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Seatbelt use to save money: Impact on hospital costs of occupants who are involved in motor vehicle crashes

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ABSTRACT

Objective: Seatbelt use is the single most effective way to save lives in motor vehicle crashes (MVC). However, although safety belt laws have been enacted in many countries, seatbelt usage throughout the world remains below optimal levels, and educational interventions may be needed to further increase seatbelt use. In addition to reducing crash-related injuries and deaths, reduced medical expenditures resulting from seatbelt use are an additional benefit that could make such interventions cost-effective. Accordingly, the objective of this study was to estimate the correlation between seatbelt use and hospital costs of injuries involved in MVC.

Methods: The data used in this study were from the Nebraska CODES database for motor vehicle crashes that occurred between 2004 and 2013. The hospital cost information and information about other factors were obtained by linking crash reports with hospital discharge data. A multivariable regression model was performed for the association between seatbelt use and hospital costs.

Results: Mean hospital costs were significantly lower among motor vehicle occupants using a lap–shoulder seatbelt ($2909), lap-only seatbelt ($2289), children's seatbelt ($1132), or booster ($1473) when compared with those not using any type of seatbelt ($7099). After adjusting for relevant factors, there were still significantly decreased hospital costs for motor vehicle occupants using a lap–shoulder seatbelt (84.7%), lap-only seatbelt (74.1%), shoulder-only seatbelt (40.6%), children's seatbelt (95.9%), or booster (82.8%) compared to those not using a seatbelt.

Conclusion: Seatbelt use is significantly associated with reduced hospital costs among injured MVC occupants. The findings in this study will provide important educational information for emergency department nurses who can encourage safety belt use for vehicle occupants.

1. Introduction

Motor vehicle crashes (MVC) are a leading cause of injury and death around the world. In the United States (U.S.), according to the National Highway Traffic Safety Administration (NHTSA), 32,719 persons died and 2.31 million persons were injured due to MVC in 2013 (NHTSA, 2013). In addition, MVC injuries also resulted in substantial costs to families and society. For example, there were 2,519,471 emergency department visits resulting from crash injuries in 2012 (Bergen et al., 2014). Approximately 7.5% of these emergency department visits were transferred to a hospital resulting in 1,057,465 hospital days for these hospitalized patients (Bergen et al., 2014). Another result of these injuries was an estimated $18.4 billion (2012 U.S. dollars) lifetime medical costs for emergency department visits and inpatient care (Bergen et al., 2014). According to the World Health Organization (WHO), approximately 1.25 million persons died and 20–50 million persons are injured each year as a result of MVC (World Health Organization, 2016). In addition, MVC cost countries approximately 3% of their gross national product (World Health Organization, 2016).

Effective prevention and reduction of death and serious injury from MVC depends on important advances in our understanding of its risk factors. Seatbelt use is the single most effective way to save lives and reduce injuries from MVC (Evans, 1996; Marine et al., 1994; Niemcryk et al., 1997; Olsen et al., 2010; Viano, 1995). According to the Centers for Disease Control and Prevention (CDC), wearing seatbelts can reduce injuries and deaths in crashes by approximately 50% (Centers for Disease Control and Prevention (CDC), 2011).

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However, in spite of the known benefits of seatbelt usage, the most recent data show that the percentage of motor vehicle occupants around the world who use seatbelts ranges widely, from 10% to 96% (World Health Organization, 2016). In the U.S., seatbelt usage has increased dramatically, from 11% in 1980 (prior to mandatory use legislation) to 68% in 1995 (Derrig et al., 2002) and to 87% in 2010 (Shults and Beck, 2012), but still remains among the lowest of the world's developed countries (Vivoda and Eby, 2011). It may well be that mandatory use legislation alone is not enough to maximize seatbelt usage. Combined with enforcement, educational interventions may be needed to further reduce death and severe injury due to MVC. As the front-line medical professionals who treat crash victims every day, emergency department nurses could be a valuable resource for educational interventions of this type. On the legislative side, the U.S.-based Emergency Nurses Association has already weighed in on this issue, releasing a report in 2008 that highlighted the kinds of laws that could prevent many MVC-related accidents, injury and fatalities (Emergency Nurses Association, 2016).

Although there have been few studies of the association between seatbelt use and medical costs among MVC victims, these studies estimated medical costs based on emergency department records or trauma registry data (Allen et al., 2006; Coley et al., 2002; Sokolosky et al., 1993). However, these studies have been hampered by the limited amount of information collected by emergency departments and trauma registries, and have not taken into account other potentially relevant factors such as the type of occupant (driver, passenger), health insurance status (Bolhofner et al., 1994), age, gender (Tavris et al., 2001), race/ethnicity (Keyes et al., 2012), alcohol consumption (Mann et al., 2011) and type of crash.

Our study used data collected as part of the Nebraska Crash Outcome Data Evaluation System (CODES), which is maintained by the Nebraska Department of Health and Human Services (DHHS). This system includes linked data from police crash reports and hospital discharge records (including inpatient, emergency department and outpatient records), which are provided to DHHS by the Nebraska Hospital Association. In addition to medical information, demographic characteristics, behaviors, and detailed crash information of motor vehicle crash victims are also included in the CODES system. The availability of this information allowed us to estimate the association between seatbelt use and MVC-related hospital costs while controlling for other relevant factors.

2. Methods and procedures

2.1. Data source and study population

There were a total 766,713 motor vehicle occupants (515,215 drivers, 251,498 passengers) involved in a motor vehicle crash (excluding motorcycle and bus) included in Nebraska CODES that occurred between 2004 and 2013. To understand the financial consequences of motor vehicle crashes, police motor vehicle crash reports were linked with inpatient hospital, emergency department and outpatient hospital discharge records. Strategic Matching LinkSolv (version 8.3) software was used to link both datasets with probabilistic record linkage techniques. The detailed linkage method has been published in our previous report (Han et al., 2015). In brief, the linkage variable included first name, last name, gender, and date of birth, date of crash and location of crash. The match weight was set at 15 (threshold), and the average match probability was 0.91. After linkage, the total hospital charges variable was added to each injured individual record in the police crash reports. A total of 90,716 MV occupants met the linkage criteria; this number was reduced to 78,576 when occupants with missing age and seatbelt use information were excluded, and this group comprised the study population. Because this study used only publicly-available or de-identified information, it was exempt from Institutional Review Board approval.

2.2. Outcome variable

Hospital costs were estimated from the variable total hospital charges. Typically, U.S. hospital costs (the amount that is actually paid to the hospital for a given service) may be dramatically different from what the hospital charges, and the cost-to-charge ratio is a method to derive actual hospital costs from hospital charges. For this study, hospital charges were converted to hospital costs using cost-to-charge ratios from Healthcare Cost and Utilization Project. All hospital costs were reported in U.S. dollars in 2013 using the Producer Price Index inflation adjustment (Bureau of Labor Statistics, 2015). Total hospital costs included costs in the following categories: general services, ICU/special care, pharmacy, laboratory, radiology, operating room, supplies, and other ancillary services. In addition, hospital costs reflect only facility-provided services; professional services (i.e., attending physicians) are entirely excluded from these amounts. We estimated a hospital cost value for each linked MV occupant in this study.

2.3. Exposure variable

Seatbelt use information was identified from the police crash report: shoulder belt use, lap belt use and both shoulder and lap belt use were defined as seatbelt use (yes), no use was defined as no seatbelt use (no) for motor vehicle occupants 13 years of age and over; child booster seat use and child safety seat use were defined as seatbelt use (yes), no use was defined as no seatbelt use (no) for occupants 12 years of age or younger.

2.4. Co-variables

In addition to seatbelt use, other factors were included in this study. A detailed description of these variables is provided in Table 1.

2.5. Statistical analysis

The means and 95% confidence intervals (CIs) of the hospital cost values were used to estimate the difference in hospital costs between motor vehicle occupants using and not using a seatbelt.

Table 1
Description of study variables and categorization schemes.

Race/ethnicity	White, African-American, Hispanic, Asian or Pacific Islander, American Indian or Alaska Native, others
Gender	Male, female
Age group	0–5, 6–12, 13–19, 20–29, 30–39, 40–49, 50–59, and 60+ years of age
Time of crash	12:00 AM–5:59 AM, 6:00 AM–11:59 AM, 12:00 PM–5:59 PM, 6:00 PM–11:59 PM
Location of crash	Local road or street, highway, interstate highway
Type of occupant	Driver, passenger
Vehicle speed limit at crash site	The speed limit of the road where the crash occurred
Type of crash	Single-vehicle, multiple-vehicle
Alcohol-impaired driving	Alcohol-impaired driving was considered present when at least one driver was reported as a drunk by police or his/her blood alcohol concentration was 0.08 or higher
Year of crash	2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013
Type of health insurance	Commercial insurance, government insurance, self-payment, other