ORIGINAL ARTICLE

Older driver involvements in police reported crashes and fatal crashes: trends and projections

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Objectives: Older drivers have become a larger part of the driving population and will continue to do so as the baby boomers reach retirement age. The purpose of this study was to identify the potential effects of this population increase on highway safety.
Methods: Driver involvement rates for all police reported crashes were calculated per capita, per licensed driver, and per vehicle-mile of travel for 1990 and 1995. Also, driver involvement rates for fatal crashes were calculated for 1983, 1990, and 1995. Based on current crash rates per licensed driver and estimates of the future number of licensed drivers, projections of crashes involving drivers aged 65 and older were made for years 2010, 2020, and 2030.
Results: Driver crash involvement rates per capita decreased with age, but fatal involvement rates per capita increased starting at age 70. The same pattern existed for involvement rates per licensed driver. For both all crashes and fatal crashes, involvement rates per mile driven increased appreciably at age 70. Using projections of population growth, it was estimated that for all ages there will be a 34% increase in the number of drivers involved in police reported crashes and a 39% increase in the number involved in fatal crashes between 1999 and 2030. In contrast, among older drivers, police reported crash involvements are expected to increase by 178% and fatal involvements may increase by 155% by 2030. Drivers aged 65 and older will account for more than half of the total increase in fatal crashes and about 40% of the expected increase in all crash involvements; they are expected to account for as much as 25% of total driver fatalities in 2030, compared with 14% presently.
Conclusions: By most measures, older drivers are at less risk of being involved in police reported crashes but at higher risk of being in fatal crashes. Although any projections of future crash counts have inherent uncertainty, there is strong evidence that older drivers will make up a substantially larger proportion of drivers involved in fatal crashes by 2030 because of future increases in the proportion of the population aged 65 and older, and trends toward increased licensure rates and higher annual mileage among older persons. Countermeasures to reduce the anticipated death toll among older drivers should address the increased susceptibility to injury of older vehicle occupants in crashes.

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As more of the US population reaches ages 65 and older, public concern grows about the potential effect on traffic safety. As people age, they tend to have deteriorating visual, cognitive, and perceptual functions that could lead to an increase in crash risk.[1–4] Nevertheless, the crash rates for older drivers are lower per capita than for drivers of other ages because older drivers are less often licensed and drive fewer miles.[5] Many older drivers report limiting their driving, especially to avoid challenging driving situations such as peak travel times and night-time driving.[2 6] Despite this self regulation, older drivers, particularly those older than 75, are at increased risk of crash involvement per mile driven.[7 8] In addition, age related physiological changes increase the likelihood that when older drivers are involved in crashes, they will die from their injuries.[9 10] A recent study estimated that relative to drivers aged 30–59, drivers aged 70–74 were twice as likely to die when involved in a crash.[7] Among drivers aged 80 and older, the risk of death per crash was about five times as high.

People born in the early 1900s reached driving age during the early years of American motorization. Subsequent generations have more lifetime driving experience than previous generations. Li *et al* found that fatality risk among older drivers has declined for each subsequent generation[11]; in contrast, an upward trend was observed among adolescents and young adults. The decline in fatality risk among older drivers is thought to result from a complex mixture of behavioral and environmental factors. With more older people now licensed to drive and driving more miles than in the past, it is unclear if this trend will continue.

Williams and Carsten examined crash rates among older drivers (aged 65 and older) and projected that although many more older drivers would be involved in fatal crashes in 2010 and 2030,[12] they still would represent a relatively small part of the overall crash problem. The present study examined trends in crash involvement and death as a function of age and provided estimates, based on more recent data, of the future contribution of older drivers to the overall motor vehicle crash problem.

METHODS

This study included only passenger vehicle drivers. For the remainder of this paper, the term "driver" refers to passenger vehicle drivers.

Fatal crashes were identified using the Fatality Analysis Reporting System (FARS) for 1983, 1990, and 1995, the most recent years for which travel data were available from the Nationwide Personal Transportation Survey (NPTS). FARS is a census of police reported fatal crashes that occur on public roads in the United States in which a death results within 30 days of the crash.[13] Police reported crashes were identified for years 1990 and 1995 using the General Estimates System

Abbreviations: FARS, Fatality Analysis Reporting System; FHWA, Federal Highway Administration; GES, General Estimates System; NPTS, Nationwide Personal Transportation Survey; VMT, vehicle-miles of travel

Table 1 Population, licensed drivers, VMT, police reported crash involvements,* and fatal crash involvements,† 1995

					All police reported crashes				Fatal crashes			
Age	Population	Licensed drivers	VMT (in millions)	Average VMT per driver	Driver involvements	Per 100000 population	Per 100000 licensed drivers	Per 100 million VMT	Driver involvements	Per 100000 population	Per 100000 licensed drivers	Per 100 million VMT
16–19	14401118	9065465	60308	6652	1467682	10191	16190	2434	6012	42	66	10.0
20–24	17982219	15525445	161412	10397	1545517	8595	9955	957	7007	39	45	4.3
25–29	18904773	18056837	245538	13598	1369734	7245	7586	558	5701	30	32	2.3
30–34	21825415	20283723	313414	15452	1297425	5945	6396	414	5344	24	26	1.7
35–39	22295957	20659060	299735	14509	1209143	5423	5853	403	4842	22	23	1.6
40–44	20259474	18977987	259565	13677	1012016	4995	5333	390	3828	19	20	1.5
45–49	17457759	16871673	230138	13640	826171	4732	4897	359	3164	18	19	1.4
50–54	13641557	12891029	160281	12434	571357	4188	4432	356	2270	17	18	1.4
55–59	11085969	10225511	103545	10126	392032	3536	3834	379	1757	16	17	1.7
60–64	10046058	8958261	86632	9671	328293	3268	3665	379	1617	16	18	1.9
65–69	9925554	8482889	71570	8437	284339	2865	3352	397	1531	15	18	2.1
70–74	8830909	7284698	49409	6783	253074	2866	3474	512	1573	18	22	3.2
75–79	6700096	5043077	25319	5021	187828	2803	3724	742	1344	20	27	5.3
80+	8162692	4244169	10956	2581	160573	1967	3783	1466	1587	19	37	14.5
16–64	167900299	151514991	1920568	12676	10019370	6613	6613	522	41542	25	27	2.2
65+	33619311	25054833	157254	6276	885814	2635	3536	563	6035	18	24	3.8

*General Estimates System; †Fatality Analysis Reporting System.

(GES). GES is a national probability sample of police reported crashes.[14] The National Highway Traffic Safety Administration administers both FARS and GES.

Estimates of annual miles driven by age group, starting at ages 16–19, were obtained from NPTS for 1983, 1990, and 1995. NPTS is a survey of households and is representative of the total non-institutionalized civilian population in the United States.[5] NPTS has two ways of estimating annual vehicle-miles of travel (VMT): asking drivers directly how much they drive each year and extrapolating mileage data from individual preassigned travel days. Because methods of collecting data for preassigned travel days changed between the 1990 and 1995 surveys, VMT data for this study of trends were derived from drivers' estimates of their annual VMT.

Population estimates for 1983, 1990, and 1995 were obtained from the US Census Bureau.[15] Licensure estimates for these years were obtained from the Federal Highway Administration (FHWA).[16–18]

Driver involvement rates for all police reported crashes were calculated for 1990 and 1995 using driver crash involvements from GES, population estimates from the US Census Bureau, licensure estimates from FHWA, and VMT from NPTS. Driver involvement rates for fatal crashes were computed for 1983, 1990, and 1995. Driver involvement rates for police reported crashes in 1983 were not calculated because GES was not available before 1988. SAS system 8.1 was used for computations.

The percentage of deaths from all causes that are represented by driver deaths was calculated for older drivers. Deaths from all causes were obtained from the Centers for Disease Control and Prevention.[19]

Licensure rates for older drivers were predicted for years 2010, 2020, and 2030. A generalized linear model was used to estimate these rates by fitting historical trend lines. Licensure rates for drivers aged 65 and older were estimated by predicting the percentage of the 1995 population aged 30 and older, 40 and older, and 50 and older that would still be driving in 2010, 2020, and 2030 using the trend lines derived from the model. Licensure rates for drivers younger than 30 were assumed to remain unchanged during 2010–30 and were estimated using average licensure rates for each age group for the 10 year period 1990–99. These rates were multiplied by the expected US population for 2010, 2020, and 2030 using middle range population estimate projections from the US Census Bureau.[20]

To predict the expected number of crash involvements, the average annual police reported crash and fatal crash rates per licensed driver were calculated using data from 1990–99. These rates, which remained relatively steady during the 10 year period, then were multiplied by the expected licensed population in 2010, 2020, and 2030. An increase in annual VMT among older drivers was not considered in the model because reliable projections of VMT were not available. The model is reasonable, notwithstanding any future increase in average annual mileage per driver, because crash rates per licensed older driver remained constant over time even as miles driven by older drivers increased.

RESULTS

In 1995, the latest year for which NPTS mileage estimates were available, the elderly (aged 65 and older) represented 17% of the US driving age population and 14% of licensed drivers (table 1). However, they accounted for just 8% of the annual miles driven. Older drivers accounted for 8% of drivers involved in police reported crashes but 13% of drivers in fatal crashes.

Although licensure among younger people has remained relatively constant, about 90%–95%, licensure has increased steadily among the elderly as more people are driving at older ages. In 1983, 63% of people aged 65 and older were licensed

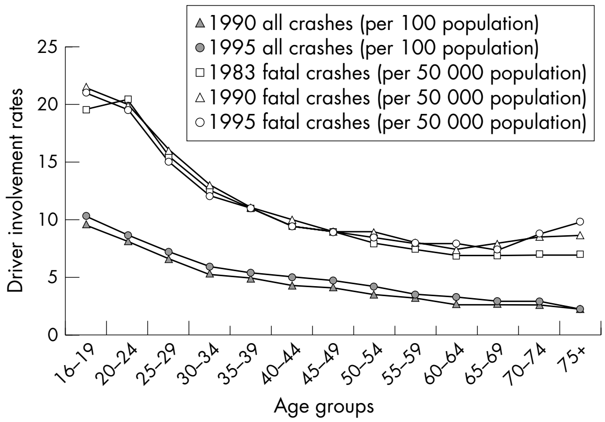

Figure 1 Driver involvement rates for all police reported crashes (General Estimates System) per 100 population (US Census Bureau) for 1990 and 1995 and for fatal crashes (Fatality Analysis Reporting System) per 50 000 population for 1983, 1990, and 1995 by age group.

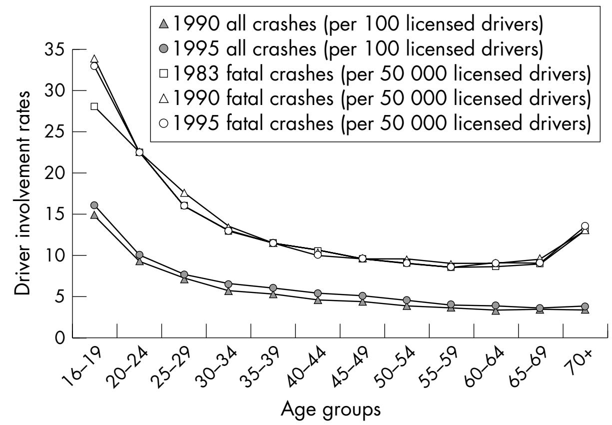

Figure 2 Driver involvement rates for all police reported crashes (General Estimates System) per 100 licensed drivers (Federal Highway Administration) for 1990 and 1995 and for fatal crashes (Fatality Analysis Reporting System) per 50 000 licensed drivers for 1983, 1990, and 1995 by age group.

to drive, compared with 75% in 1995. Among those aged 70 and older, licensure increased from 56% in 1983 to 70% in 1995. As a proportion of all licensed drivers, the elderly increased from 11% to 14% during this period. Older drivers also have been driving more miles. Between 1983 and 1995, average annual mileage for the driving population increased 25% but went up 44% for drivers aged 65 and older, from 4345 to 6276 miles per year. This represents just more than half the average driver's 11 764 miles per year in 1995 (table 1).

The 3799 deaths among drivers aged 65 and older represented 18% of all driver deaths in 1995, up from 12% in 1983. However, these deaths represented less than 1% of deaths from all causes among people aged 65 and older because older people die from many other causes.[19]

For all age groups, driver involvement rates per capita for all police reported crashes remained relatively constant between 1990 and 1995. The highest involvement rates were among the youngest drivers and gradually decreased throughout life, with the lowest rate for drivers aged 75 and older (fig 1, table 1). In 1983, driver involvement rates per capita for fatal crashes remained constant after age 60; in 1990 and 1995, however, involvement rates were higher for drivers aged 70 and older. Between 1983 and 1995, fatal crash involvement rates for drivers aged 70 and older increased 34%; in comparison, fatal crash involvement rates for drivers aged 16–69 declined 4% during the same period.

Per licensed driver, involvement rates for all police reported crashes and for fatal crashes remained relatively constant over time, except among teenage drivers, whose fatal involvement rates increased between 1983 and the 1990s (fig 2). Driver involvement rates for all crashes were highest among the youngest drivers, gradually decreasing, and then stabilizing by age 55 (fig 2, table 1). Driver involvement rates for fatal crashes had a similar pattern until leveling off by age 55 and then increasing at ages 70 and older.

Per VMT, driver involvement rates for all police reported crashes also remained constant between 1990 and 1995 (fig 3). The highest involvement rates continued to be among the youngest drivers, leveling off around age 30 (fig 3, table 1). At about age 65, involvement rates started to increase, rising substantially after age 70. Driver involvement rates for fatal crashes followed a similar pattern to involvement rates for all crashes—rates were very high among teenagers but rose more precipitously than rates for all crashes after age 70. Fatal crash involvement rates for drivers aged 75 and older were nearly as high as those for drivers aged 16–19.

Trends in fatal crash involvement rates per VMT for older and younger drivers have been encouraging. Unlike involve-

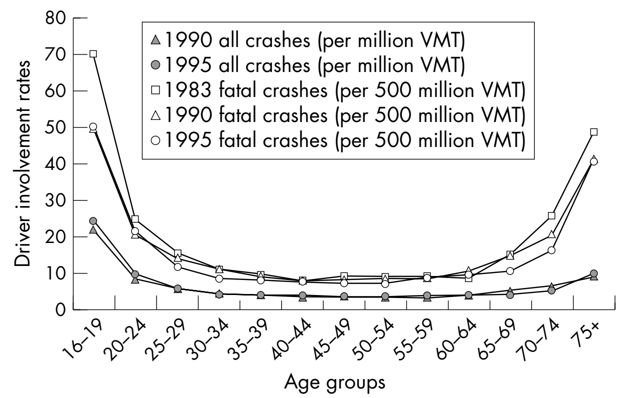

Figure 3 Driver involvement rates for all police reported crashes (General Estimates System) per million vehicle-miles of travel (VMT) (Nationwide Personal Transportation Survey) for 1990 and 1995 and for fatal crashes (Fatality Analysis Reporting System) per 500 million VMT for 1983, 1990, and 1995 by age group.

ment rates for all police reported crashes, there were notable improvements in fatal crash involvement rates by age between 1983 and 1995 (fig 3). During this period, the fatal crash involvement rate for the oldest drivers (aged 75 and older) declined 20%, from 49 to 41 per 500 million VMT. A greater decline, more than 30%, occurred among drivers aged 65–74. Younger drivers (aged 16–19) had about a 30% decline.

The population aged 65 and older made up 14% of all drivers in fatal crashes in 1999 (table 2). Based on projections, their expected percentage contribution to fatal crash involvements in 2010 is 15%, and this is expected to increase to 20% in 2020 and 25% in 2030 (table 2, fig 4). Similarly, the population aged 65 and older contributed 8% of drivers in all police reported crashes in 1999, and this percentage is projected to be 9% in 2010, 13% in 2020, and 16% in 2030.

For all age groups, between 1999 and 2030, there will be an estimated 39% increase in the number of drivers involved in fatal crashes and a 34% increase in the number involved in police reported crashes. In contrast, it is estimated that there will be a 155% increase in the number of older drivers (aged 65 and older) involved in fatal crashes between 1999 and 2030 and that they will account for 54% of the total projected increase in fatal crash involvements. The number of drivers aged 65 and older involved in all police reported crashes is expected to increase 178%, thus accounting for 41% of the total increase. Even in 2030, however, drivers aged 65 and

Table 2 Total projections for drivers involved in fatal and all police reported crashes, licensed drivers, and population aged 16+ (driving age)*: 2010, 2020, 2030

				% Aged 65+		
Year	Aged 16–64	Aged 65+	Total	Involvements	Licensed drivers	Driving age population
Police reported crash involvements						
1999	9178232	787280	9965512	8	14	16
2010	10536275	1084375	11620650	9	15	17
2020	10784552	1593362	12377914	13	18	21
2030	11180287	2186539	13366826	16	22	25
Fatal crash involvements						
1999	38880	6108	44988	14	Same as above	Same as above
2010	44321	7721	52042	15		
2020	45478	11345	56823	20		
2030	47023	15568	62591	25		

*US Census Bureau, medium projections.

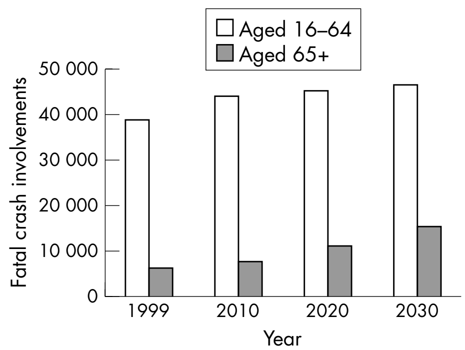

Figure 4 Total projections for drivers aged 16–64 and 65+ involved in fatal crashes for 2010, 2020, and 2030.

older will not be overinvolved in relation to their representation in the overall driving age population. In 1999, they represented 16% of the driving age population (aged 16 and older), 14% of drivers in fatal crashes, and 8% of drivers in all police reported crashes. In 2030, it is estimated they will represent 25% of the driving age population, 25% of drivers in fatal crashes, and 16% of drivers in all crashes.

DISCUSSION

Older drivers are growing in numbers at a greater rate than other age groups, keeping their licenses longer, and driving more miles per license holder. These trends are expected to continue. Thus, older drivers will become an increasing proportion of the overall motor vehicle crash problem, although this trend will not begin to accelerate until after 2010. Even in 2030, however, older drivers in relation to their numbers in the population are expected to be under-represented in all crashes and not over-represented in fatal crashes. In contrast, the youngest drivers are at highest risk of involvement in police reported crashes and fatal crashes relative to their numbers.

The projections reported by this study are important not in terms of their absolute values, but in estimating future changes in the relative contributions of older drivers to the overall crash problem. Any projections of future crash counts have inherent uncertainty; however, there is strong evidence that older drivers will make up a substantially larger proportion of drivers involved in fatal crashes by 2030.

Limitations

The study's projections are only as accurate as the assumptions about licensing and continued stable crash rates per licensed driver. If mileage per licensed driver increases more than it has in the past, and if crash rates per licensed driver go up, crash involvement rates could be even higher. Burkhardt *et al* projected higher numbers of older driver crash involvements using rates based on estimated miles of travel,[21] predicting that older drivers would be driving approximately 12 000 miles a year by 2030. These estimates appear high given that driving currently decreases by nearly 50% after age 64.[5] The present study used licensure based rates because rates per licensed driver have remained relatively steady during the past decade or more despite increases in mileage during this time.

The total number of fatal crashes also could rise because of the increasing proportion of older drivers, who have higher death rates per crash than younger drivers.[7] Health improvements might make future older populations less frail than the current older population; however, this benefit might be counterbalanced by the resulting increases in licensure and miles driven.[2 6]

The number of crash involvements and fatal crash involvements among drivers of all ages could be fewer than projected because of improvements in belt use rates, vehicle crashworthiness, roadway design, and other driving conditions in addition to reductions in alcohol impaired driving. For example, if traffic becomes more congested, travel speeds could slow, which would reduce the number of fatal crashes. During the past 30 years, the number of traffic deaths has decreased or remained the same in spite of increasing vehicle travel, but we do not know if these improvements in death rates per mile will continue.

Age cohort effects also could reduce the expected impact of increased older drivers on the road. Li *et al* demonstrated that more recent birth cohorts have lower crash fatality risk at the same age than older birth cohorts,[11] attributing this finding to a complex aggregation of environmental and behavioral factors.

IMPLICATIONS FOR PREVENTION

Because older vehicle occupants will comprise a large proportion of future deaths in motor vehicle crashes, public health efforts to reduce their morbidity and mortality should be pursued. Research suggests that addressing older drivers' fragility should receive greater emphasis from sponsors of motor vehicle safety research because fragility is the over-riding factor in the increased involvements of older drivers in fatal crashes.[7] Older drivers are more likely than younger drivers to die when involved in crashes because of increased vulnerability to injury from physical impacts, which starts manifesting itself at ages 60–64.[7 22 23] In particular, chest injuries and fractures occur much more frequently among older vehicle occupants.[10]

Further research is needed on vehicle modifications to prevent injuries and deaths due to frailty. Improvements in vehicle crashworthiness and restraints, such as tailoring airbag deployments to the characteristics of individual vehicle occupants, should provide better protection to the fragile bodies of older vehicle occupants involved in crashes. Seat belt designs that distribute restraining forces over a wider area currently are being researched, including belts that would be wider, inflatable, provide slower deceleration, or have four points of attachment to the vehicle.[24–26]

Making vehicles easier to drive with larger displays and other enhancements to visibility might reduce the cognitive burden associated with driving and should help some older drivers. A high proportion of multiple vehicle fatal crashes involving older drivers occur at intersections.[27] Better road and traffic engineering, such as protected left turn lanes and left turn signals at intersections, should reduce the crash involvement rates for drivers of all ages at intersections.[28]

One possible countermeasure may be to have stricter requirements for license renewal once a certain age has been reached. However, age alone is not a good predictor of crash risk. Research is under way to develop screening tests for older drivers, but no test has been identified that can reliably identify at-risk drivers.[1 29] Screening for serious impairments may be feasible. However, it is unlikely that a screening test for driving ability could be developed that would not result in restricting many motorists who could safely continue to drive. Furthermore, any driving restrictions will have limited effects on the problem of older occupant fragility. Thus, efforts to restrict driving in older populations need to be carefully balanced against any decrease in elderly mobility and increased emphasis should be placed on methods of protecting older drivers and passengers when they travel in vehicles.

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