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Factors affecting teen drivers' crash-related length of stay in the hospital

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ABSTRACT

Teen drivers have higher rates of traffic crashes and crash-related hospitalization than other driver groups. Crash-related hospital length of stay (LOS) is not only a measure of financial costs and level of injury severity but also longer term effects following a traffic crash. Thus, it is important to investigate the effects of crash factors on the crash-related hospital length of stay of this driver group. The South Carolina Crash Outcome Data Evaluation System (SC CODES) from 2005 to 2007 was used to construct zero-inflated negative binomial regression models to predict teen drivers' hospital length of stay based on the corresponding crash characteristics. The results found that not wearing a seatbelt increased male teen drivers' probability of being admitted to the hospital by 79.2% and their LOS by 40.5%. In addition, distracted male drivers had 51.42% lower odds to be admitted to the hospital than male drivers who were not distracted, whereas female distracted drivers had 34.6% higher odds to be admitted to the hospital than female drivers who were not distracted. Not wearing a seatbelt, drug use, and speeding are associated with a higher likelihood of being admitted to the hospital or longer hospital length of stay for both male and female teen drivers. Fatigued driving and driving at night are two factors unique to male teen drivers which increase their likelihood of being admitted to the hospital. Evaluating the implications of crash factors on hospital admissions and length of stay increases our understanding of crash factors and their safety consequences.

1. Introduction

Teen drivers (16–19 year-olds) have higher motor vehicle crash rates per licensed driver than other driver groups (McGwin and Brown, 1999), possibly because of their lack of experience and maturity (Mayhew et al., 2003; McCartt et al., 2009). These crash-related injuries result in not only missed school or work days for the teens but also place a financial strain on them and their parents (Corso et al., 2006; Gardner et al., 2007). Studies have suggested that crash-related hospital length of stay (LOS) and injury severity are positively correlated (Sassani et al., 2004; Haghparast-Bidgoli et al., 2013; Devos et al., 2015). This also supports previous research conducted by Hobbs et al. (1979), who identified a cause-effect relationship between victims' injury severity following a crash and their hospital LOS. Moreover, unlike the injury severity outcomes coded by the police, the hospital LOS provides an objective measure of drivers' injury severity.

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Previous studies have found that several crash factors influence teen drivers' crash-related injury severity, which impact the hospital LOS. More specifically, teens had lower seatbelt use rates than drivers in other age groups (Kim et al., 1994, 1995; Mouzakes et al., 2001), with approximately two thirds of teens killed or injured in traffic crashes in 2004 being non-seatbelt users (NHTSA, 2005). In addition, driving under the influence of alcohol is another factor that may elevate the crash injury severity for drivers, especially for teen drivers (Zador et al., 2000; Keall et al., 2004, 2005). Zador et al. (2000), Keall et al. (2004), and Keall et al. (2005) identified that at the same level of alcohol consumption, teen drivers had a higher risk of severe injuries than experienced adult drivers. The time of day of a crash has also been found to affect injury severity, with nighttime and weekends increasing the severe crash risks for drivers, especially for teen drivers (Williams, 2003). Fatigue and sleepiness were associated with severe injuries (Lal and Craig, 2001; Philip et al., 2005) and more frequently occurred among younger and more inexperienced drivers than older, experienced ones (O'Brien and Mindell, 2005). Additionally, driver distraction has been found to degrade driving performance, increasing the likelihood of crashes (Neyens and Boyle, 2008), again a factor pertinent for inexperienced drivers who need to pay additional attention to their driving (Goodwin et al., 2012). Because of this need to focus fully on driving, teen drivers may be more vulnerable when they engage in non-driving tasks (Lee, 2007).

Weather has also been identified as a significant factor influencing the severity of driver injuries. According to the study conducted by Edwards (1999), the frequency of crashes resulting in minor injuries increased during rain, while the crash injury severity decreased in adverse weather compared with that in clear weather. Similarly, Neyens and Boyle (2008) found that teen drivers were less likely to be severely injured while driving in adverse weather. In addition to common crash factors, the presence of passengers also affects the injury severity of crashes for teen drivers (Preusser et al., 1998; Williams, 2003). It has been shown that teen drivers who have passengers present were more likely to be involved in aggressive driving behaviors (e.g., speeding and short headway), especially if these passengers were teenagers (Williams, 2003; Simons-Morton et al., 2005; Lambert-Bélanger et al., 2012; Conner and Smith, 2014).

A driver's sex may also impact crash severity and the resulting hospital LOS. Several studies have suggested significant driving behavior differences between male and female drivers (Ulfarsson and Mannering, 2004; Morgan and Mannering, 2011). For example, male drivers have been found to be more likely to engage in behaviors associated with severe crashes and injures (Kim et al., 1995) than female drivers, Simons-Morton et al. (2005) finding male teens drove faster than their female counterparts and much faster in the presence of a male teen passenger. Past research has identified that in the same circumstances female drivers had a higher likelihood of crash-related deaths relative to males (Evans, 1988; Duncan et al., 1998; Evans, 2001). Abdelwahab and Abdel-Aty (2001) found that female drivers were more likely to be severely injured than males in traffic crashes. Specifically, the protective function of the seatbelt differed between male and female drivers, resulting in belted females being more likely to suffer severe injury than males (Bose et al., 2011). Rice and Zhu (2013) also found that the fatal crash risk for obese female drivers were higher than that for obese males.

While a number of studies have focused on the relationship between teen drivers' crash characteristics and the severity of their crash-related injuries, few, if any, have evaluated the effects of crash characteristics on teen drivers' hospital LOS. one exception being the research conducted by Peek-Asa et al. (2011), who used a linear regression model to examine these factors and their relationships. Their results identified that most injury characteristics (e.g., injury areas) significantly predict hospital LOS while very few occupants' characteristics (e.g., sex or age) do so. However, further research on the relationship between crash factors and teen drivers' characteristics on their hospital length of stay is needed to understand how it may be possible to reduce the financial burden, decrease missed school or work days, and increase quality of life for teens injured in crashes. To address this need, the study reported here evaluated the effects of teen driver characteristics (e.g., sex), environmental conditions (e.g., weather), and crash types (e.g., head-on crash) on teen drivers' hospital LOS.

2. Materials and methods

2.1. Data source

The South Carolina Crash Outcome Data Evaluation System (SC CODES) crash data from January 2005 to December 2007 were used for this study. This CODES data system links state-level crash data with health care outcome data from hospitals (Johnson et al., 1996; Finison and Dubrow, 2002). To avoid potential errors in matching health care and crash data, only data with positive match weights were included in this analysis. The vehicle body types in this study were limited to passenger cars, light trucks, passenger vans, and SUVs, as other vehicle body types such as motorcycles, buses, or heavy trucks have different dynamics, and the data were further reduced to include only motor vehicles that were moving (i.e., parked vehicles were not included in the analysis). Rear-end, angular, head-on, sideswipe, and single vehicle crashes were the five types of crash identified in the CODES. The crashes excluded from this study included those with the drivers' sex coded as missing and those with the speed limit (e.g., 22, 56, 67 mph) not identified as a standard US speed limit (i.e., 25, 35, 65 mph), as the coded speed limit may be caused by typos. In addition, if the patients' discharge status was identified as expired, their records were excluded because the hospital LOS may not reflect the actual severity of fatal injuries (i.e., the drivers may have suffered severe injuries and died with very short hospital LOS).

Similar to NHTSA (2009) and Zhang et al. (2000), both of which defined higher speed limit roads as those with limits equal to or above 60 mph and lower speed limit roads as those below 60 mph, this research coded crashes on a roadway

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