRACT

**Background:** Following hospital discharge after traumatic injuries, many patients' rehabilitation is inhibited by poor health-related quality of life (HRQoL).

**Objective:** The purpose of this review is to identify factors that influence the HRQoL of polytrauma patients after hospital discharge.

**Methods:** A systematic literature search was performed in CINAHL and PubMed databases for English-language articles published between January 2015 and January 2020. Articles that dealt with pediatric or narrow adult populations, exclusively considered brain and spinal cord injuries, burn injuries, or isolated fractures were excluded. In total, 22 nonexperimental cohort studies were eligible for inclusion.

**Results:** Based on these studies, with minor disagreements explainable by deficient sampling, variables that impacted

HRQoL fell into 11 categories: demographics, preinjury HRQoL, preexisting conditions, mental health status, injury type and location, injury severity, course of hospitalization, time after injury, financial and employment status, functional capacity, and pain.

**Conclusion:** The finding with the greatest implications was that mental health, positive coping, self-efficacy, and perception of physical state significantly influence HRQoL after injury and, along with other modifiable variables, can be optimized by directed treatment. Additionally, targeted assessments and interventions can be utilized to improve quality of life for patients with nonmodifiable risk factors.

## Key Words

Health-related quality of life, HRQoL, Polytrauma, Quality-of-life outcomes, Traumatic injury

## BACKGROUND

In 2018, approximately 3 million people in the United States survived hospitalization after sustaining a traumatic injury (Centers for Disease Control and Prevention, 2019). This indicates that U.S. hospitals are remarkably capable of preserving injured patients' lives, but, unfortunately, the hospitals' positive impact often ceases at discharge. Once out of the hospital, patients who survive traumatic injury must find ways to adjust to and cope with many long-term, drastic life changes such as newly emerged mental health disorders, trouble with cognition, physical limitations, and ongoing pain (Wihlke, Strommer, Troeng, & Brattstrom, 2019). Prior investigators found at 1 year after hospitalization for a traumatic injury, 59% of patients

reported moderate or worse pain, 32% had not attained full functional recovery, 16% had significant indications for diagnosis of posttraumatic stress disorder (PTSD), and just 44.5% of patients had returned to work (Wihlke et al., 2019). Other investigators reported a more significant delay in return to work, concluding that fewer than one-third of patients with traumatic injuries had returned to pre-injury employment status 1 year after hospital discharge (Larsen, Goethgen, Rasmussen, Iyer, & Elsoe, 2016). These consequences of injury have a tremendous direct influence on the patient's health state but may also have indirect repercussions. For instance, a delayed return to work impacts financial and health insurance status, which can prevent adequate ongoing care and recovery. These derangements often cause a poor health-related quality of life (HRQoL) for people who survive hospitalization after traumatic injury.

HRQoL is a person's self-perceived health state and is composed of a combined assessment of social, emotional, mental, and physical function (Centers for Disease Control and Prevention, 2018). HRQoL is assessed through validated, self-report instrumentation, such as the EQ-5D with a visual analog scale (VAS) (EuroQol Research Foundation, 2020). This instrument provides researchers and clinicians with information regarding the patient's perceptions of their health in terms of best to worst possible health state as marked on the VAS in addition to scores in

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5 domains: mobility, self-care, ability to engage in usual activities, pain, and anxiety or depression (EuroQoL Research Foundation, 2020). Previous investigators have suggested that, due to the unique challenges that trauma patients face during recovery, a trauma-specific HRQoL screening instrument is indicated (Wanner, deRoon-Cassini, Kodadek, & Brasel, 2015). However, such an instrument does not exist at this time, forcing trauma investigators to use a variety of other instruments to capture HRQoL, including short-form surveys (the SF-12, -20, and -36), trauma outcome profile (TOP), health utilities index (HUI), and the World Health Organization Quality of Life (WHOQOL)- BREF in addition to the EQ-5D, which all measure similar domains with different screening questions (HUInc, 2018; Pirente et al., 2006; RAND Health Care, 2020; World Health Organization, 2020). Despite capturing similar domains, lack of a uniform instrument dedicated to measurement of HRQoL in trauma patients remains an issue in having a full understanding of the variables associated with HRQoL, and perhaps capture of HRQoL at all.

In accordance with Maslow's hierarchy of needs, health care professionals in the hospital setting focus primarily on optimization of physiologic health as compared to the patient's state on arrival (Maslow, 1943). The patient's clinical condition at discharge may be remarkably improved compared to their state at the time of admission or to the expected prognosis, but the patient's HRQoL may still be poor or drastically deviated from baseline. This is because HRQoL relies on patient self-report instead of the providers' assessment. If the patient does not feel their own health state to be improved or bearable, it is an indication that the health care team could be doing more to provide optimal, multidimensional, patient-centered care.

## OBJECTIVE

The purpose of this review was to explore and describe variables associated with HRQoL at and after hospital discharge experienced by adult polytrauma patients. By enhancing the knowledge surrounding the derangements in HRQoL experienced by this patient population, recommendations for future research and intervention development can be suggested with the goal of improving the outcomes reported in the literature.

## METHODS

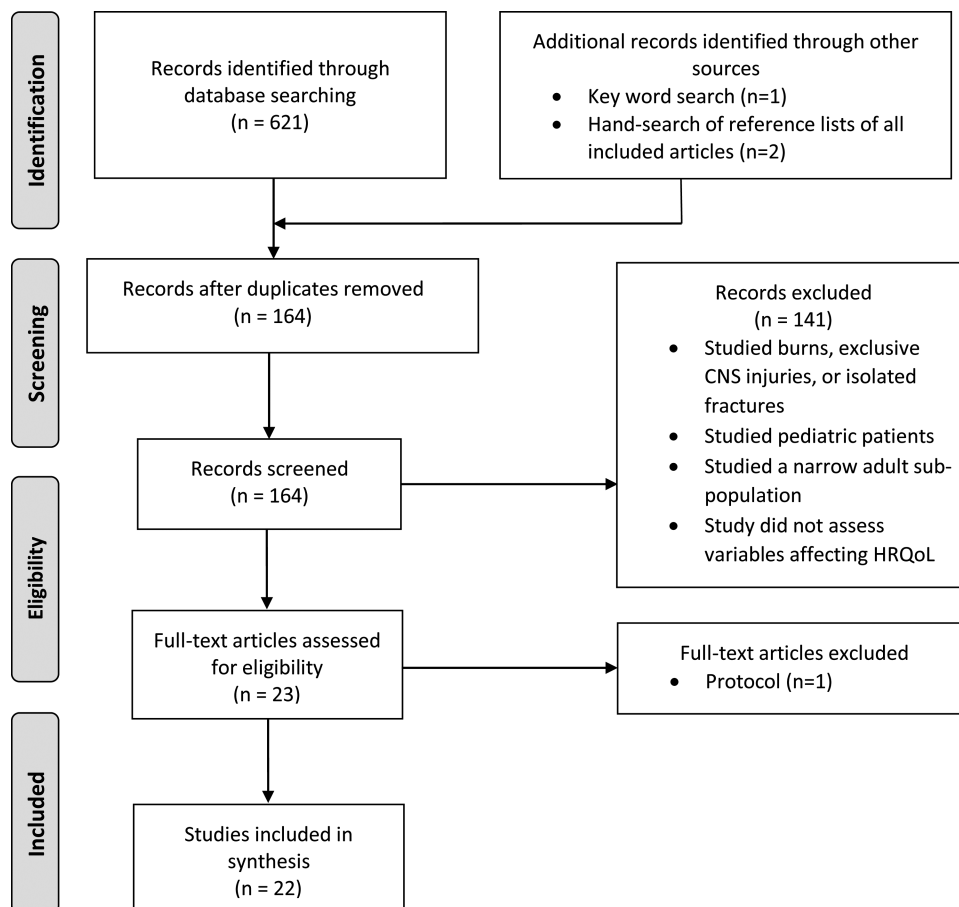
To identify variables associated with HRQoL in polytrauma patients post-discharge, a systematic review of the literature was conducted in CINAHL and PubMed Legacy between November 2019 and January 2020. The search strategy was developed, in consultation with a medical librarian, using Boolean operators, database-specific subject headings, and text words. The search strategy for PubMed Legacy can be found in Figure 1.

This search found 240 results in PubMed and 381 results in CINAHL (Figure 2). To further narrow the field of results, resulting in 189 articles, all non-English publications before 2015 were excluded. The year 2015 was selected as the frontend cutoff to align with the National Academies recommendation to benchmark the quality of trauma care by incorporating HRQoL metrics into routine postdischarge data collection (National Academies of Science, Engineering, and Medicine, 2016; Rios-Diaz et al., 2017). Duplicate records from the database searches were removed. All abstracts were screened for relevance, and articles that discussed brain and spinal cord injuries, burn injuries, and isolated fractures were excluded and thus discarded. Sequelae of central nervous system injuries involve altered neurological function, which distinctively impacts HRQoL (Ong, Wilson, & Henzel, 2020; Sherer et al., 2020); assessment of quality of life after burn injury involves unique criteria, which are best described by a burn-specific screening instrument (Gauffin & Oster, 2019), and postsurgery outcomes for isolated fractures are typically very optimistic, including absence of pain and preserved social function (Ribeiro de Avila, Bento, Gomes, Leitao, & Fortuna de Sousa, 2018). As such, the prognoses, and therefore the HRQoL of these patient populations, cannot be compared to polytrauma patients. Additionally, articles that exclusively studied subpopulations, such as geriatric trauma patients, pregnant trauma patients, were removed during the screening process.

After application of these exclusion criteria, 20 articles were retained for full-text review. One of the articles was a research protocol replaced by its associated primary research study, found by keyword search. To identify potential eligible studies that may not have been captured by the electronic databases search, a hand search of reference lists from each of the 20 selected articles was

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((((multiple trauma[MeSH Terms]) OR (trauma[Title/Abstract])) OR ("trauma patients"[Title/Abstract])) OR (trauma center*[Title/Abstract])) OR (polytrauma*[Title/Abstract])) AND (((surveys and questionnaires[MeSH Terms]) OR (survey[Title/Abstract])) OR (questionnaire[Title/Abstract])) OR (instrument*[Title/Abstract])) OR (measurement*[Title/Abstract])) AND (((quality of life[MeSH Terms]) OR (health related quality of life[Title/Abstract])) OR (health related quality of life outcome[Title/Abstract]))
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**Figure 1.** PubMed legacy search strategy including Boolean operators, database-specific subject headings, and text words.



**Figure 2.** PRISMA-adapted flowchart of search results with exclusion and retention of the articles in the review. Flowchart based on Moher, Liberati, Tetzlaff, Altman, and PRISMA Group (2009).

performed, through which two articles that met the inclusion criteria were identified. The reference lists of these two articles were also searched for eligible articles, with no result. In total, 22 articles, all cohort designs, were eligible for inclusion in the following discussion. Each study was independently reviewed by authors L.A.S. and J.T.H. using the National Heart, Lung, and Blood Institute Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies (National Heart, Lung, and Blood Institute, 2020).

## RESULTS

### Quality of Evidence

Twenty-two articles were examined in their entirety, evaluated, and summarized (see the Supplemental Digital Content Table, available at: <http://links.lww.com/JTN/A23>). All included studies were nonexperimental cohort studies. Of the 22 studies reviewed, 16 utilized prospective data collection (Aitken et al., 2016; de Munter et al., 2019; Dinh et al., 2016; Gabbe et al., 2015, 2017; Gross, Morell, & Amsler, 2018; Kendrick et al., 2017; Larsen et al.,

2016; Rios-Diaz et al., 2017; Soberg, Bautz-Holter, Finset, Roise, & Andelic, 2015; Spijker, Jones, Duijff, Smith, & Christey, 2018; Spronk et al., 2019; Tamura, Kuriyama, & Kaihara, 2019; van Delft-Schreurs et al., 2017; van der Vliet et al., 2019; Wad, Laursen, Fruergaard, Morgen, & Dahl, 2018) and 10 utilized longitudinal data collection (Aitken et al., 2016; de Munter et al., 2019; Dinh et al., 2016; Gabbe et al., 2015, 2017; Kendrick et al., 2017; Larsen et al., 2016; Soberg et al., 2015; Spronk et al., 2019; Tamura et al., 2019). Six of the studies were performed in the Netherlands, four in Australia, two each in Germany, Denmark, and the United States, and one each in the U.K., Norway, Switzerland, New Zealand, Japan, and Sweden. The average sample size was 1,088 participants, with a range of 53 to 10,166 participants. Although many of the studies reported the mean Injury Severity Score (ISS), others did not measure severity or used a different standard to quantify injury severity. Additionally, not all 22 studies reported injury type (i.e., blunt vs. penetrating trauma). Therefore, the mean severity score and injury classification of all participants included in this review cannot be reported. The HRQoL was a primary measure

in each of the studies, used to contextualize health status and holistic recovery after injury. The study participants were recruited from those who presented to a hospital with injuries or appeared in a trauma registry after such an event, and these patients were followed for up to 15 years depending on the longevity of the study. The participants in each selected study were adults 18 years and older, with the exception of the study by Spijker et al. (2018), who included participants as young as 16, and Zwingmann et al. (2016), who included participants as young as 6 years old.

After reconciliation of differences in ratings by the two reviewers, resulting in 100% agreeance, 41% (9) of the studies were rated as fair quality, 32% (7) of the studies were rated good, and the remaining 27% (6) were rated poor. However, the reviewers acknowledge that there may have been bias in the poor quality rating of two of the studies (Gabbe et al., 2015; Haagsma, Bonsel, de Jongh, & Polinder, 2019) due to their decreased relevance to this review. The main consideration for decreased quality rating was use of a population sample that was too broad, too specific, or too small to provide conclusions that were meaningful to this review.

## Synthesis of Evidence

Many variables that affect HRQoL after a traumatic injury emerged from the included studies. Each of these variables can be classified as belonging to one of the following 11 groups: demographics, preinjury HRQoL, preexisting conditions, mental health status, injury classifications, injury severity, course of hospitalization, time after injury, financial and employment status, functional capacity, and pain.

### Demographic Variables

Soberg et al. (2015) found that demographic variables such as age, gender, and education at the time of injury did not significantly affect HRQoL 10 years after the injury. However, at earlier time points, other investigators have found that these variables impacted patients' quality of life (de Munter et al., 2019; Gabbe et al., 2017; Gunning, van Heijl, van Wessem, & Leenen, 2017; Kendrick et al., 2017; van Delft-Schreurs et al., 2017; van der Vliet et al., 2019; Zwingmann et al., 2016).

### Age

Increasing age was associated with diminished HRQoL following a traumatic injury (Gabbe et al., 2017; Kendrick et al., 2017; van der Vliet et al., 2019; Zwingmann et al., 2016). Specifically, increased age was associated with a greater degree of impairment of physical and emotional function as long as 6 years following the injury (Gunning et al., 2017; van Delft-Schreurs et al., 2017; Zwingmann et al., 2016). Gross et al. (2018) found that age did not affect HRQoL as measured by the EQ-5D, SF-36, and

TOP until after age 80. Younger age was associated with worse anxiety or depression scores determined by the EQ-5D, but patients in the younger age groups (18–25 years) were the only participants who continued to improve their usual activities domain scores more than 2 years after injury (Gabbe et al., 2017). Oppositely, van Delft-Schreurs et al. (2017) found that age was not associated with overall HRQoL. Other investigators used various assessments of HRQoL and compared covariates, and although age was significantly associated with HRQoL in these models, there was no consensus on the impact of age on HRQoL as a whole (de Munter et al., 2019).

### Gender

Female gender was associated with decreased HRQoL (de Munter et al., 2019; Gunning et al., 2017; van Delft-Schreurs et al., 2017; van der Vliet et al., 2019). In particular, female gender correlated with lower scores in the usual activities, pain or discomfort, and anxiety or depression domains of the EQ-5D (Gabbe et al., 2017). No definitive conclusion was reached about the effect of gender on HRQoL when utilizing the EQ-VAS, although males appear to have slightly worse HRQoL by this measurement (Kendrick et al., 2017).

### Educational Level

Increased educational level was associated with better HRQoL, although patients with lower educational level suffered deficits in all five domains of the EQ-5D in two separate investigations (de Munter et al., 2019; Gabbe et al., 2017). Low educational level was, specifically, a predictor of decreased physical function after injury in one study reviewed (van Delft-Schreurs et al., 2017).

### Household Composition

Living alone was associated with a worse HRQoL, according to the WHOQOL-BREF, than living with other persons (van Delft-Schreurs et al., 2017). Increased social support was associated with improved mental composite scores quantified by the SF-36 (Aitken et al., 2016).

### Preexisting Conditions

Patients with serious comorbidities, assessed by the Charlson Comorbidity Index (CCI), had worse EQ-5D mobility, self-care, and usual activities scores (Gabbe et al., 2017). In contrast, Kendrick et al. (2017) reported that patients who had preexisting medical conditions had greater improvements in HRQoL than those who had none. However, those with preexisting physical conditions reported more physical limitations following traumatic injury than their counterparts who were healthy at the time of injury (van Delft-Schreurs et al., 2017). Additionally, preexisting frailty for trauma patients older than 65 years, as assessed by the Groningen Frailty Indicator, was associated with

a decreased HRQoL after the injuring event (de Munter et al., 2019).

### Preinjury HRQoL

Higher preinjury EQ-5D and EQ-VAS values were found to be the strongest predictors for better HRQoL after injury, according to a study by de Munter et al. (2019). However, preinjury status may not be a reliable measure because recalled HRQoL by the EQ-5D overestimated the actual measured severity in a separate investigation, making the previous health state seem worse (Spronk et al., 2019). Although still not wholly accurate, estimated EQ-VAS values have been suggested to be less misleading (Spronk et al., 2019). Retrospective assessment of preinjury HRQoL using the EQ-5D and EQ-VAS at 1 week postinjury and 1 year postinjury did not indicate any significant widespread changes with time, implying that the unreliability of this measure is at least constant (Haagsma et al., 2019).

Despite evidence suggesting that preinjury HRQoL affects postinjury HRQoL, the variability of this relationship is concerning for consensus. Previous investigators found that PTSD, comorbidities, age, education level, and ISS—all were related to ability of participants to recall their preinjury HRQoL; thus, the notion of preinjury status directly affecting postinjury status may be confounded (Haagsma et al., 2019; Spronk et al., 2019).

### Mental Health Status

Preexisting mental health, drug, or alcohol disorders were associated with more severe EQ-5D anxiety or depression scores and a worse SF-12 mental health component score following injury (Dinh et al., 2016; Gabbe et al., 2017; Kendrick et al., 2017; van Delft-Schreurs et al., 2017). With an increase in number of psychiatric comorbidities, HRQoL subsequently became increasingly debilitated (Kendrick et al., 2017).

Increased report of depressive symptoms, determined by the Hospital Anxiety and Depression Scale (HADS), was related to decreased HRQoL at various time points following injury (Kendrick et al., 2017). An increase in the HADS anxiety dimension at 1 month after injury was also associated with a worse EQ-5D score (Kendrick et al., 2017). The score of these symptoms was comparable at 2, 4, and 12 months after injury, indicating long-term influence with little to no improvement (Kendrick et al., 2017). Predictably, increased Beck Depression Inventory-II scores were associated with worse SF-36 mental health domain scores (Zwingmann et al., 2016). From a cohort of polytrauma patients, 42% met the criteria for diagnosis of PTSD approximately 6 years after the injury, suggesting PTSD as a common, significant, and long-term sequela in this patient population (Zwingmann et al., 2016). Additionally, patients who reported a psychologic complaint

also had increased report of physical complaints compared to their counterparts without psychologic concerns (van Delft-Schreurs et al., 2017).

Although not a medical disorder, deficient coping mechanism is a relevant nursing diagnosis related to mental health. Soberg et al. (2015) determined that an increase in approach-oriented coping is one of the most significant predictors of improved HRQoL at 10 years after injury. It can be inferred that the lack of productive coping is associated with a worse HRQoL at that time point. Moreover, Aitken et al. (2016) found that higher self-efficacy was associated with better SF-36 mental and physical composite scores, whereas a higher perception of the influence of injury on life was associated with worse physical function scores.

## Injury Classifications

### Injury Type

Orthopedic injury and having multiple injuries were associated with decreased HRQoL, particularly related to pain or discomfort and usual activities (Gabbe et al., 2017). Larsen and colleagues concluded that the number of fractures had no discernable effect on HRQoL, but this inconsistent result may have been biased by a sample size of only 53 participants (Larsen et al., 2016).

Patients with blunt traumatic injuries had lower physical function domain scores than participants with other injury types (Gunning et al., 2017). Specifically, injuries caused by a low fall resulted in decreased mobility and self-care scores (Gabbe et al., 2017). Those who were injured as pedal cyclists or pedestrians had better usual activities scores than others in the cohort (Gabbe et al., 2017). Dinh et al. (2016) found that assault and pedestrian mechanisms of injury were associated with worse mental component scores by the SF-12. Gabbe et al. (2017) confirmed that traumatic injuries caused by assault or intentional self-harm were associated with worse scores in the anxiety or depression domains of the EQ-5D.

### Injury Location

Injury to the extremities was associated with inferior HRQoL, notably in the physical and bodily function domains (Gross et al., 2018; Gunning et al., 2017). In particular, lower limb injuries had a strong association with more physical limitations and decreased overall HRQoL (Dinh et al., 2016; Kendrick et al., 2017; van Delft-Schreurs et al., 2017; van der Vliet et al., 2019). More severe and persistent physical pain was also associated with lower limb injury for as long as 6 years after the injury occurred (van Delft-Schreurs et al., 2017; Zwingmann et al., 2016). Furthermore, lower limb injury was associated with worse social functioning than other injury sites, which can affect mental health sequelae (van Delft-Schreurs et al., 2017).

After lower limb injuries, combined upper and lower limb injuries had the most diminished HRQoL, followed by upper limb injuries (Kendrick et al., 2017).

### **Injury Severity**

An increased ISS was found to be associated with decreased HRQoL in four investigations (de Munter et al., 2019; Gunning et al., 2017; van der Vliet et al., 2019; Wad et al., 2018). In particular, an increased ISS was associated with worse physical component scores determined by the SF-12 (Dinh et al., 2016). The same relationship between injury severity and HRQoL was noted when injury severity was quantified by other measurements, including Abbreviated Injury Scale classification, revised trauma score, and American Society of Anesthesiologists fitness grade (de Munter et al., 2019; Gunning et al., 2017; Kendrick et al., 2017). Predicted mortality by the revised injury severity classification, a lower probability of survival, and survival after predicted death were also associated with worse HRQoL after hospital discharge (Fleischhacker et al., 2018; Gunning et al., 2017).

Two prior studies contested this relationship between HRQoL and injury severity. van Delft-Schreurs et al. (2017) found that the increased ISS was associated with decreased physical function but had no relationship with HRQoL as a whole, and Larsen et al. (2016) found that at 6 and 12 months after hospital admission, the ISS and New Injury Severity Score had no significant impact on HRQoL.

### **Course of Hospitalization**

Increase in length of hospital stay was associated with a progressively reduced HRQoL in multiple studies (Aitken et al., 2016; de Munter et al., 2019; Gunning et al., 2017; Kendrick et al., 2017; van Delft-Schreurs et al., 2017). Specifically, a hospitalization longer than 10 days resulted in a worse HRQoL than shorter hospital stays, according to the EQ-5D (Spijker et al., 2018). Patients who had undergone a stay in the intensive care unit (ICU) reported more physical limitations than those who were not admitted to the ICU and increased length of stay within the ICU corresponded with worse overall HRQoL after leaving the hospital (Gunning et al., 2017; van Delft-Schreurs et al., 2017). Need for intubation on arrival to the emergency department and higher degree of organ failure during ICU stay were also associated with decreased HRQoL as measured by the EQ-5D (Fleischhacker et al., 2018).

### **Time After Injury**

At various time points through the first 6 months after injury, overall HRQoL of trauma patients improved when measured by the EQ-5D, SF-36, and HUI in several investigations (Aitken et al., 2016; de Munter et al., 2019; Gabbe et al., 2015, 2017; Kendrick et al., 2017; Larsen

et al., 2016; Spronk et al., 2019; Wihlke et al., 2019). At 4 months after injury, the self-care domain of the EQ-5D was the least affected by injury (Alghnam, Wegener, Bhalla, Colantuoni, & Castillo, 2015). Role-physical and physical functioning domains of the SF-12 were the areas of worst performance in a 6-month follow-up cohort, whereas the mental component summary was comparable to the national average (Rios-Diaz et al., 2017). Tamura et al. (2019) found the opposite result when utilizing the SF-36; the role-physical and physical functioning composite scores improved between discharge and 6 months, whereas mental composite scores became worse during this time. However, Dinh et al. (2016) found that when adjusted for the confounding effects of age, education, and compensable status, physical and mental composite scores determined by the SF-12 were not significantly different between 3 and 6 months. Aitken et al. (2016) noted that SF-36 physical component scores improved rapidly through the first 6 months before progress slowed to a more gradual rate, whereas mental health component scores improved more slowly during this time.

Previous investigators demonstrated that HRQoL scores continued to improve through the first year following injury, noting that the first year was the time of greatest improvement (de Munter et al., 2019; Gabbe et al., 2015; Kendrick et al., 2017; Rios-Diaz et al., 2017; Spronk et al., 2019; Wihlke et al., 2019). However, others have reported that the rate of progress significantly decreases between 6 and 12 months, showing little to no improvement in HRQoL scores (de Munter et al., 2019; Larsen et al., 2016; Tamura et al., 2019). Wihlke et al. (2019) noted that the EQ-5D mobility domain scores stayed the same or worsened between 6 and 12 months after injury. Gabbe et al. (2015) reported the same effect concerning the anxiety or depression dimension, suggesting a halt in recovery the further out that patients are from discharge. Other investigators found that the average SF-12 mental component summary at 12 months was very optimistic, similar to both the results from the 6-month cohort and the national average score, which included noninjured respondents (Rios-Diaz et al., 2017). Gabbe et al. (2017) also found that the EQ-5D self-care dimension score improved until 12 months after injury but did not improve after that time point. Wihlke et al. (2019) reported that the most significant deficits through the first year were consistently in the pain and discomfort domain, in which 78%, 73%, and 59% of the participants reported moderate to significant deficit at 3, 6, and 12 months, respectively.

These findings indicate that, at 6 months, impaired physical function is the greatest concern; however, pain and mental health become more concerning at 12 months post-injury. This trend was reinforced by Alghnam et al. (2015), who reported that all EQ-5D domain scores

continued to improve at approximately 16 months after injury. However, significant deficit was still present in the usual activities, pain or discomfort, and anxiety or depression domains. Two years after injury, over half of the trauma patient population studied by van Delft-Schreurs et al. (2017) reported persistence of severe pain, and overall HRQoL was still significantly below population norms at this time point (Aitken et al., 2016). Six years after injury, trauma patients scored well in the self-care domain of the EQ-5D; but anxiety and depressive symptoms, mobility issues, usual activities, and pain remained ongoing challenges in one third to one half of this injured population (Zwingmann et al., 2016). At 10 years, the overall HRQoL of the trauma injury population was still decreased, but mental health component scores from the SF-36 were not significantly different from the adjusted population norm at this time point, indicating slow but valuable improvement in this area (Soberg et al., 2015). At 15 years after injury, the latest time point measured out of the reviewed studies, HRQoL was still significantly worse than the national average (Wad et al., 2018).

Not only did poor HRQoL persist in trauma patients at least 15 years after injury, some investigators reported that it became more severely impaired. Gabbe et al. (2017) reported that the only dimension of the EQ-5D that consistently improved through 3 years after injury was the usual activities domain. There were fluctuations in the longevity of sustained improvement of the mobility, pain, anxiety, and depression subscales between 12 and 36 months (Gabbe et al., 2017). The overall HRQoL of this cohort improved until 24 months, at which point it worsened due to increased scores in the pain dimension (Gabbe et al., 2017). A more gradual, nonlinear association was reported by Fleischhacker et al. (2018), who assessed HRQoL in a cohort of trauma patients using the EQ-5D and EQ-VAS and reported that HRQoL peaked between 4 and 5 years after injury. At the end of this peak, 30% of trauma patients were still undergoing treatment and procedures related to their injuries, and HRQoL began to decline, although this finding may be attributed to the effects of comorbid conditions and secondary disease (Fleischhacker et al., 2018).

## Financial and Employment Status

### Financial Loss

Polytrauma patients who suffered financial loss following their injury had significantly reduced scores in all SF-36 domains and most TOP domains compared to those who did not consider themselves to have suffered financially (Zwingmann et al., 2016). Participants who were claiming compensation for their injury or using traffic or work insurance had, respectively, worse EQ-5D scores in all

domains or worse mental health composite scores by the SF-36 than those who used other means to cover injury-related expenses (Aitken et al., 2016; Gabbe et al., 2017). Low socioeconomic status was also associated with lower HRQoL, specifically in the pain or discomfort and anxiety or depression domains of the EQ-5D (Gabbe et al., 2017). Similarly, those with increased income had better mental composite scores by the SF-36 (Aitken et al., 2016).

### Employment Status

Patients who were not working prior to injury had worse mobility, self-care, and anxiety or depression scores after injury (Gabbe et al., 2017). Additionally, patients who were unemployed before injury stopped improving in the mobility and self-care categories 6 months after injury, compared to other injured patients who improved for 2 years (Gabbe et al., 2017). van Delft-Schreurs et al. (2017) also found that unemployment prior to injury was associated with increased physical limitations and decreased HRQoL afterward.

Unemployment or inability to work after injury had the least adverse impact on HRQoL, whereas employment after injury was associated with the worst EQ-5D scores (Kendrick et al., 2017). This was also supported by Zwingmann et al. (2016), who found that polytrauma patients who had lost their job or changed their job by the time of follow-up assessment 6 years after injury had significantly better HRQoL than their counterparts who had retained their employment status.

These findings indicate that unemployment before injury and employment after injury negatively affect HRQoL outcomes. van Delft-Schreurs et al. (2017) contradicted the latter finding by claiming that unemployment after injury was associated with more physical limitations and decreased HRQoL as measured by the WHOQOL-BREF. Additionally, Larsen et al. (2016) concluded that there were no significant differences in HRQoL between patients who returned to their preinjury work status and patients who did not.

### Functional Capacity

The findings of previous investigators agree that, with decreased functional capacity, patients suffer worse HRQoL (de Munter et al., 2019; Kendrick et al., 2017). For every 1 unit increase in the Social Functioning Questionnaire score, there was a 1.14-point increase in the EQ-5D score, equating to worsening HRQoL (Kendrick et al., 2017). Similarly, de Munter et al. (2019) found that the decreased functional capacity index was also associated with decreased HRQoL. Physical and cognitive functions at 1 year after injury were among the greatest indicators of improved HRQoL at 10 years after injury (Soberg et al., 2015).

## Pain

Increased pain score, as assessed by the pain VAS, was associated with decreased HRQoL (Kendrick et al., 2017). For each increasing pain VAS quintile, there was an increased severity on the EQ-5D, except for the fifth quintile, which was associated with a better HRQoL than the fourth quintile (Kendrick et al., 2017). Earlier and improved pain management enhances physical function and thereby improves quality of life in the long term; notably, decreased bodily pain at 2 years after injury was one of the most significant predictors of improved HRQoL at 10 years after injury (Soberg et al., 2015).

## DISCUSSION

Analysis of the included studies concluded that a variety of demographic, socioeconomic, and clinical variables affect HRQoL in trauma patients; however, the findings related to time after injury are perhaps of the greatest significance: HRQoL slows or even stops improving in the first year after injury, whereas HRQoL deficits may be evident for 15 years after the initial injury occurred (Aitken et al., 2016; de Munter et al., 2019; Larsen et al., 2016; Soberg et al., 2015; Tamura et al., 2019; Wad et al., 2018; Zwingmann et al., 2016).

Increased age decreased overall HRQoL scores, particularly after 80 years old (Gabbe et al., 2017; Gross et al., 2018; Kendrick et al., 2017; van der Vliet et al., 2019; Zwingmann et al., 2016). However, it is notable that younger age exacerbated the anxiety and depression domains of HRQoL, indicating that health care professionals should be particularly vigilant in assessing and treating mental health disorders in this population (Gabbe et al., 2017). Trauma patients between 18 and 25 were the only age group which improved in physical activity scores more than 2 years following injury, most likely due to a longer lifespan and greater degree of physical health prior to injury (Gabbe et al., 2017). van Delft-Schreurs et al. (2017) found that age was unassociated with HRQoL but suggest that this finding may be due to the older adult population's acceptance of a decreased HRQoL as a supposed natural occurrence with the aging process. de Munter et al. (2019) did not find an association between age and HRQoL, but these results may be confounded by the increased average age of the participants in this study, at nearly 64 years old (de Munter et al., 2019). Female gender was associated with worse HRQoL (de Munter et al., 2019; Gunning et al., 2017; van Delft-Schreurs et al., 2017; van der Vliet et al., 2019). The Holbrook and Hoyt (2004) study, which focused on the role of gender in trauma outcomes, confirmed that women suffer worse HRQoL outcomes but deemed this finding to be unexplainable; thus, further research to understand this association is warranted. Lower educational level was also associated with more adverse HRQoL outcomes (de

Munter et al., 2019; Gabbe et al., 2017; van Delft-Schreurs et al., 2017). Increased social support and living with others were both associated with improved HRQoL (Aitken et al., 2016; van Delft-Schreurs et al., 2017). At 10 years after injury, demographic variables at the time of injury no longer have a discernable effect on HRQoL, suggesting that HRQoL is affected by other contributing factors (Soberg et al., 2015). There is considerable variation in demographic domains, particularly in light of the geographic and cultural diversity of the articles included in this review. As a result, any consensus on the impact of these variables may be inexact.

Trauma patients with preexisting conditions, both psychological or physiological, suffered decreased HRQoL compared to those who were healthy before injury (de Munter et al., 2019; Dinh et al., 2016; Gabbe et al., 2017; Kendrick et al., 2017; van Delft-Schreurs et al., 2017). However, compared to their own baseline, the HRQoL of participants with preexisting conditions did not deteriorate at as great a rate as the rest of the cohort (Kendrick et al., 2017). This is likely because these patients often already experience a poor HRQoL compared to population norms and may therefore be less sensitive to further decline of HRQoL after their injury. Regardless of increased tolerance, these patients still require treatment to optimize their quality of life.

A baseline, preinjury assessment of HRQoL is helpful to ascertain a patient's recovery status. Prospective HRQoL data are preferred to retrospective assessment but are often difficult to obtain in this patient population due to the unexpected nature of traumatic injury. Therefore, an understanding of the imprecision of retrospectively assessed data is required (de Munter et al., 2019; Spronk et al., 2019). Due to variables that confound the accuracy of retrospective HRQoL assessment, such as PTSD, comorbidities, age, education level, and injury severity, the retrospective average is best applied to the entire cohort and not to subgroups (Haagsma et al., 2019; Spronk et al., 2019). Utilization of the EQ-VAS for retrospective assessment of HRQoL could lead to more accurate results (Spronk et al., 2019).

An important sequela of traumatic injury to consider is the development of one or more mental health disorders. Poor SF-12 mental health component scores and poor EQ-5D anxiety and depression scores were associated with assault, pedestrian, and self-inflicted injury mechanisms (Dinh et al., 2016; Gabbe et al., 2017). Following injury, trauma patients are prone to anxiety, depression, and PTSD (Kendrick et al., 2017; Zwingmann et al., 2016). This finding was predictable, but the high rate of incidence and longevity of these disorders is startling. Deficient coping can lead to poor HRQoL outcomes for 10 or more years following the injury (Soberg et al., 2015). Increased perception of the impact of injury on life is



associated with worse HRQoL, whereas increased self-efficacy is associated with better HRQoL (Aitken et al., 2016). Mental and emotional treatment must be instituted in these patients' plan of care both before and after discharge to ease these longstanding consequences of injury and thereby improve HRQoL (Zwingmann et al., 2016).

Both orthopedic trauma and multiple traumas were associated with severely decreased HRQoL (Gabbe et al., 2017). Lower extremity involvement further decreased HRQoL, particularly physical component scores (Dinh et al., 2016; Kendrick et al., 2017; van Delft-Schreurs et al., 2017; van der Vliet et al., 2019; Zwingmann et al., 2016). It can be concluded that a combination of these factors, polytraumatic orthopedic injury with the lower limb involvement, is the injury type with the greatest risk of HRQoL deficit. This finding is likely related to both the actual and perceived physical limitations that follow this injury type and the frustration and difficulty of relearning activities of daily living. With this intricate association of physical and mental health, trauma and rehabilitation nurses must enhance integration of holistic care in their practice to improve patient outcomes.

A lengthy hospital stay with major events such as organ failure, need for endotracheal intubation and mechanical ventilation, and ICU admission were associated with decreased HRQoL following discharge (Aitken et al., 2016; de Munter et al., 2019; Fleischhacker et al., 2018; Gunning et al., 2017; Kendrick et al., 2017; Spijker et al., 2018; van Delft-Schreurs et al., 2017). However, increased injury severity is often the cause of a convoluted or difficult course of hospitalization, so these variables cannot be fully separated. Increased injury severity, no matter the instrument or standard by which it is quantified, was correlated with decreased HRQoL (de Munter et al., 2019; Dinh et al., 2016; Fleischhacker et al., 2018; Gunning et al., 2017; Kendrick et al., 2017; van der Vliet et al., 2019; Wad et al., 2018). This finding was unsurprising; in general, the worse the injury, the more difficult the recovery and the more numerous the sequelae. Incongruously, Larsen et al. (2016) and van Delft-Schreurs et al. (2017) found that increased injury severity did not impact HRQoL. In Larsen and colleagues' study, this result may be due to a very small sample of only 53 participants. van Delft-Schreurs and collaborators suggested that their finding could be confounded by a phenomenon in which more severely injured trauma patients experience a better HRQoL than their less severely injured counterparts due to a closer brush with death and renewed appreciation for life.

Perhaps the most significant finding is that improvement of HRQoL seems to stall or even stop between 6 months and 1 year after injury, whereas problems related to decreased HRQoL persist 15 or more years after injury (Aitken et al., 2016; de Munter et al., 2019; Larsen

et al., 2016; Soberg et al., 2015; Tamura et al., 2019; Wad et al., 2018; Zwingmann et al., 2016). It can be concluded that there is a lack of adequate treatment directed toward HRQoL in trauma care during and beyond hospitalization, which delays the healing process and lengthens the time for which patients struggle with the aftereffects of injury.

As could be expected, financial difficulty was associated with decreased HRQoL (Aitken et al., 2016; Gabbe et al., 2017; Zwingmann et al., 2016). Surprisingly, unemployment status was associated with better HRQoL following traumatic injury than those who retained their preinjury employment status (Kendrick et al., 2017; Zwingmann et al., 2016). This finding could be due to patients' inability to survive without an income, necessitating a return to the workforce before sufficient recovery has occurred and damaging the patients' quality of life as a result. However, van Delft-Schreurs et al. (2017) reached the opposite conclusion when they found that unemployment is associated with decreased HRQoL. Larsen et al. (2016) indicated that employment status does not impact HRQoL, but with a sample of only 53 participants, this conclusion should not be extrapolated to the entire trauma patient population. With three different conclusions on the relationship between HRQoL and employment status, no definitive global conclusion can be reached, and further investigation is warranted to elucidate this association.

Increased pain and decreased functionality were connected to worse HRQoL scores (de Munter et al., 2019; Kendrick et al., 2017). These findings were predictable because pain or discomfort, mobility, and self-care are three of the dimensions assessed by the EQ-5D to calculate HRQoL.

### Implications for Practice

Each of these findings contributes a distinct, significant influence on HRQoL after traumatic injury. Practice improvement should focus on the implementation of a wraparound trauma care protocol, which includes care directed toward improving the patients' HRQoL based on the identified associated variables. van Delft-Schreurs et al. (2017) suggested that a patient's HRQoL is less dependent on their physical condition than how they mentally view their injury. Additionally, Soberg et al. (2015) proposed a more comprehensive approach to traumatic injury rehabilitation, including treatment directed toward enhanced coping and better utilization of mental health resources. Based on these suggestions, implementation of motivational interviewing techniques during hospitalization and throughout rehabilitation could increase resiliency and coping, thereby reducing mental health disorder occurrence rates and enhancing functional recovery. Integration of rehabilitation psychologists into the trauma team, rather than consulting separate psychiatry services, can provide continuity of care as well as staff support

and education, thereby improving patient-centered care and potentially mental health and HRQoL outcomes (Warren, Stucky, & Sherman, 2014). Because competent social functioning, social support, and self-efficacy augment mental health according to Soberg et al. (2015) and Aitken et al. (2016), greater availability of and earlier implementation of traumatic injury-specific support groups, as well as physical and occupational therapy to enhance the necessary skills, may improve quality of life in this patient population. Increased utilization of social workers who can connect patients with community resources, as well as improved education about and assessment of readiness to return to work, may allow and encourage trauma patients to delay returning to a job until they are recovered enough to be capable of working safely.

### Implications for Research

Future investigators should focus on the development and adoption of a uniform trauma-specific HRQoL instrument. Such an instrument would be ideal for investigators to capture and understand variables related to HRQoL of trauma patients, and, further, develop and test interventions to inform clinicians on strategies to optimize HRQoL in trauma patients (Gunning et al., 2017). Some variables that are associated with poor HRQoL are nonmodifiable, such as age, gender, education level, and preexisting conditions. However, depending on the patient's presentation of these variables, they may be prone to various deficiencies in different domains comprising HRQoL and need more focused treatments according to their established risk. For instance, based on the work of prior investigators, a young woman is at high risk for mental health deficit following traumatic injury, whereas an older man is at a greatest risk for functional deficit. For both patients, the medical team should create an individualized plan of care that more comprehensively assesses and treats the specific complications for which the patient is at greatest risk. This care plan individualization should be used in addition to providing the standard wraparound, early-onset, long-term HRQoL-directed care according to the protocol previously described. With better identification of present risk factors, initiation of inpatient treatment, and follow-up care after the initial hospitalization, the duration of traumatic injury sequelae may be decreased; however, further longitudinal research is warranted to determine the optimal duration and frequency for the most effective follow-up care.

### LIMITATIONS

The findings of this review should be considered within the context of limitations. First, the diverse geographical location of studies led to complexities of data synthesis due to differences in health care systems and structures, socioeconomic environment, and cultural perspective.

Additionally, HRQoL was measured by a variety of instruments, making scores challenging to compare between studies. Sampling and design were also inconsistent across the included studies, which might limit comparison. Only three studies (Soberg et al., 2015; Wad et al., 2018; Zwingmann et al., 2016) dealt with exclusively polytrauma patients. A prospective, longitudinal study design would be preferable to determine how HRQoL is influenced, but some of the included studies were cross-sectional and retrospective. The participants of one study (van Delft-Schreurs et al., 2017) had a 68% occurrence of intracranial injury, which may influence physical and psychological well-being and thereby affect the accuracy of the study's results. Finally, there was variability in the method of assessment of covariates as well as which covariates were assessed in each of the included studies.

### CONCLUSION

HRQoL outcomes and the contributing factors are underexamined in the polytrauma population, particularly in the United States. This group of patients is of unique interest due to its dual claim of a high rate of survivability and the most severe HRQoL outcomes within the larger trauma patient population (Gabbe et al., 2017; Kendrick et al., 2017; van der Vliet et al., 2019; Zwingmann et al., 2016). Prior investigators have established, with only minor disagreements that were explainable by deficient population sampling, that this trend is significantly associated with numerous variables. Treatment directed toward these variables is likely to improve HRQoL, and it is therefore imperative that early, targeted interventions be developed for use in hospitals to ease the drastic and long-lasting sequelae of traumatic injury.

### KEY POINTS

- Decreased HRQoL is a well-established, long-term consequence of traumatic injury.
- There is a deficiency of adequate mental health treatment for trauma patients.
- Resiliency and coping resources as part of a wraparound trauma care protocol may improve HRQoL outcomes.
- Research to determine effective frequency and duration of follow-up care is indicated.

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