Intersection Crashes Among Drivers in Their 60s, 70s, and 80s

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Analyses of National Highway Traffic Safety Administration's Fatality Analysis Reporting System (FARS) and National Automotive Sampling System (NASS)/General Estimates System (GES) data from 2002 – 2006 revealed specific performance errors and combinations of driver, vehicle, and roadway/environmental characteristics associated with older drivers' crashes at intersections. For subsets of the two-vehicle crash data within each national database, crash involvement ratios based on comparisons of at-fault to not-at-fault drivers within groups of drivers age <20 to 80+, segregated in 10-year cohorts, provide exposure-adjusted estimates of the magnitude of particular risk factors. While FARS and GES data show elevated crash risk for older drivers, the effect was more pronounced in the FARS data. This exaggeration likely reflects increased frailty with increasing age; young and middle-aged drivers may have survived crashes that were fatal to the oldest drivers. While the data are consistent with the literature in that more complex driving tasks pose the most risk for older drivers, these data also provide information about the scale of the increased risk.

BACKGROUND

Older Driver Risk

Older adults are generally capable, conscientious drivers, but some have experienced changes associated with normal aging, with medical conditions common in older adults, or medications to address those medical conditions that undermine their ability to drive safely. Thus, these drivers may pose a hazard to themselves and to other road users.

Studies have compared characteristics of older driver crashes to those of younger or middle-aged drivers. Braitman, Kirley, Ferguson, and Chaudhary (2007) reported differences in crash characteristics between two groups of older drivers. In failure-to-yield crashes, drivers ages 70-79 tended to make gap acceptance errors; drivers 80 and older were more likely to have been unaware of an oncoming vehicle.

Researchers have highlighted a number of older driver difficulties related to specific traffic maneuvers and roadway conditions. Staplin and Lyles (1991) analyzed 1986-1988 Michigan crash data to examine older drivers' errors when merging and changing lanes on limited-access highways, turning left against traffic, making gap-acceptance maneuvers when crossing traffic, and overtaking on two-lane roadways. The authors used induced exposure analyses to identify older drivers' errors that were associated with at-fault crashes.

Reinfurt, Stewart, Stutts, and Rodgman (2000) conducted induced exposure analyses of Fatality Analysis Reporting System (FARS) and National Automotive Sampling System (NASS)/General Estimates System (GES) data for North Carolina to identify situations associated with increased rates of at-fault crashes among older drivers. The study included two-vehicle crashes in which investigating officers cited one and only one driver as having contributed to the crash. The results showed increased driver age to be associated with higher rates of crashes involving left turns, particularly at intersections controlled by stop signs or yield signs as opposed to traffic signals.

Garber and Srinivasan (1991) conducted induced exposure analyses on Virginia intersection crash data. They reported that these older drivers were at elevated risk for intersection crashes in both urban and rural areas. Results from this study indicated that older drivers' risk was elevated for angle, sideswipe, and head-on crashes.

Stutts, Martell, and Staplin (2009) extend previous findings by analyzing characteristics of the driver, vehicle, roadway, and environment associated with increased crash involvement by older drivers using five years of FARS (fatal crashes) and GES (a representative sample of police reported crashes) data (2002 through 2006).

Researchers analyzed the data using two different approaches. The report provides descriptive analyses of single-vehicle and two-vehicle crashes that flagged situations in which older drivers were overrepresented compared to middle-aged drivers. Induced exposure analyses examined the two-vehicle crashes in the databases to compare the ratios of at-fault to not-at-fault drivers within age groups. With these analyses, each group functioned as its own control, thus reducing the influence of differences in driving exposure across age groups with respect to a particular factor such as driving at night or on Interstate highways.

Age related changes that undermine driving safety occur gradually. Many studies have included all drivers over a given age, generally 60 or 65, in a single older driver group. However, analyzing data for all older drivers in this way may not reveal situations that are risky for only the oldest drivers. Therefore, in the current study, older drivers were divided into three age groups: 60-69, 70-79, and 80 and older. The remainder of this document is based on the Stutts, Martell, and Staplin (2009) study.

METHODS

Development of Data Files

The 2002-2006 FARS and GES crash data were analyzed to identify factors associated with older driver crashes. FARS is a census database of all traffic crashes involving one or more fatalities occurring in the 50 U.S. States, the District of Columbia, and Puerto Rico. During the years covered in this study, approximately 38,000 fatal crashes were reported annually. In contrast, the GES database is derived from a stratified sample of approximately 50,000 police-reported crashes of all severity levels (including property damage only), that is then weighted to reflect national estimates.

Analyses were restricted to single-vehicle and two-vehicle crashes that involved vehicles most commonly driven by older adults: passenger cars, sport utility vehicles, light vans, pickups, and other light trucks. Two-vehicle crashes included in the induced exposure analyses were those in which both vehicles were one of these body types and only one of the drivers had a contributing factor or moving violation (see Reinfurt et al., 2000). Violations not related to driver performance (e.g., driving with a suspended or revoked license) were not considered in determining fault. This approach allowed researchers to identify fault in 88.5% of the two-vehicle crashes involving eligible vehicle types in the FARS data and 52% of those in the GES data.

The FARS data analyses included 109,937 crashes (72,847 single-vehicle plus 37,090 two-vehicle, where one vehicle was identified at fault). The GES data analyses were based on a raw number of 181,698 crashes (69,689 single-vehicle and 112,009 two-vehicle, without regard to fault), which translated into 23.5 million weighted crashes (see Table 1).

Table 1. Eligible single- and two-vehicle crashes for 2002–2006 FARS and GES study files

Crash Type and Fault Status	FARS	GES	
		Unweighted	Weighted
Single-vehicle	72,847	69,689	7,860,000
Two-vehicle, only one driver at-fault	37,090	62,090	8,112,000
Two-vehicle, neither driver at fault	1,624	45,062	6,975,000
Two-vehicle, both drivers at fault	3,195	4,857	567,000
Two-vehicle, without regard to fault	41,909	112,009	15,654,000

Data Analysis

Descriptive Data. Separate analyses were conducted on the single-vehicle and two-vehicle crashes. Crosstabulations identified vehicle maneuvers, crash types, or situations in which older drivers were over-represented compared to other age groups. Data for older drivers were analyzed in age groups of 60-69, 70-79, and 80 and older. Analyses focused on characteristics of the driver, the vehicle, roadway/environment, and the crash. These analyses identified scenarios that comprised a substantial proportion of older driver crashes. These are situations where countermeasures could be most effective.

Induced Exposure Data. Induced exposure analyses conducted on crashes that fit the criteria described above compared at-fault versus not-at-fault crash involvement ratios (CIRs) across driver age categories. This approach controlled for different exposure levels across age groups.

The induced exposure analyses included eight categories of driver age: <20, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79, and 80+. Table 2 shows the layout for the induced exposure analyses for a specific crash characteristic. The right-hand column contains the total number of at-fault drivers for each age group (D1). The bottom row contains the total number of not-at-fault drivers for each age group (D2). Thus, cell D1a is the number of drivers under age 20 found to be at fault in a specific situation; cell D2a is the number of drivers under age 20 who were not at fault. The CIR for each factor was calculated by dividing D1a by D2a.

Table 2. Induced exposure table for a specified two-vehicle crash situation

Driver 1 Age (at fault)	Driver 2 Age (not-at-fault)								
	<20	20-29	30-39	40-49	50-59	60-69	70-79	80+	Total
<20									D1$_a$
20-29									D1$_b$
30-39									D1$_c$
40-49									D1$_d$
50-59									D1$_e$
60-69									D1$_f$
70-79									D1$_g$
80+									D1$_h$
Total	D2$_a$	D2$_b$	D2$_c$	D2$_d$	D2$_e$	D2$_f$	D2$_g$	D2$_h$	Total

The CIRs indicate the ratio of at-fault to not-at-fault drivers for each age group. A CIR value below 1.0 indicates that a particular driver group was *underrepresented* in at-fault crashes involving a designated geometric, operational, or environmental factor; the more the CIR value exceeds 1.0, the more strongly the group is *overrepresented* in that crash type.

RESULTS

Descriptive Analyses.

Older drivers were overrepresented in a variety of types of crashes consistent with findings from previous studies. The patterns of overrepresentation were generally similar in the FARS and GES data. Drivers 70 and older, and particularly those 80 and older, were overrepresented in intersection crashes. Intersections controlled by stop signs, and to a lesser extent, traffic signals, posed particular hazards for drivers 70 and older. The GES data provided evidence that older drivers experienced severe injuries and fatalities at higher rates than other age groups.

Table 3 provides data to allow comparison of the proportions of drivers in the three oldest groups with those for all drivers. The values in each column are the percentages of drivers in crashes for each age group. Not all levels of variables are presented; only those levels considered most relevant to this paper were included. Thus, the columns totals are typically less than 100%.

The ratio of males' to females' fatal crashes among older drivers was similar to that for all drivers; however, the groups' rates were different under some conditions. Drivers 70 and older were underrepresented in non-intersection crashes, and overrepresented in those at or near intersections. The elevation in risk for the oldest drivers was particularly evident at intersections controlled by stop signs.

Table 3. FARS descriptive results – driver and roadway characteristics.

Driver Characteristics	FARS Two-Vehicle Crashes			
	60-69	70-79	80+	All ages
Gender				
Male	64.70	62.58	65.08	65.97
Female	35.30	37.42	34.92	33.70
Relation to intersection				
Non-intersection	52.49	39.32	27.17	53.73
Intersection	41.25	51.82	62.21	40.08
Traffic Control				
Signal	12.26	15.00	16.52	12.67
Stop sign	22.68	28.82	35.88	21.27

Table 4 shows a similar pattern for police reported crashes. Crash ratios for males and females 60 and older were similar to those for all age groups, and the older groups were overrepresented in crashes at intersections, particularly those controlled by stop signs. Older drivers' crash rates at signal-controlled intersections were similar to those for all drivers.

Table 4. GES descriptive results – driver and roadway characteristics.

Driver Characteristics	GES Two-Vehicle Crashes			
	60-69	70-79	80+	All ages
Gender				
Male	57.51	56.50	56.31	54.57
Female	42.49	43.50	43.69	45.43
Relation to intersection				
Non-intersection	22.71	19.34	15.36	25.96
Intersection	34.59	40.51	45.19	32.24
Traffic Control				
Signal	31.04	30.44	28.55	29.38
Stop sign	16.68	19.53	22.26	15.86

Induced Exposure Analyses.

As Figure 1 illustrates, FARS data CIRs for all two-vehicle fatal crashes create a "J" curve: the oldest drivers' CIRs (ratio of at-fault to not-at-fault crashes) were much higher than those of drivers younger than 20. GES data produce a "U" curve, with the youngest and oldest drivers' CIRs similar, and elevated above those of middle-aged drivers. The pattern was similar for men and women. Note that collapsing across the the three oldest groups would likely result in underrepresenting the risk for the oldest drivers and overresenting that for drivers ages 60-69.

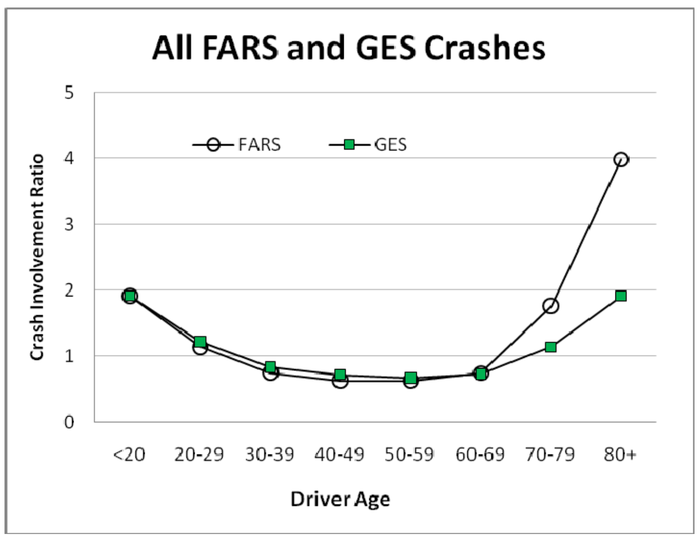

Figure 1. CIRs for all FARS and GES two-vehicle crashes by driver age.

Intersection crashes. Performance differences among the three oldest groups of drivers are particularly evident when examining CIRs for all two-vehicle fatal crashes at intersections (Figure 2). While at-fault CIRs in fatal crashes (dotted line) were near even (CIR = 1.0) for 60- to 69-year-old drivers, the ratios increased substantially for drivers in their 70s (CIR = 2.4). Drivers 80 and older demonstrated a fivefold increase in CIR over that of the 60-69 group (CIR = 5.4).

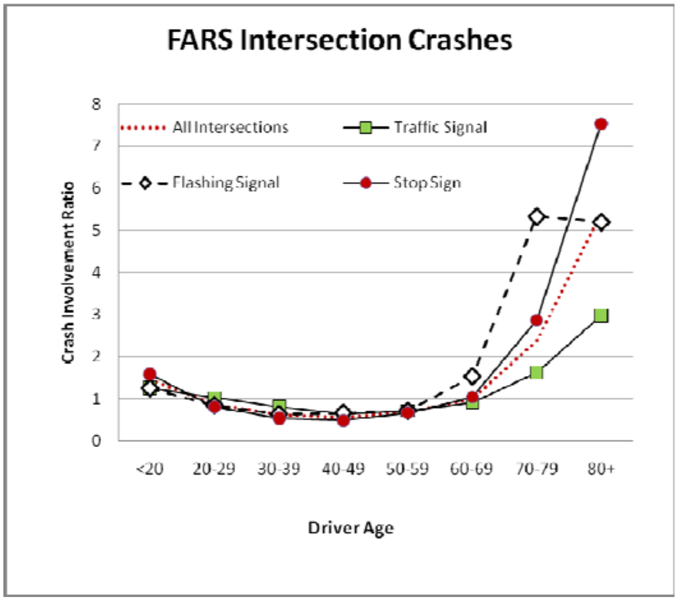

Figure 2. CIRs for FARS two-vehicle intersection crashes by traffic control device and driver age. Note change in scale from Figure 1.

The findings for intersections with different traffic control types further demonstrates the importance of considering data for the 60-69, 70-79 and 80+ age groups separately. As Figure 2 illustrates, drivers 60 and older were less likely to be deemed at-fault in crashes at intersections controlled by traffic signals than at other intersections. The benefit of traffic signals was barely discernable for the 60-69 group (CIR = 0.9) and somewhat modest for the 70-79 (CIR = 1.6) group. However, signals proved a substantial benefit for the oldest group of drivers (CIR = 3.0). Conversely, the 60-69 group demonstrated little difficulty in navigating intersections controlled by stop signs (CIR = 1.0), while the at-fault crash rates increased markedly for the 70-79 and 80+ groups (CIRs = 2.9 and 7.5, respectively). At-fault crash rates were elevated for all older drivers at intersections controlled by flashing signals.

The analyses of GES data, which represent police-reported crashes, show smaller differences among the three oldest driver groups (Figure 3). FARS and GES analyses demonstrated similar CIRs for drivers younger than 70; however, those for the 70-79 group showed a sharper increase in the FARS than the GES data. This effect was exaggerated for drivers 80 and older.

Vehicle maneuvers. Figure 4 provides additional insight into older drivers' risks as they navigate intersections. The fatal crash data show older drivers' risk of at-fault crashes when turning left at signal controlled intersections began to rise beginning around age 50; CIRs increased sharply with increasing age.

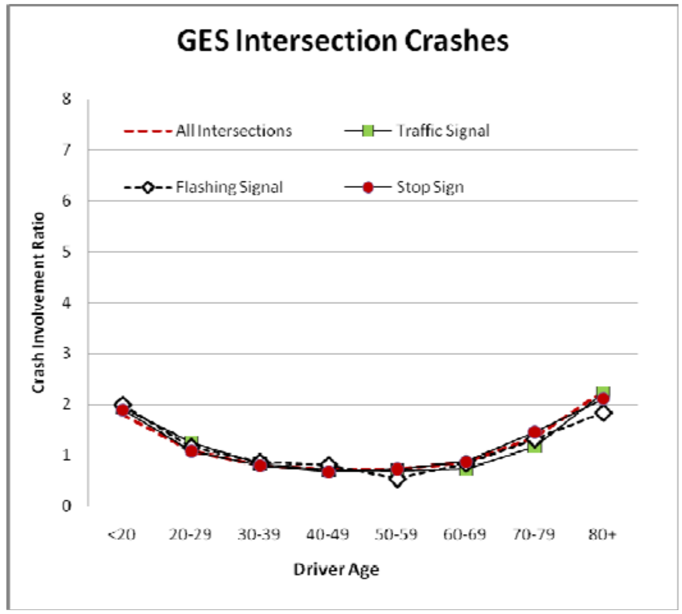

Figure 3. CIRs for GES two-vehicle intersection crashes by traffic control device and driver age.

CIRs for drivers younger than 70 were minimally elevated at intersections controlled by stop signs. However, these intersections were more problematic than were those controlled by traffic signals for the oldest group (Figure 4). While previous research has reported that left turns pose hazards for older drivers, these analyses provide information about the magnitude of that risk. Figure 4 reveals the extent to which traffic signals were associated with reduced risk for the oldest drivers going straight through intersections.

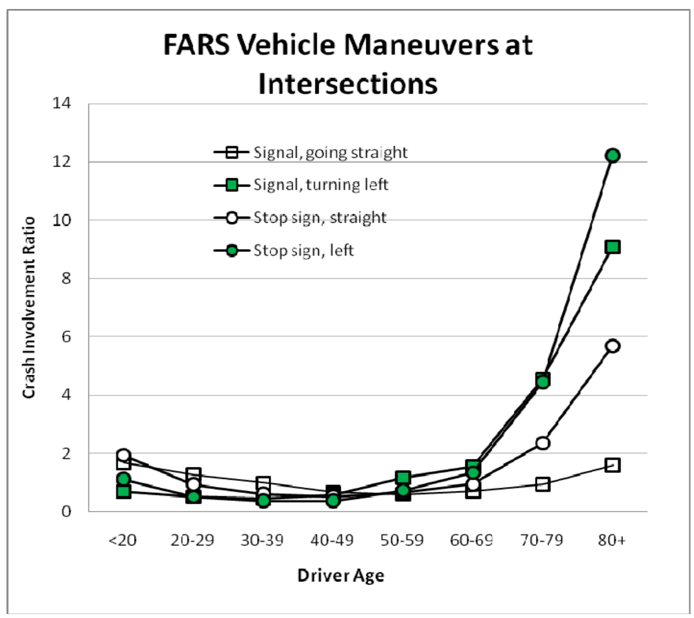

Figure 4. CIRs for fatal two-vehicle crashes at intersections by vehicle maneuver and driver age. Note change in scale from Figure 3.

Police-reported crash data show a flatter, U curve (see Figure 5); however, navigating left turns still posed an increased risk for drivers 70 and older.

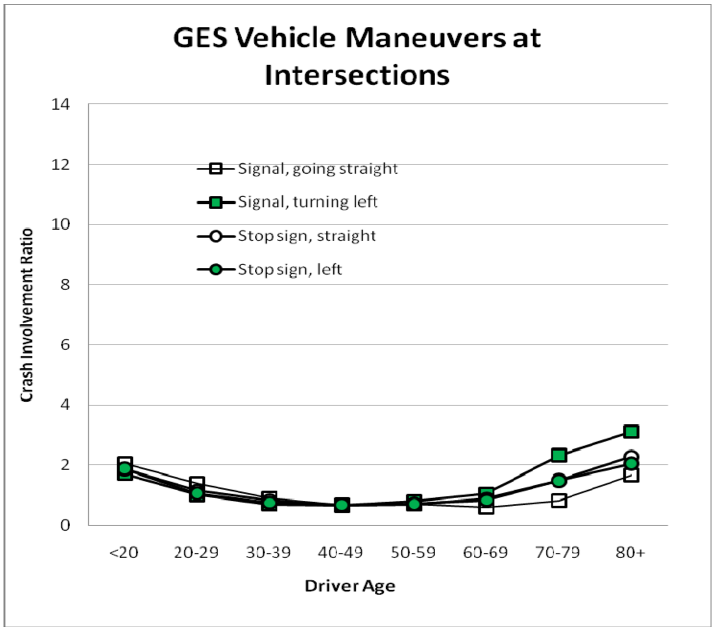

Figure 5. CIRs for police-reported two-vehicle crashes at intersections controlled by stop signs by vehicle maneuver and driver age.

DISCUSSION

Analyses of the FARS and GES databases illustrated the crash experiences of older drivers in the United States. The analyses highlighted differences in over- and under-involvement of drivers ages 60-69, 70-79, and 80 and older in various crash types defined by specific maneuvers, traffic situations, and roadway and environmental conditions. This information will be useful in guiding development of countermeasures to enhance the safety of these drivers.

CIRs based on the comparison of at-fault to not-at-fault drivers within specific groups to drivers of all age groups provide additional, exposure-adjusted estimates of the magnitude of risk factors. Dividing findings for older drivers into subgroups of ages 60-69, 70-79 and 80and older quantify the extent to which specific elements increase or reduce risk for each of these groups of older drivers. Differences among these groups highlight the limitations of analyses that group data for all older drivers. Combining data for drivers in their 60s with those a decade or more older can be expected to mask age-related differences in driving performance. This level of detail will allow driving recommendations to be tailored to address the limitations of each age group.

CIRs calculated from FARS data were markedly higher than those generated from GES data, particularly for the oldest groups. This is likely due to the added contribution of frailty to risk due to age-related changes in the functional abilities needed to drive safely.

The results of these national crash data analyses will be useful in developing and selecting screening and assessment tools and in developing countermeasures to improve safety and maintaining mobility for the fastest growing segment of the driving population.

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