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Age-related differences in fatal intersection crashes in the United States

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ABSTRACT

Objective: Given the aging U.S. population and resulting number of older drivers in the coming years, it is important to understand the factors leading to their involvement in vehicle crashes and develop counter-measures to reduce their frequency and severity. This is also useful for helping older adults "age in place" in terms of accessibility, mobility, quality of life and safety. Thus, the objective of this study was to provide up-to-date data on differences in age-related risks and rates for involvement in fatal intersection motor-vehicle crashes in the US.
Methods: Pooled data for the years 2011–2014 from the FARS, a census of fatal traffic crashes within the 50 States, the District of Columbia, and Puerto Rico, created by the US National Highway Traffic Safety Administration (NHTSA) were used to calculate summary statistics including annualized crash rates. Multivariate logistic regression models were used to evaluate age and gender-related differences in fatal intersection crash risk, controlling for covariates. An induced exposure analysis was conducted to calculate crash involvement ratios (CIRs) for all two-vehicle fatal intersection crashes. Older and younger drivers were compared with respect to the presence of factors related to intersection crashes using a multivariate Poisson regression model.
Results: During the period of 2011–2014, among the reported 120,809 fatal accidents in the US involving 178,489 drivers of vehicles, 48,733 (28%) were drivers involved in fatal intersection crashes. Age-adjusted annualized fatal intersection crash rates per 100,000 licensed drivers were highest for drivers aged 85 or older (9.89/100,000), followed by 20 years of age (8.93/100,000). Teen and older drivers (55+ years of age) were over-involved in fatal intersection crashes, drivers from 20 to 54 years old were under-involved. Male and female drivers, 70–74 years of age, were 20% and 21%, respectively, more likely to be involved in a fatal intersection crash than 20–24 year olds (of same gender). By age 85, fatal intersection crash risk for all drivers was almost doubled. Significant differences in factors related to crashes involving younger (<65) and older (65+ years) drivers were time of day, lighting and weather conditions, day of week, roadway type and number of lanes, presence of visible traffic controls, speed limit and estimated driving speed, and whether the driver was deemed at fault for the crash
Conclusion: The results provide the most up-to-date analysis of aging and fatal intersection crash risk in the US, and underscore several trends worthy of further investigation. Older adults face a number of challenges associated with natural aging, including sensory, perceptual, cognitive and motor declines that may impact their driving. As with younger drivers, expanded or renewed approaches to driver training at licensing renewals, as well as safety-based technological advances are viable avenues toward improving the safety outlook for older adults.

1. Introduction

Each year fatal crashes in the U.S. lead to an estimated societal burden of more than $230 billion from medical and other costs (NHTSA, 2010a,b). After six consecutive years of declining rates on U.S. highways, crash and fatality rates increased in 2012 (NHTSA,

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2013a,b), in which there were 33,561 people killed in roadway crashes, 3.3% higher compared with 32,479 in 2011. This increase was consistent across most crash characteristics – such as vehicle type, alcohol impairment, and location of the crash. Accordingly, there were an estimated 2.36 million people injured in motor vehicle traffic crashes (increase of 6.5% compared with 2.22 million in 2011) according to NHTSA's National Automotive Sampling System (NASS) General Estimates System (GES). Collectively, these numbers underscore the reality that, although we have made many gains in traffic safety, crash and fatality rates remain high.

Intersections are a particularly dangerous location for drivers, pedestrians and bicyclists. Intersection-related motor vehicle crashes accounted for 44.8% of all crashes and 21.5% of all fatal crashes in 2007 (Federal Highway Administration [FHWA], 2009). An earlier study (for the years 1994–1995) reported that the risk of a fatal crash for older drivers aged 65–69, compared with the risk for drivers aged 40–49 in the U.S. was 2.26 times higher for multiple-vehicle involvements at intersections and 1.29 times higher in all other situations (Preusser et al., 1998). These statistics demonstrate why intersection safety and understanding the mechanism of these crashes are priorities – and especially in considering differences across the life span. A study examining the characteristics of an estimated 787,236 motor vehicle intersection between 2005 and 2007, using data from the National Motor Vehicle Crash Causation Survey (NMVCCS), showed that 96% of intersection crashes had critical factors attributed to drivers, while in less than 3%, the factors were related to the vehicle or environment (NHTSA, 2010a,b).

While the proximities and conflicting trajectories of vehicles contribute greatly to the dangers associated with intersections, these are also areas that are often densely packed with critical driving-related (and often driving-unrelated) information that drivers must contend with. In short, intersections are complex features of the environment. Complexity can be influenced by the road geometry and lane configurations, presence and nature of traffic control devices, the volume of other road users and the density of other objects, buildings, advertisements, among many other elements. Drivers at intersections must therefore be attentive and vigilant with respect to traffic and other road users in their own and adjacent lanes as well as on cross roads, not to mention traffic control devices, signage and other road information. Various studies have examined the impact of intersections or driving scenes of varying complexity on drivers' visual scanning, decision-making and performance (e.g., Werneke and Vollrath, 2012; Edwards et al., 2003; Ho et al., 2001), all of which have some bearing on overall safety. The role of the complexity of intersections leading to increased crash risk is of particular concern among older adults (Braitman et al., 2007). Older adults tend to exhibit sensory, perceptual, cognitive and motor declines (e.g., Salthouse, 2004), all of which can impact their ability to deal with the complexities of intersections. Crash data corroborates some of these known deficiencies; older drivers have been identified as having a higher frequency of intersection crashes involving vehicles crossing paths prior to the collision, compared with their involvement in all crash types (Viano and Ridella, 1996). Moreover, in documenting critical driver errors involved in serious crashes in the NMVCSS, Cicchino and McCartt (2015) found that over 70% of older drivers' (aged 70 and over) surveillance errors involved attentional failures, such as looking but failing to see vehicles or traffic control devices.

After age 60, with a sharp increase after age 80, driver fragility and over-involvement in crashes is estimated to account for 34–45% of fatal crash risk (Li et al., 2003). The authors suggested that fragility is of "over-riding importance in explaining the increased fatality risk per unit of travel among older drivers" (p. 233), however excess crash involvement became a clear contributing factor among older drivers at ages 75–79.

There have been a number of studies that have utilized Fatality Analysis Reporting System (FARS) data that have reported important and actionable findings. Examples include studies of the effects of seating position, combined with restraint use and air bag status, on children's risk of dying in crashes (Braver et al., 1998; Berg et al., 1999), studies that examined the independent contribution of driver age and gender (Preusser et al., 1998; Stutts et al., 2009; Sifrit et al., 2011 and Tefft, 2012), and also studies examined crash and vehicle characteristics (Bedard et al., 2002; Li et al., 2003) that found significant differences by age and gender suggesting specific safety needs of older drivers and female drivers. However, much of the literature concerning older adults and intersection safety is based on older data and so is in need of updating in order to provide a more immediate picture of the state of driver safety at intersections. In this study, we sought to (1) provide an up-to-date analysis of age and gender differences in fatal intersection crash involvement rates in the US for the period of 2011–2014, and (2) identify which specific risk factors were associated with age-related risks in fatal intersection crashes. Given the aging of the U.S. population and the number of older drivers expected in the coming years, it is important to understand the factors leading to these crashes and to develop counter-measures to reduce their frequency and severity. Naturally, this effort is also relevant for helping older adults "age in place" in terms of accessibility, mobility, quality of life and safety.

2. Methods

2.1. Design and data sources

FARS data for all crash-related fatalities for the years 2011–2014 were downloaded from the National Highway Traffic Safety Administration (NHTSA) website (ftp://ftp.nhtsa.dot.gov/FARS). Individual FARS datasets were first merged by year and then pooled across all years. FARS has collected data based on a complete census of fatal traffic crashes within the 50 US states, the District of Columbia and Puerto Rico since 1975 (NHTSA, 2013a,b). To assure high quality and consistency of these data, NHTSA has a cooperative agreement with agencies in each state to provide comprehensive information on all qualifying fatal crashes in the state (managed by 10 regional offices). FARS data are obtained from police accident reports, death certificates, state vehicle registration files, coroner/medical examiner reports, state driver licensing files, hospital medical reports, state highway department data, emergency medical service reports, vital statistics and other state records. FARS state analysts are responsible for gathering, translating, and transferring data to the National Center for Statistics and Analysis (NCSA) in a standard format. The FARS data do not include personal identifying information (e.g., names, addresses, and social security numbers) and are made available to the public fully conforming to the Privacy Act. The current study was approved by the New England Independent Review Board (NEIRB).

2.2. Inclusion criteria

For the current analysis, inclusion criteria for a crash from FARS to be utilized include: (1) crash must have involved a motor vehicle traveling on a traffic way customarily open to the public, (2) must have resulted in the death of an occupant of a vehicle or a non-occupant within 30 days (720 h) of the crash, and (3) the vehicle involved was in transport and the driver was present at the time of the crash.

2.3. Data analysis

The annualized number of fatal intersection crashes during the period of 2011–2014 (per 100,000 licensed drivers) was