Accident Analysis and Prevention 115 (2018) 151–159

Contents lists available at ScienceDirect

Accident Analysis and Prevention

journal homepage: www.elsevier.com/locate/aap

Measuring and assessing risk of quality of life loss following a road traffic injury: A proposed methodology for use of a composite score

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ARTICLE INFO

Keywords:
Composite score
Injury burden
Quality of life
Road traffic injuries
Sweden

ABSTRACT

Introduction: Assessments of the impact of road traffic injuries (RTIs) on quality of life (QoL) can benefit from the use of combined characteristics of the injurious event.
Aim: The burden of having sustained a RTI was computed using a composite score that comprised three elements (i.e. number of injuries sustained in the crash, body parts affected, and severity of the injuries) that relate to the probability of subsequent long-term QoL lost by individuals 1–4 years after the crash.
Methodology: The QoL of injured victims aged 11–90 years that crashed in Sweden between 2007 and 2009 was compared with that of a random sample of non-injured individuals frequency-matched by sex and age. Injury information to build the composite score was obtained from a national register that contains data on the number of injuries, their severity, and the body parts affected. The QoL was assessed in 2010 for both injured and non-injured individuals using the standardized Euro Quality of Life questionnaire. Logistic regression was used to investigate whether the composite score was predictive of low QoL (< 90% of the mean of non-injured referents) adjusting for sex, age, and time elapsed since the injury occurrence. The composite score was grouped into five exposure categories (0.01–1, 1.01–1.5, 1.51–2, 2.01–3 and 3.01–9 units).
Results: Compared with the non-injured reference group, all exposure categories showed statistically significant increased adjusted ORs for low QoL ranging from 2.35 (95% CI 1.48–3.72) in the 0.01–1.00 lowest injury category to 6.10 (95% CI 3.65–10.2) in the highest 3.01–9.00 with a slightly decreasing plateau in the intermediate categories (point ORs between 3.86 and 3.06). Yet, all 95% CIs across the exposure categories overlapped.
Conclusion: Long-term reduction in QoL is a burden experienced by the victims of mild to severe RTCs. The proposed composite score can be an initial step in the development of more elaborated instruments that can be useful in policy making and regulation.

1. Introduction

More than one billion people are disabled worldwide; from these, a large proportion is associated with injury events, which are responsible for 11% of all disability-adjusted life years (DALYs) (Lozano et al., 2012; Murray et al., 2013). Many of these injuries are the result of road traffic crashes (RTC). In fact, nearly 50 million people suffer from non-fatal road traffic injuries (RTIs) every year resulting in long-term impairment (WHO, 2013). Victims often do not recover their pre-crash health even after 18 months of the event (Ameratunga et al., 2006).

Quality of life (QoL) among RTI survivors has been a key element of the road traffic burden. Understandably, research within this area has focused mostly on individuals who have sustained severe injuries (Ameratunga et al., 2006; Fitzharris et al., 2007). Even sexual function after traumatic pelvic fracture has been studied and associated with lower QoL among injured individuals one year after the crash (Harvey-Kelly et al., 2014).

Studies on minor or less severe RTIs and QoL are scarcer, but there is indirect evidence pointing to relevant short- and long-term consequences. An Australian study reported that individuals with minor RTIs from an emergency unit had physical and mental baseline QoL scores below the reference norm, which improved slightly at six months, but not thereafter (Littleton et al., 2011). Another study with hospitalized and non-hospitalized injured drivers, as surrogates of injury severity, also reported lower general and mental health in both groups after 5–18 months of the crash compared with baseline measures, indicating that the longer-term health burden would likely be "underappreciated" among those not hospitalized (Ameratunga et al.,

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https://doi.org/10.1016/j.aap.2018.02.009
Received 24 April 2017; Received in revised form 12 January 2018; Accepted 9 February 2018

2006).

A study aimed at identifying predictors of the evolution of QoL following accidental injuries showed that while reduced occupational function was attributable to injury severity, it did not have a direct effect in the predicted change in subjective QoL (Moergeli et al., 2012). Actually, researchers have noticed that significant improvement in QoL can persist up to the second year, mostly for physical functioning, but not for mental health (Soberg et al., 2007).

Recently, there has been interest about the effect of RTCs in survivors with mild injuries. One study found that individuals with minor injuries had poor physical and mental health-related QoL, especially when high pain levels and comorbid psychiatric disorders are present (Kenardy et al., 2015); such low QoL levels did not improve even after two years of the crash. Another study comparing QoL between whiplash patients and other injuries one year after the crash reported that sociodemographic factors, pre-accident psychological history, and post-traumatic stress disorder had more impact in the QoL than the type of injury sustained (Hours et al., 2014).

Identifying which injuries will lead to future disabilities has been a difficult task due to the limited correlation between the initial assessment and the long-term consequences of the injuries. Measures like the Abbreviated Injury Scale (AIS) (States, 1969), from which other instruments have been derived, including the Injury Severity Score (ISS) (Baker et al., 1974) and the New ISS (Osler et al., 1997), have focused on the survival probability of injured individuals shortly after the crash to predict life-threatening injuries, but not so on their long-term impact. In the early eighties, the Rating System for Serious Consequences was proposed to recognize permanent medical impairments by body regions according to AIS categories (Gustafsson et al., 1985). Attempts have also been made to assign an impairment score to AIS diagnoses based on medical consensus and loss of individuals' income (Miller, 1993) or on their functional capacity one year after the injury (MacKenzie et al., 1996), and more recently the health-related QoL has been used to measure the change in health status over time (Coons et al., 2000). Yet, efforts to develop an appropriate method are still needed, to which this study could be a contribution, as it proposes the use of a composite measure that includes relevant dimensions of the injury burden in terms of its impact on the future QoL of individuals injured in RTCs.

In this study we computed a relatively simple composite score that takes into account key injury dimensions (i.e. number, location, and severity) to assess the overall burden of injuries in the QoL lost by individuals one to four years after the RTC occurrence. We believe that such measure can give further perspective for the development of a more refined and validated index that can be of use in policy making and regulation by public and private institutions.

2. Materials and methods

2.1. Study design

The QoL of injured victims aged 11–90 years that crashed in Sweden between 2007 and 2009 was compared with that of a random sample of non-injured referent individuals using frequency matching by sex and age.

The data for the analyses conducted here were assembled using both primary (i.e. survey) and secondary (i.e. register) sources. The severity of each distinct injury was assessed using the AIS (States, 1969), a validated measure to classify and describe the severity of injuries (AAAM, 2005), as it was recorded in the Swedish Traffic Accident Data Acquisition (STRADA) system (Swedish Transport Agency, 2001). This national register contains information about the date, place, health consequences, and other characteristics related to all RTCs occurring in the entire national road network resulting in death or significant injury requiring medical care. The system is routinely fed with information coming from police and hospitals reports. Hospital data comprised a number of variables such as the body parts affected divided up into ten categories (i.e. head, cervical spine, face, upper extremities, lower extremities and pelvis, thorax, thoracic spine, abdomen, lumbar spine, and external) and the severity of the injuries sustained (i.e. minor, moderate, serious, severe, critical, and maximum), which are then used to compute the AIS for each body part injured.

On the other hand, the individuals' QoL was determined by sending a standardized Euro Quality of Life (EQL-5D-3L) questionnaire (Kind, 1996) to measure the generic health status of individuals, which included the injured and non-injured groups to be able to establish meaningful comparisons.

2.2. Sample size and selection

A theoretical sample was designed in 2010 with the aim of obtaining 100 randomly selected individuals injured between 2007 and 2009 based on the AIS so that each of the ten body parts, and the five AIS categories used (maximum was excluded) were represented. In this way, up to five thousand individuals could be potentially sampled (i.e. ten body parts, five injury severity categories, 100 individuals). However, when performing the actual sampling, many body parts/severity categories did not fulfill the expected 100 observations, namely, there were insufficient injured individuals representing all theoretical categories (e.g. minor AIS for abdomen with only 26 instead of 100); severe and critical injuries were very few.

Non-injured reference individuals were randomly sampled from the Swedish Population Registry aimed at frequency matching the age (i.e. month of birth) and sex of injured individuals. These were normal healthy people who had not been injured previously, and who did not have a major medical concern at the time of the study.

While the total eligible sample comprised 9522 participants, only 3995 completed the EQL-5D-3L questionnaire (after two reminders at weeks 3 and 6 of the initial survey date) resulting in a response rate of 37.7% among the injured (n = 1797) and 46.1% among the referents (n = 2198). However, since individuals aged less than 10 and older than 90 years were excluded in this study, the final sample with complete information for this analysis comprised 1698 injured and 2110 referent individuals.

2.3. Quality of life (QoL) assessment

The standardized EQL-5D-3L (Euro Quality of Life, 5 dimensions, 3 levels) self-complete questionnaire paper version for measuring generic health status was used (Kind, 1996). This is a valid and reliable descriptive instrument that investigates five dimensions (i.e. mobility, self-care, usual activities, pain/discomfort, and anxiety/depression), in which respondents can self-rate their health status as with "no problems", "some (moderate) problems", or "extreme (severe) problems"; in this way, 243 possible health states are defined, each of which is referred as a 5-digit code (e.g. 11223 indicates no problems with mobility and self-care, some problems when performing usual activities, moderate pain/discomfort, and severe anxiety/depression) at the time of completion (for more details please see https://euroqol.org/euroqol/). Among other uses, this instrument has been used for research purposes (Burström et al., 2001; Sun et al., 2012), especially in Europe, to measure changes in health-related QoL over time in patients (Rabin and de Charro, 2001).

Health states were converted into a single summary index by applying a formula that gives weights to each level in each dimension using "value sets" modeled from all possible health states using a representative sample of the United Kingdom general population as reference. Time trade-off value sets for the health states based on the UK reference (Dolan, 1997) were as follows: Full health for all five dimensions = 1; mobility 2 = −0.069 and 3 = −0.314; self-care 2 = −0.104 and 3 = −0.214; usual activities 2 = −0.036 and 3 = −0.094; pain/discomfort 2 = −0.123 and 3 = −0.386; anxiety/depression 2 = −0.071 and 3 = −0.236; and constants when at least