Traffic accident victims and polytrauma patients: injury patterns, outcome and their influencing factors

Leijdesdorff, H.A.

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Summary

Road traffic accidents (RTA) contribute significantly to the global burden of trauma. The World Health Organization indicates that approximately 1.3 million people die each year on the world's roads and between 20 and 50 million sustain non-fatal injuries. The introduction of extensive traffic safety laws, preventive governmental programs and substantial changes in (the organisation of) pre- and in-hospital trauma care have resulted in a gradual decrease in road traffic injuries and fatalities in the 1990s and onward in the Netherlands. Since 2006, however, the number of seriously injured road traffic participants has been increasing despite these government measures to improve road safety. In 2018, an estimated 21,700 people were seriously injured in traffic in the Netherlands, approximately 1,000 more than in 2017.

In **Chapter 1** the discussion about outcome and injury patterns after RTAs in the Netherlands is introduced. The primary aim of this thesis was to analyse injury patterns, injury severity and mortality for different types of road traffic participants involved in accidents in the Netherlands. Secondly, the association between blood alcohol concentrations, TBI patterns and patient outcome was analysed. Finally, patient and injury characteristics associated with HRQoL, fatigue and societal participation in polytrauma patients were identified.

Further reduction of RTA fatalities is a key priority in the European Union. Since data on injury patterns related to mortality in RTAs are scarce, **Chapter 2** describes the injury patterns and injury severity of in-hospital deceased RTA victims in the Netherlands. A total of 497 RTA victims deceased during the period 2015 – 2016 were analysed. Most of them were bicyclists and all deceased motorcyclists suffered severe trauma (Injury Severity Score ≥ 16). Head trauma was most frequently diagnosed in pedestrians and bicyclists. Therefore, further prevention of head trauma is needed to reduce RTA fatalities, especially among bicyclists. Trauma to the thorax was most frequently found in motorcyclists and motorists. Remarkable was that more than 10% of the severely injured (Injury Severity Score ≥ 16) RTA victims were not transported directly to a level I trauma centre and that the majority of this group was older than 75 years. Thus, under-triage of the severity of the injury in elderly RTA victims is obvious and should be addressed in the early phases of trauma care, especially during prehospital triage and initial care at admission.

RTAs involving motorized two-wheeled vehicle (MTV) riders often result in severe morbidity and mortality. The three categories of MTVs (motorcycles, mopeds and light-mopeds) in the Netherlands offered the possibility to compare the relation of different types of MTV and their specific driver groups, with injury severity and mortality in hospital-admitted MTV crash victims. **Chapter 3** presents an analysis of injury severity

and mortality among 33,495 MTV crash victims. Overall, in light-moped riders, not only severe head injuries were most common, but also the prevalence of severe trauma and mortality was highest compared with motorcyclists and moped riders. The young motorcycle riders and elderly light-moped riders are two vulnerable groups in daily MTV traffic, with high chances of severe injury and mortality, upon hospitalization. These differences in age and also the use of different types of MTVs are of significant clinical and societal importance. Apart from the influence of the type of MTV on injury severity and mortality, this study pointed out that - despite previous protective measures - continuing improvement of the safety of all MTV users is urgent and the introduction of mandatory helmet usage in light-moped riders should be considered.

It is well known that the elderly are over-represented in both RTA fatalities and seriously injured road users. As the Dutch population is ageing, the increased desire for self-reliance and autonomy of older people will probably strengthen this trend. The Netherlands Social Support Act (WMO) dictates that municipalities give mobility scooters on loan to persons with limited physical capabilities who want to remain mobile. As a result of this desire for mobility, the number of mobility scooters is expected to grow among this specific group of persons to around 600,000 in 2030. **Chapter 4** describes the characteristics and clinical outcomes of 242 victims of motorized mobility scooter (MMS) crashes which were included in the trauma registry of the Trauma Centre West-Netherlands (TCW). In this study, both low-energy and high-energy crashes involving the MMS resulted in serious injuries and sometimes death. Especially elderly MMS users sustained severe trauma in this study. Consequently, improved awareness of MMS patient characteristics by multidisciplinary medical teams may help to avoid underestimation of the injury severity in this vulnerable population.

The objective of the study described in **Chapter 5**, was to analyse and determine the incidence, risk factors, hospital triage, and outcome of patients with severe traumatic brain injuries (sTBIs) caused by road traffic accidents. This study shows that especially age, Glasgow Coma Scale, and type of haemorrhage were independent prognostic factors for in-hospital mortality after sTBI. Between different types of road users, in-hospital mortality ranged from 4.2% in moped riders to 14.1% in motorists. However, pedestrians had the highest risk to sustain sTBI and, more specifically, intracranial haemorrhage. In general, specific brain injury patterns have been distinguished for specific road user groups, and independent prognostic risk factors for sTBI were identified.

The second part of this thesis focuses on the impact of alcohol intoxication on injury patterns and short-term outcome in patients with traumatic brain injuries (TBI). **Chapter 6** presents the association of different levels of blood alcohol concentrations

(BAC) with TBI characteristics and outcome. Adult patients with moderate to severe TBI (Abbreviated Injury Scale ≥ 2) and measured BAC admitted to hospitals in the Trauma Centre West-Netherlands (TCW) region during a 5 year period were analysed. In concordance with recent literature suggesting a neuroprotective effect of alcohol on TBI, possibly associated with less morbidity and mortality, this study found that in patients with moderate to severe TBI, increasing BACs were associated with less severe TBI, fewer ICU admissions and higher survival.

The introduction of all-inclusive trauma systems and centralization of trauma care has gradually resulted in reduced trauma-related mortality in the Netherlands. As a result, an increasing number of trauma patients survive their injuries and often face severe and prolonged deficits in health-related quality of life (HRQoL). HRQoL has therefore become an increasingly important outcome measure to evaluate further enhancement of trauma care. However, little is known about the relation between fatigue and reduced societal participation in severely injured trauma patients after recovery with the occurrence of reduced HRQoL. With this in mind, the last part of this thesis focuses on the associations between and determinants for HRQoL, fatigue and societal participation in polytrauma patients. **Chapter 7** describes the analysis of 283 polytrauma patients (Injury Severity Score≥16) admitted to two level-I trauma centre locations in the Trauma Centre West-Netherlands region. HRQoL was measured using the Short Form Health Survey (SF-36), and fatigue and societal participation were respectively measured using the Multidimensional Fatigue Inventory and the Utrecht Scale for Evaluation of Rehabilitation-Participation. One to two years after the trauma, polytrauma patients reported reduced HRQoL, which was also associated with more fatigue and reduced societal participation. Also, severe head injury was associated with worse mental health and female patients reported more general and mental fatigue and were less satisfied with their ability to perform daily activities. Thus, trauma rehabilitation strategies for polytrauma patients might focus on early recognition of reduced HRQoL, fatigue and societal participation and facilitate early intervention to improve these outcomes.

The general discussion in **chapter 8** presents an overview of the clinical implications of the main findings, future perspectives as well as issues that remain to be studied relating to factors influencing both injury patterns and injury outcome of RTA victims and polytrauma patients.