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Variations in hospital costs after traffic injuries: The importance of sociodemographic aspects and comorbidities

Stefanie Devos[a,*], Griet Van Belleghem[a], Karen Pien[b], Ives Hubloue[d], Isidoor Lauwaert[c], Tom van Lier[d], Lieven Annemans[e], Koen Putman[a]

[a] Interuniversity Centre for Health Economics Research, Faculty of Medicine and Pharmacy, Vrije Universiteit Brussel, Laarbeeklaan 103, 1090 Brussel, Belgium
[b] Medical Registration, Universitair Ziekenhuis Brussel, Laarbeeklaan 101, 1090 Brussel, Belgium
[c] Emergency and Disaster Medicine, Department Emergency Medicine, Universitair Ziekenhuis Brussel, Laarbeeklaan 101, 1090 Brussel, Belgium
[d] Mobility, Logistics and Automotive Technology Research Centre, Vrije Universiteit Brussel, Pleinlaan 2, 1050 Brussel, Belgium
[e] Interuniversity Centre for Health Economics Research, Faculty of Medicine & Health Science, Ghent University, De Pintelaan 185, 9000 Ghent, Belgium

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ABSTRACT

Objective: The impact of sociodemographic aspects and comorbidities on the inpatient hospital care costs of traffic victims are not clear. The main goal of this study is to provide insights into the sociodemographic characteristics and clinical conditions (including comorbidities) of the victims that result in higher hospital costs.
Participants: For the period 2009–2011, people admitted to a hospital as a result of a road traffic crash (N = 64,304) were identified in the national Minimal Hospital Dataset, after which they were linked to their respective claims data from the sickness funds.
Methods: A generalized linear model was used to analyse hospital costs controlling for roadway user categories, demographics (gender, age, individual socioeconomic status (SES)), and clinical factors (the nature, location, and severity of injury, and comorbidities).
Results: The median hospital cost was € 2801 (IQR € 1510–€ 7175, 2015 Euros). There was no significant difference between gender. Low SES inpatients incurred 16% (95% CI: 14%–18%) higher hospital costs than inpatients of high SES. The presence of comorbidities was associated with an increased hospital cost, however with varying magnitude. For example traffic victims suffering from dementia incur significantly higher hospital costs than those who were not (49% higher, 95% CI: 44%–53%), whereas diabetes was associated with a smaller increase in costs compared to non-diabetics (13%, 95% CI: 10%–16%).
Conclusion: Comorbidities and low SES are associated with higher hospital costs for traffic victims, notwithstanding their age, and the nature and the severity of their injury. The broad variability of hospital costs among trauma inpatients should be accounted for when reconsidering financing models. Furthermore, the strong predictive value of some comorbidities and SES on hospital costs should be considered when projections of future health care utilisation in traffic safety scenarios are prepared.

Introduction

By 2030, it is believed that road traffic injuries will be the fifth leading cause of death and the third leading cause of disability worldwide with an increasing physical, psychological, and economical impact on society [1]. The most important cost categories among the total societal costs of traffic crashes are the medical costs, production losses, material damages, administrative costs, and the so-called *risk value*, which functions as an estimate of pain, grief, and suffering caused by traffic crashes, translated into monetary values [2–4]. In this study, the focus will be on the medical costs, and more specifically, the total hospital costs associated with traffic injuries. The European Commission aspires with the 'European Road Safety Action Programme 2011–2020' to reduce fatal crashes by 50% between 2010 and 2020 and to arrive at a number close to zero by 2050 [5]. Besides reducing fatal crashes, there is an increased focus on reducing the number of serious road traffic injuries in Europe. In Belgium, as in several other countries, traffic crash statistics are currently provided by the police [6]. The Belgian definition of 'serious injury' is a minimum of 24 h hospitalisation following a road collision. Police officials indicate in their registration file if a traffic victim was (or is expected to be)

* Corresponding author.
E-mail address: sdevos@vub.ac.be (S. Devos).

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hospitalised for at least 24 h [7]. However, the police generally lack sufficient medical knowledge to judge this correctly. Belgian crash statistics reveal that the decrease in road traffic crashes with seriously injured victims is progressing less positively than the decrease in fatal crashes [8]. The same trend has been observed in other countries as well [9,10].

In addition to the official crash statistics recorded by the police, hospital discharge data provide a useful overview of seriously injured traffic victims [11–13]. Furthermore, the claims data routinely collected by the hospitals can be used to estimate the total hospital costs incurred by traffic victims, and can provide insight into the factors associated with higher hospital costs. Detailed information on seriously injured traffic victims, their associated hospital costs, and any variations in these costs would be beneficial for policy makers, as they would allow for the estimation of hospital costs for various subgroups of traffic victims. This could be relevant for the appraisal of health and hospital financing mechanisms. Furthermore, this kind of data can be an additional source of information for road safety policy, for example to estimate the current burden of traffic crashes with seriously injured victims or to identify the main risk groups in terms of higher costs. Once this methodology is further tested and refined, this data would be useful in monitoring new traffic regulations over time, and to compare future and current policy regulations and prevention programs with each other.

The primary goal of this study is to provide an overview of the characteristics of serious traffic injury, using hospital discharge data. Some research has been conducted on the distribution of roadway users, including the nature and location of injury, gender, and age [11,15,16]. However, these studies only included traffic victims surviving motor vehicle crashes. In this study, traffic crashes are defined as all traffic crashes involving pedestrians, cyclists, motor vehicle drivers or passengers, or motorcycle drivers or passengers. The second goal is to provide insights into the characteristics of traffic injury victims that are specifically associated with higher hospital costs. Therefore, we aim to identify the most important cost drivers among traffic victims' socio-demographic characteristics and their clinical conditions. Commonly identified significant factors affecting hospital costs (i.e. cost drivers) after an injury, in general, are the following: age [17–20], gender [14,19,20], the type of injury [14,20], the injured body region [18], injury severity [14,17,19], other physical injuries [21], and low socio-economic status [14,21,22]. However, these results were observed in small subsets of trauma inpatients such as patients with traumatic brain injury (TBI) [17,18,21] and young car crash victims [19,20,22], or were estimated based on a rather small sample size [14]. To the best of our knowledge, no study has yet controlled for patients' comorbidities while estimating the hospital costs associated with traffic injuries. However, previous research confirmed that 16% of all trauma patients had a prevalence of at least one comorbidity [23]. One study demonstrated that the presence of comorbidity affects the length of stay among trauma patients [24]. The authors reported that comorbidity and age were both independent, significant predictors of length of hospitalisation, above and beyond what was expected based on their injury severity [24].

Methods

Data sources

This retrospective study included data provided by the Belgian Federal Public Service Health (FPS Health) on all traffic victims admitted to a Belgian hospital between 2009 and 2011. Belgian hospitals are obliged to provide their discharge data to FPS Health as part of the Minimal Hospital Dataset (MHD). Traffic victims were a priori identified based on either relevant E-codes (E810–E819, E826, E827, E829) as registered in the MHD, or by the code 'type of roadway user' in the emergency department files. For each patient treated in an emergency department after a traffic crash (and before admission to the hospital), the variable 'type of roadway user' has to be registered in his or her emergency department file. This information was also available and enabled the identification of traffic victims for whom no E-code was registered in the MHD. Only pedestrians, cyclists, motorcyclists, as well as motor vehicle drivers and their passengers, were included in this study. Passengers of public transport and horse riders injured on public roads were not included. The hospital discharge data provides information on sociodemographic patient characteristics (age, gender), diagnostics (categorised according to the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) for main and secondary diagnoses), healthcare related information (e.g. date of hospital admission and discharge, length of stay, days on the intensive care unit, transfer to another hospital), roadway user type, and discharge destination. The main diagnosis for admission was considered as the main injury. If the main diagnosis upon admission was not an injury (ICD-9-CM code was not between 800 and 959), we considered the secondary diagnosis with the most severe ICD-9-CM based Injury Severity Score (ICISS) as the main injury for these patients. ICISS is recommended to indicate injury severity when only ICD-9-CM diagnoses are available [25]. It is the product of the survival risk ratios of the 10 most severe injuries. A survival risk ratio indicates the probability of surviving a certain ICD-9-CM injury. ICISS is a score between 1 and 0, where '1′ indicates a 100% chance of survival, and '0′ no chance of survival [26]. In order to be more informative in the regression analyses, we scaled the ICISS from 0 to 100 by multiplying the original ICISS value by 100 and we reversed the scale: 100* (1-ICISS), the XICISS. This way, the higher the XICISS, the more severe the injuries suffered by the patient. Traffic victims for whom no injury was reported, were excluded from the analyses (i.e. no main or secondary diagnosis was deemed an injury). The Barell Injury Diagnostics Matrix was used to define the nature and location of injury. The nature of the injury was divided into the following categories: 1) fractures (ICD 800–829), 2) dislocations (ICD 830–839), 3) sprains and strains (ICD 840–848), 4) internal injuries (ICD 850–854, 860–869, 952, 995.55), 5) open wounds (ICD 870–897), 6) superficial injuries including contusions (ICD 910–924), 7) burns (ICD 940–949), 8) amputations (ICD 885–887, 895–897), 9) crush injuries (ICD 925–929), 10) injuries to nerves and the spinal cord (ICD 950–951, 953–957), and 11) unspecified injuries (ICD 959). The location of the injury was categorised as follows: 1) traumatic brain injury (TBI), 2) other head, face or neck injury, 3) torso, 4) vertebrae or spine, 5) upper extremities, 6) lower extremities, and 7) unclassifiable by site. The following pre-existing comorbidities were considered: 1) cancer, 2) diabetes, 3) dementia, 4) diseases of the musculoskeletal system and connective tissue, 5) diseases of the circulatory system, 6) diseases of the respiratory system, 7) diseases of the nervous system and sense organs, 8) anaemia, 9) diseases of the digestive system, 10) diseases of the genitourinary system, 11) blood coagulation, 12) substance abuse, and 13) symptoms, signs, and ill-defined conditions. If inpatients were suffering from an acute illness at the moment of hospitalisation, this was included in the analyses as a dummy variable. Examples of acute illness are pneumonia, kidney failure, cardiac arrest, etc. A list with the specific conditions (ICD-9-CM codes) that are considered under each of the comorbidities, and under acute illnesses, is available upon request.

Claims data were identified in the databases of all national sickness funds and were provided by the InterMutualistic Agency (IMA). In these databases, the claims are collected for all in-