Accident Analysis and Prevention 80 (2015) 211–219

Contents lists available at ScienceDirect

Accident Analysis and Prevention

journal homepage: www.elsevier.com/locate/aap

Critical older driver errors in a national sample of serious U.S. crashes

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ARTICLE INFO

Article history:
Received 27 October 2014
Received in revised form 27 February 2015
Accepted 14 April 2015
Available online xxx

Keywords:
Older drivers
Crash investigation
Driver error
Intersection crashes
Gap acceptance
Inadequate surveillance
Gender differences

ABSTRACT

Objective: Older drivers are at increased risk of crash involvement per mile traveled. The purpose of this study was to examine older driver errors in serious crashes to determine which errors are most prevalent.
Methods: The National Highway Traffic Safety Administration's National Motor Vehicle Crash Causation Survey collected in-depth, on-scene data for a nationally representative sample of 5470 U.S. police-reported passenger vehicle crashes during 2005–2007 for which emergency medical services were dispatched. There were 620 crashes involving 647 drivers aged 70 and older, representing 250,504 crash-involved older drivers. The proportion of various critical errors made by drivers aged 70 and older were compared with those made by drivers aged 35–54.
Results: Driver error was the critical reason for 97% of crashes involving older drivers. Among older drivers who made critical errors, the most common were inadequate surveillance (33%) and misjudgment of the length of a gap between vehicles or of another vehicle's speed, illegal maneuvers, medical events, and daydreaming (6% each). Inadequate surveillance (33% vs. 22%) and gap or speed misjudgment errors (6% vs. 3%) were more prevalent among older drivers than middle-aged drivers. Seventy-one percent of older drivers' inadequate surveillance errors were due to looking and not seeing another vehicle or failing to see a traffic control rather than failing to look, compared with 40% of inadequate surveillance errors among middle-aged drivers. About two-thirds (66%) of older drivers' inadequate surveillance errors and 77% of their gap or speed misjudgment errors were made when turning left at intersections. When older drivers traveled off the edge of the road or traveled over the lane line, this was most commonly due to non-performance errors such as medical events (51% and 44%, respectively), whereas middle-aged drivers were involved in these crash types for other reasons. Gap or speed misjudgment errors and inadequate surveillance errors were significantly more prevalent among female older drivers than among female middle-aged drivers, but the prevalence of these errors did not differ significantly between older and middle-aged male drivers. These errors comprised 51% of errors among older female drivers but only 31% among older male drivers.
Conclusions: Efforts to reduce older driver crash involvements should focus on diminishing the likelihood of the most common driver errors. Countermeasures that simplify or remove the need to make left turns across traffic such as roundabouts, protected left turn signals, and diverging diamond intersection designs could decrease the frequency of inadequate surveillance and gap or speed misjudgment errors. In the future, vehicle-to-vehicle and vehicle-to-infrastructure communications may also help protect older drivers from these errors.

1. Introduction

Progress has been made in reducing crash involvement rates for drivers 70 and older since the mid-1990s (Cicchino and McCartt, 2014). Nevertheless, insurance claim rates begin to rise at age 65 (Highway Loss Data Institute, 2014), and police-reported crash risk per mile traveled begins to increase at age 70 (Cicchino and McCartt, 2014). The number of adults aged 70 and older in the United States is expected to increase considerably, from 10% of the population in 2013 to 15% in 2030 (U.S. Census Bureau, 2014a,b), leading to continued interest in reducing crashes among older drivers.

To develop effective countermeasures to reduce crashes among older drivers, it is essential to understand the types of crashes in which they are involved and the circumstances that lead to their crashes. It is well-established that older drivers are over-involved in angle, overtaking, merging, and intersection crashes in particular, especially those where the older driver was turning

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http://dx.doi.org/10.1016/j.aap.2015.04.015
0001-4575/

left (Mayhew et al., 2006). Age-related cognitive, visual, and physical impairments can affect the ability to perform driving tasks and navigate the kinds of complex roadway situations where older drivers' crashes often occur (Anstey et al., 2005).

Evidence from experimental studies give insight into the types of errors older drivers make that can potentially lead to crashes. When briefly viewing photos of traffic scenes, drivers aged 65 and older were more likely than younger drivers to judge that it was safe to continue through an intersection after a hazard entered the scene that made proceeding unsafe (Caird et al., 2005). Among drivers 65 and older, reaction time to traffic hazards presented in a video increased with age and with declines in cognitive and perceptual abilities (Horswill et al., 2008). In simulator studies, older drivers turning left decreased the size of the gap in traffic they would accept as vehicle speeds increase more than younger drivers, suggesting that older drivers attend more to another vehicle's distance than to its speed when making gap acceptance decisions (Staplin, 1995; Yan et al., 2007).

Much of what is known about the errors that older drivers do make in crashes comes from examinations of police reports generated after a crash. In a review of traffic violations attributed to drivers aged 65 and older involved in daytime crashes in Florida during 2005, researchers determined that crashes were most often due to failure to yield (Classen et al., 2010). Clarke et al. (2010) studied intersection crashes involving drivers 60 and older that were reported to three midland police forces in the United Kingdom during 1994–2007. In these crashes, the most frequent error leading to crashes was visual search problems, followed by poor judgment of another vehicle's approach speed. Compared with crash-involved younger drivers, contributing factors to older drivers' crash involvements more often include failing to yield the right-of-way (Brar and Rickard, 2013; Finison and Dubrow, 2002; Griffin, 2004; Stutts et al., 2009), disobeying traffic controls (Baldock et al., 2002; Brar and Rickard, 2013; Griffin, 2004), inattention (Finison and Dubrow, 2002; Stutts et al., 2009), or impairment by illness (Griffin, 2004).

A few studies have used additional data sources to examine the errors of crash-involved older drivers with greater specificity. Oxley et al. (2006) studied police crash reports and investigated sites of crashes involving drivers aged 65 and older that occurred at high-crash intersections in four jurisdictions in Australia and New Zealand. Inappropriate gap selection and high task complexity were contributing factors in the majority of crashes. Hakamies-Blomqvist (1993) conducted on-scene investigations of at-fault fatal crashes in Finland during 1984–1989 and determined that crashes of drivers aged 65 and older were more often caused by observation errors, defined as inattention or faulty perception, compared with crashes of drivers aged 26–40. Braitman et al. (2007) interviewed at-fault drivers aged 70 and older and aged 35–54 involved in intersection crashes in Connecticut in addition to examining police crash reports and photographs of the intersections. In failure-to-yield crashes, older drivers most often made search and detection errors, defined as errors leading to a failure to detect other vehicles or traffic control devices, or evaluation errors, defined as misjudgment of another vehicle's speed, intention, or direction, or failure to interpret an intersection's design.

The type of information available in crash reports and the consistency with which it is collected can be limited. Although Braitman et al. (2007),Hakamies-Blomqvist (1993), and Oxley et al. (2006) used richer information sources to examine driver error, their studies also have important limitations. Namely, Braitman et al. (2007) and Oxley et al. (2006) were limited in geographic scope, a weakness shared with other studies of U.S. state crash data, and their focus was restricted to intersection crashes. The investigation by Hakamies-Blomqvist (1993) focused on fatal crash involvements, which precluded interviewing many of the crash-involved drivers and provided information on only the most severe crashes.

In the National Motor Vehicle Crash Causation Survey (NMVCCS) conducted by the National Highway Traffic Safety Administration (NHTSA), a sample of U.S. crashes requiring emergency medical response were examined in-depth by investigators, who collected a variety of on-scene and other information. The current study examined errors in the NMVCCS database made by drivers 70 and older, the age at which police-reported crash risk per mile traveled begins to rise (Cicchino and McCartt, 2014), and compared them with those of middle-aged drivers aged 35–54. This study also examined how errors varied by crash type. Because of the variety of information collected by the NMVCCS, the standardized fashion in which it was collected, and the nationally representative sample, the NMVCCS overcomes some key limitations of prior studies examining older driver errors. Given that older women are more likely to be involved in intersection and left-turn crashes than older men (Chandraratna and Stamatiadis, 2003; Finison and Dubrow, 2002; Griffin, 2004; Stamatiadis, 1996), gender differences were additionally investigated.

2. Methods

2.1. NMVCCS database

The NMVCCS is a nationally representative sample of U.S. police-reported crashes on public roads involving at least one passenger vehicle towed from the scene, occurring between 6 a.m. and midnight, and for which emergency medical services were dispatched (NHTSA, 2008a). A total of 5470 crashes were investigated during July 2005–December 2007 in 24 primary sampling units representing combinations of geographic regions (Northeast, Midwest, South, or West) and extents of urbanization (central city, large county, or group of contiguous counties). The data were weighted by NHTSA using a comprehensive two-stage procedure that incorporated design weights and adjustments to make the NMVCCS sample representative of the more than 2 million crashes meeting the study criteria that occurred nationally during the study period. Further details on the sampling design and case weighting procedures is available in Choi et al. (2008). More than three-quarters (78%) of the weighted crashes involved injuries, including 18% that involved incapacitating injuries and 2% that involved fatalities.

Two trained investigators were assigned to each primary sampling unit, and each investigator responded to a maximum of two crashes per week. Investigators arrived on-scene at the crash and documented characteristics of the crash scene, photographed the crash scene and vehicles, and interviewed drivers, passengers, witnesses, and police and other first responders. Data were collected on more than 600 factors regarding drivers, vehicles, the roadway, and the environment. Complete datasets were generated for the first three vehicles involved in the collision, which were designated as case vehicles. To qualify for the study, one of the case vehicles must have been present when the investigator arrived at the crash scene, and a complete police crash report must have been available. Information from the crash investigation, the police crash report, and medical records from post-crash treatment when available were considered in the investigator's reconstruction of the crash circumstances. NHTSA (2008b) describes the protocol used in the field to document crashes, including detailed descriptions of all data elements collected.

Using a method originally proposed by Perchonok (1972), the chain of events that preceded each case vehicle's involvement in the crash was reconstructed. An important element in this chain was the critical reason, defined as the immediate reason for the