Effect of Passenger Presence on Older Drivers' Risk of Fatal Crash Involvement

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ABSTRACT

Objective: To determine the association between passenger presence and risk of fatal crash involvement in relation to driver and passenger age and gender, focusing especially on drivers ages 65 and older.

Methods: Data on US fatal crashes were obtained for 2002-09. Using the quasi-induced exposure methodology, logistic regression analysis was used to predict the odds of fatal crash involvement as a function of driver age and gender as well as passenger age and gender.

Results: Overall, risk of fatal crash involvement with passengers was 43 percent lower for drivers ages 65-74 and 38 percent lower for drivers 75 and older. Older drivers' risk of fatal crash involvement was lower with almost all combinations of passenger age and gender; there was no reduction in risk with passengers ages 75 and older. Effects were stronger at nonintersection than at intersection locations.

Conclusion: Older drivers' crash risk is lower with almost every combination of passenger age group and gender. It is unclear whether the presence of passengers lowers older driver crash risk or whether safer drivers tend to ride with passengers.

Key words: Older drivers; fatality; fatal crash risk; passengers; quasi-induced exposure; intersection

INTRODUCTION

It is well established that the presence of passengers in vehicles can influence driver behavior as well as crash and fatal crash involvement, and that effects differ depending on the age of the driver. A 2007 summary of the research literature found that passenger presence is associated with increased crash risk and increased fatal crash risk for teenage drivers, and decreased risk for drivers about 30 and older (Williams et al., 2007). More recent studies have confirmed these relationships (Engstrom et al., 2008; Lee and Abdel-Aty, 2008; Ouimet et al., 2010). For ages 20-29 the evidence is mixed, including reports of positive, negative, or neutral effects (Williams et al., 2007)

Studies also have reported a dose-response relationship between the number of passengers and crash risk. For teenage drivers, the more passengers present the greater the crash risk (Chen et al., 2000; Doherty et al., 1998). For drivers 30 and older, there is some evidence that increasing numbers of passengers decreases crash risk (Chen et al., 2000; Engstrom et al., 2008; Lee and Abdel-Aty, 2008).

Some studies have examined the protective effects of passengers for adult drivers of different ages, with inconsistent results. One study found a net protective effect of passenger presence on the crash risk for adult drivers, but detected no significant difference in risk associated with any specific age and gender driver/passenger combination (Reuda-Domingo et al., 2004). Geyer and Ragland (2005) reported that the protective effects of passengers for adult male drivers increased with driver age. Although most studies have found protective effects of passengers for the oldest driver age groups (Engstrom et al., 2008; Preusser et al., 1998; Vollrath et al., 2002), one study reported mixed results, with no protective effect for drivers ages 65-74 and an increased risk with two or more passengers for drivers 75 and older (Hin et al., 2003).

The reasons for the differential effect of passengers on crash risk for drivers of different ages are not fully understood. Most of the attention has been devoted to teenage drivers, whose increased risk primarily is limited to situations where passengers are teenagers or slightly older. The increased risk is attributed to the distractions provided by passengers and the effect of passengers on driver risk taking; it is hypothesized that both of these factors are related to developmental influences (Allen and Brown, 2008) combined with driving inexperience. There is a variety of supporting evidence for this explanation, based on self-reported behavior, characteristics of crashes involving multiple teenagers, and differences in driving behavior with teenage passengers present (Regan and Mitsopoulos, 2001; Simons-Morton et al., 2005; Williams et al., 1998). In a study including a nationally representative sample of drivers ages 16-18 involved in serious crashes, peer passengers affected male teen driver crashes through increased driver distraction and risky driving and affected female crash involvement primarily through increased driver distraction (Curry et al., 2012)

Less attention has been given to why passenger presence is associated with reduced crash involvement for drivers 30 and older. One can postulate that passengers can be helpful co-pilots, keeping drivers alert, assisting with navigation, warning of impending hazards, and operating the radio, climate controls, or cell phone. Or, depending on their relationships to drivers and associated role

expectations, passengers may improve driver behavior and alertness compared with how drivers would operate vehicles when alone. Another possibility is that safer older drivers tend to ride with passengers more often than less safe older drivers.

Identifying passenger/driver interactions that reduce crash risk may be particularly relevant in the case of senior drivers, many of whom have age-related impairments that affect their driving and might benefit from passenger assistance. The effects of driver gender and passenger age and gender have been examined for teenage drivers. Ouimet et al. (2010) examined fatal crash risk per trip and per mile traveled among young drivers (ages 15-20) with one passenger versus no passengers, by the age and gender of passengers. For both male and female young drivers, the highest risk was associated with one young male passenger. A smaller elevated fatal crash risk also was observed with one young female passenger. One passenger 35 or older, of either gender, was associated with lower fatal crash risk for both male and female young drivers.

A similar examination has not been done for older drivers. In studies of older drivers and passengers, some attention has been given to investigating whether passengers are more or less protective on certain types of roads, or in relation to road features such as curvature, or for specific driving maneuvers such as passing other vehicles. (Bedard and Meyers, 2004; Hing et al., 2003; Padlo et al., 2005). The current study extends this research by examining how the effects of passengers on older drivers' fatal crash risk vary by driver gender, passenger age and gender, and at intersection versus nonintersection locations.

METHODS

The effect of passengers on the risk of fatal crash involvement was examined. Exposure to various passenger and nonpassenger driving situations was estimated using a technique known as indirect, or quasi-induced, exposure (Waller et al., 1973). Quasi-induced exposure follows from the concept that any driver may be the victim in a multiple-vehicle crash caused by another driver. These not-at-fault crash involvements are used as a surrogate measure of exposure to crash risk. It also is assumed that single-vehicle crashes are caused entirely by attributes of the driver-vehicle combination involved; thus, the drivers in single-vehicle crashes are considered at-fault. In this approach, the ratio of the number of drivers at fault in fatal crashes to the number of drivers not at fault in fatal crashes represents the risk of fatal crash involvement. The unit of analysis was drivers of passenger vehicles (cars, SUVs, minivans, and pickups) involved in fatal crashes during 2002-09. Information on crashes involving these drivers was obtained from the Fatality Analysis Reporting System (FARS), a census of crashes occurring on public roadways in the United States in which at least one person dies within 30 days. Passenger vehicle drivers were excluded if they were younger than 16 or their ages were unknown, they were driving special use/emergency vehicles, or there were more than 9 passengers in their vehicles. Crashes in which the only fatality was a pedestrian or bicyclist also were excluded because the factors used to determine fault in the study are not coded for pedestrians, and most do not

apply to bicyclists. Drivers were coded as being at-fault if they were assigned at least 1 of 33 specified driver-related factors included in the FARS files, as derived from police crash reports (Appendix A). FARS includes up to four such factors for each driver. Drivers in single-vehicle crashes were assumed to be at fault regardless of whether they were assigned any driver-related factors.

Driver ages were coded as 16-19, 20-29, 30-64, 65-74, and 75 and older. When stratifying by gender and age of passengers, age groups 65-74 and 75 and older were combined to maintain adequate sample size. For drivers transporting passengers, the passenger ages were coded as younger than 13, 13-19, 20-29, 30-64, 65-74, and 75 and older. For passengers to be coded into one of these groups, all passengers in the vehicle had to fall into that age category. Another category was comprised of mixed ages, when passengers were in two or more age groups. The ages of passengers were unknown for about 1 percent of driver involvements, and these involvements were excluded from analyses that examined passenger age.

Passenger gender was coded as one male passenger, two or more male passengers, one female passenger, two or more female passengers, mixed gender passengers, and any passenger younger than 13. It was assumed that gender was irrelevant for the youngest passengers. Passenger gender was unknown for less than 1 percent of driver involvements, and these involvements were excluded from analyses that examined passenger gender.

Unconditional binary logistic regression analyses estimated the relative risk of involvement in a fatal crash with at least one passenger versus no passengers. An initial binary logistic regression model included the age category of the driver, passenger presence, and the interaction between these two factors. For each age category, odds ratios for passenger presence were calculated using parameter estimates from the main effect of passenger presence and the interaction between passenger presence and driver age. Odds ratios greater than 1 indicate a greater risk with passengers than without. Separate models then were conducted by driver gender. For male and female older drivers, the primary focus of the study, additional models were developed incorporating passenger gender and then passenger age as predictors, with no passenger as a reference category. Finally, because older drivers tend to be overrepresented in intersection crashes (Mayhew et al., 2006), models were conducted for older drivers at intersection and nonintersection locations.

RESULTS

There were 318,465 passenger vehicle drivers involved in fatal crashes during 2002-09. Table 1 lists the percent distribution of fatal crash driver involvements by driver age group, fault, and passenger presence. About 13 percent of the drivers were 65 or older. Young drivers were most often at fault (80 percent), followed by the oldest drivers (75 and older) (78 percent). Overall, 41 percent of drivers were transporting passengers. Young drivers also were the most likely to be transporting at least one passenger (55 percent), and the oldest drivers were the least likely (34 percent).

Table 2 lists the percent distribution of fatal crash involvements by driver age and gender groups and passenger age group. In general, drivers in a specific age group, regardless of gender, were most likely to be transporting passengers of similar ages. Female drivers ages 20-64 were far more likely than other drivers to be transporting children 12 or younger.

Table 3 lists the percent distribution of fatal crash involvements by driver age and gender groups and passenger gender groups. Among male drivers with passengers, those ages 16-29 were most likely to be carrying one male passenger, and those 65 and older were most likely to be carrying one female passenger. Among female drivers with passengers, those ages 16-19 were most likely to be carrying one female passenger, and those ages 20-64 were most likely to be carrying at least one child passenger 12 or younger. Female drivers 65 and older were most likely to be carrying one male passenger.

Effects of Passenger Presence on Fatal Crash Risk

Table 4 lists the odds ratios from logistic regression models estimating the effect of the presence of at least one passenger on the relative risk of involvement in a fatal crash for each driver age group. Results indicated that having passengers was associated with an increased risk of fatal crash involvement for teenage drivers and a decreased risk for drivers 30 and older. The decreased risk was greatest for drivers 65 and older; the fatal crash risk for these drivers was at least one-third lower. There was a no significant effect of passengers for drivers ages 20-29.

Table 5 lists the effect estimates of passenger presence on the risk of fatal crash involvement for each driver age and gender group. The risk of fatal crash involvement was lower with passengers for all age groups of male and female drivers 30 and older. Estimated effects were greatest for male drivers 65 and older, for whom the risk of fatal crash involvement when passengers were present was half the risk when passengers were not present. Among drivers ages 16-19, the risk of fatal crash involvement was higher with passengers than when driving alone, and this effect was larger for male drivers than for female drivers. Passengers did not significantly affect fatal crash risk among male or female drivers ages 20-29.

Additional regression models were conducted for male and female older drivers that examined the role of passenger gender (Table 6) and passenger age (Table 7). Because of small sample sizes, a single older driver group (65 and older) was used. For male drivers 65 and older, all combinations of passenger gender strongly and significantly decreased the risk of fatal crash involvement (Table 6). Effects were largest with at least one child passenger and effects were smallest with one male passenger. For female older drivers, all passenger gender combinations also decreased risk, but to a lesser degree than for male drivers. Effects were largest with mixed gender passengers and were smallest (and not statistically significant) with two or more male passengers or one female passenger. For male drivers 65 and older, fatal crash risk was lower with all passenger age groups younger than 75, although the lower risk associated with passengers ages 13-19 was not significant, likely because of the small sample size. The largest effects occurred with passengers ages 30-74. For female older drivers,

risk of fatal crash involvement was lower for all passenger age groups except passengers 75 and older, but most effects were not statistically significant, again likely due to small sample sizes. The largest reduction occurred with passengers of mixed ages. Sample sizes were too small to support analyses examining passenger age and gender simultaneously.

Driver Crash Risk at Intersection versus Nonintersection Locations

Logistic regression models examined the effects of passengers on the risk of fatal crash involvement at intersection versus nonintersection locations (Table 8). For drivers 30 and older, fatal crash risk was lower with passengers at both intersection and nonintersection locations, but reductions were greater at nonintersections. There was little passenger effect for drivers ages 20-29 at intersection or nonintersection locations. For teenage drivers, fatal crash risk was higher with passengers at both intersection and nonintersection locations, but effects were stronger at intersections.

DISCUSSION

Several previous studies have found that fatal crash risk for teenage drivers is higher with passengers than without but that passengers have a protective effect for drivers older than 30. For teenage drivers, risk increases as the number of passengers increases (Chen et al., 2000; Doherty et al., 1998). For these drivers, the detrimental effects of passengers on fatal crash risk generally are confined to teenage passengers, particularly male teenage passengers, regardless of the gender of the driver (Ouimet et al., 2010). Until the present study, the effects of gender/age driver and passenger combinations on fatal crash risk have not been thoroughly investigated for older drivers. Contrary to the findings for teenage drivers, fatal crash risk for drivers 65 and older was lower in the presence of any combination of passenger age and gender with only one exception. There was no significant effect of passengers 75 and older.

A limitation of the current study (and this type of research generally) is the challenge of having only imperfect measures of exposure for estimating the risk of fatal crash involvement. The current study uses the method of quasi-induced exposure, which has been applied by other researchers to estimate the crash risk of various factors (e.g., Hing et al., 2003; Jiang and Lyles, 2011; Preusser et al., 1998; Yan et al., 2005). The method of quasi-induced exposure uses exposure estimates based on a subset of non-culpable drivers whose fatal crash involvement was unrelated to their pre-crash driving behavior, and the potential shortcomings of this method have been discussed by other researchers (Cooper et al., 2010; DeYoung et al., 1997). The approach assumes that the determination of “fault” in the crash by investigating police officers is correct, and that drivers found to be not “at fault” are a good representation of all drivers on the road. It is impossible to know with certainty the extent to which these assumptions are valid. However, several studies, using different methodologies, have supported the notion that the quasi-induced exposure approach yields reasonable estimates of exposure (e.g., Chandraratna and Stamatiadis, 2009; Lyles et al.; 1991; Kirk and Stamatiadis, 2001).

Another limitation is that the analysis does not provide explanations for why passengers may be beneficial for drivers older than 30, and particularly for older drivers. One possibility is that passengers younger than 75 aid in the driving task by, for example, providing a second pair of eyes, issuing warnings, or helping to keep drivers alert. Perhaps adult drivers drive more safely when they feel responsible for the safety of their passenger(s). An alternative explanation is that safer drivers tend to ride with passengers. Notably, when two older people travel together, the more able person can drive. Similarly, passengers may be more willing to ride with safer drivers. A better understanding of the reasons why passengers can be beneficial for older drivers may help with identification of potential countermeasures, including helping passengers learn how to be maximally useful. It is unclear why the reduction in fatal crash risk was not found with passengers ages 75 and older, but perhaps the oldest passengers were more likely to have impairments (e.g., vision, cognition) that made it for difficult for them to be helpful or assistive, or even were distracting to the drivers.

A surprising finding was that the benefit of passengers for older drivers was greater at nonintersection than at intersection locations. Given the complexities of safely traveling through intersections, and the potential help a passenger could provide, one would expect a greater benefit of passengers at intersections, particularly because older drivers are overrepresented in fatal multiple-vehicle crashes at intersections. In a study of intersection crashes involving injuries in Connecticut during 2003-04, drivers 70 and older were more likely than 35-54 year-old drivers to fail-to-yeild right of way. Among the very oldest drivers (80 and older), the primary factor was failing to see the other vehicle (Braitman et al., 2007). Although passengers may potentially help drivers detect other vehicles, perhaps the extra distraction that passengers can create detracts somewhat from their benefit in more complex driving environments. In the current study, fatal crash risk was still lower with passengers than without, including at intersections, but not more so than at non-intersection locations.

Driver and passenger interactions are complex and not well understood. For example, older couples may have long-established ways of interacting; it is unknown to what extent the nature of interactions may change with aging. Some limited information on navigation strategies used by older couples is available. For example, drivers 55 and older reported that having a passenger to share navigation tasks enabled them to focus on driving safely, particularly in unfamiliar locations (Vrkljan and Polgar, 2007). Case studies suggest that some Alzheimer's patients continue to drive with the aid of spouses or friends (Shua-Haim and Gross, 1996). More studies of the experiences of older drivers when they travel alone and with passengers might be instructive and could provide some insight into ways that passengers benefit drivers, as well as information about when and why older drivers travel with passengers. Large-scale studies that observe older drivers' travel patterns and driving behavior with and without passengers may provide insight on which types of driver/passenger interactions may affect driving.

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REFERENCES

Allen JP, Brown BB. Adolescents, peers, and motor vehicles: the perfect storm? *Amer J Prev Med*. 2008;35:289-93.

Bedard M., Meyers JR. The influence of passengers on older drivers involved in fatal crashes. *Exp Aging Res*. 2004; 30, 205-15.

Braitman KA, Kirley BB, Ferguson S, Chaudhary NK. Factors leading to older drivers' intersection crashes. *Traffic Inj Prev*. 2007;8:267-74.

Chen L, Baker SP, Braver ER, Li G. Carrying passengers as a risk factor for crashes fatal to 16- and 17-year-old drivers. *Journal A Med Assoc*. 2000;283:1578-82.

Chandraratna S, Stamatiadis N. Evaluation of the quasi-induced exposure assumptions. *Accid Anal Prev*. 2009;41:308-13.

Cooper PJ, Meckle W, Anderson L. The efficiency of using non-capable crash-claim involvements from insurance data as a means of estimating travel exposure for road-user subgroups. *J Safety Res*. 2010;41:129-36.

Curry AE, Mirman JH, Kallan MJ, Winston FK, Durbin DR. Peer passengers: How do they affect teen crashes? *J Adolesc Health*. 2012;50:588-94.

DeYoung DJ, Peck RC, Helander CJ. Estimating the exposure and fatal crash rates of suspended/revoked and unlicensed drivers in California. *Accid Anal Prev*. 1997;29:17-23.

Doherty ST, Audrey JC, MacGregor C. The situational risks of young drivers: the influence of passengers, time of day, and day of week on accident rates. *Accid Anal Prev.* 1998;30:45-52.

Engstrom I, Gregersen NP, Granstrom K, Nyberg A. 2008. Young drivers—reduced crash risk with passengers in the vehicle. *Accid Anal Prev. 2008*;40:341-48.

Geyer JA, Ragland DR. Vehicle occupancy and crash risk. *Transp Res Rec*. 2005;1908:187-94.

Hing JYC, Stamatiadis N, Aultman-Hall L. Evaluating the impact of passengers on the safety of older drivers. *J Safety Res*. 2003;34, 343-351.

Jiang X, Lyles RW. Exposure-based assessment of the effectiveness of Michigan's graduated driver licensing nighttime driving restriction. *Saf Sci*. 2011;49:484-90.

Kirk A, Stamatiadis N. *Evaluation of the quasi-induced exposure*. University of Kentucky: Final Report for the Southeastern Transportation Center USDOT Transportation Center. 2001.

Lee C, Abdel-Aty M. Presence of passengers: does it increase or reduce driver's crash potential. *Accid Anal Prev.* 2008;40:1703-12.

Lyles RW, Stamatiadis P, Lighthizer DR. Quasi-induced exposure revisited. *Accid Anal Prev*. 1991;23:275-85.

Mayhew DR, Simpson, HM, Ferguson SA. Collisions involving senior drivers: High-risk conditions and locations. *Traffic Inj Prev*. 2006;7:117-24.

Ouimet MC. Simons-Morton BG, Zador PL, Lerner ND, Freedman M, Duncan GD, Wang, J. Using the U.S National Household Travel Survey to estimate the impact of passenger characteristics on young drivers' relative risk of fatal crash involvement. *Accid Anal Prev*. 2010;42:689-94.

Padlo P, Aultman-Hall L, Stamatiadis N. Passengers and other factors affecting the safety of young and older drivers. *Transp Res Rec*., Report 1937. 2005:7-13.

Preusser DP, Ferguson SA, Williams AF. The effect of teenage passengers on the fatal crash risk of teenage drivers. *Accid Anal Prev*. 1998; 30:217-22.

Preusser DF, Williams AF, Ferguson SA, Ullmer RG, Weinstein HB. Fatal crash risk for older drivers at intersections. *Accid Anal Prev.* 1998;30:151-59.

Regan MA, Mitsopoulos E. Understanding Passenger Influences on Driver Behavior: Implications for Road Safety and Recommendations for Countermeasure Development. Melbourne, Australia: Monash University Accident Research Center. 2001; Report No. 180.

Reuda-Domingo T, Lardellli-Claret P, Luna-del-Castillo, JD, Jimenez-Moleon JJ, Garcia-Martin M, Bueno-Cavanillas A. The influence of passengers on the risk of the driver causing a car collision in Spain. Analysis of collisions from 1990 to 1999. *Accid Anal Prev.* 2004; 36:481-89.

Shua-Haim JR, Gross JS. The "co-pilot" driver syndrome. *J Am Geriatr Soc*. 1996;4:815-17.

Simons-Morton B, Lerner N, Singer J. The observed effects of teenage passengers on the risky diving behavior of teenage drivers. *Accid Anal Prev.* 2005; 37:973-82.

Vollrath, M., Mellinger, T., Kruger, H-P. How the presence of passengers influences the risk of a collision with another vehicle. *Accid Anal Prev*. 2002;34:649-54.

Vrkljan BH, Polgar JM. Driving, navigation, and vehicular technology: experiences of older drivers and their co-pilots. *Traffic Inj Prev.* 2007;8:403-10.

Waller PF, Reinfurt DW, Freeman JL, Imrey PB. Methods for measuring exposure to automobile accidents. San Francisco: Paper presented at 101st meeting of the American Public Health Association; 1973.

Williams AF, Ferguson SA, McCartt AT. Passenger effects on teenage driving and opportunities for reducing the risks of such travel. *J Safety Res*. 2007;38:381-90.

Williams AF, Preusser DP, Ferguson SA. Fatal crashes involving 16-year-old drivers: narrative descriptions. *J Traffic Safety Med*. 1998;26:11-17.

Yan X, Radwan E, Abdel-Aty M. Characteristics of rear-end accidents at signalized intersections using multiple logistic regression model. *Accid Anal Prev*. 2005;37:983-95.

Table I Percent distribution of passenger vehicle fatal crash involvements by driver age group, fault, and passenger presence, 2002-09

Driver age	Number	Percent	Driver at fault	Passenger(s) present
16-19	37,489	12	80	55
20-29	82,467	26	72	46
30-64	157,266	49	59	36
65-74	19,481	6	63	37
75+	21,762	7	78	34
All ages	318,465	100	67	41

Table II Percent distribution of passenger vehicle fatal crash involvements by driver age and gender groups and passenger age groups

			Age of passengers							
Driver age	n*	No passenger	≤ 13	13-19	20-29	30-64	65-74	75+	Mixed ages	Total
Male drivers										
16-19	25,602	46	1	37	6	2	0	0	9	100
20-29	60,052	57	1	6	20	5	0	0	10	100
30-64	106,742	68	2	2	4	15	1	1	9	100
65-74	13,089	64	1	1	1	11	15	3	6	100
75+	14,325	64	0	0	0	3	7	23	3	100
Female drivers										
16-19	11,886	48	3	29	6	2	0	0	11	100
20-29	22,408	53	12	3	13	5	0	0	13	100
30-64	50,517	60	8	4	2	11	1	2	12	100
65-74	6,392	64	3	1	1	6	9	11	5	100
75+	7,432	72	1	0	0	3	2	20	2	100

*Passengers with unknown age were excluded.

Table III Percent distribution of passenger vehicle fatal crash involvements by driver age and gender groups and passenger gender group

				Gender of passengers					
Driver age	N*	No passenger	Any passenger age <13	One male passenger	Two or more male passengers	One female passenger	Two or more female passengers	Mixed gender	Total
Male drivers									
16-19	25,442	45	3	20	12	8	2	9	100
20-29	59,732	56	5	17	8	9	1	5	100
30-64	106,163	67	7	9	3	10	1	3	100
65-74	13,033	63	2	5	1	24	2	3	100
75+	14,284	61	1	3	0	29	2	2	100
Female drivers									
16-19	11,815	47	8	11	3	15	6	10	100
20-29	22,240	52	21	10	2	8	2	4	100
30-64	50,177	59	16	9	1	8	2	3	100
65-74	6,377	64	5	16	1	10	2	2	100
75+	7,417	72	1	14	0	10	2	1	100

*Passengers with unknown gender were excluded.

Table IV Logistic regression model estimating effect of passenger presence on risk of fatal crash involvement by driver age

Driver age	Odds ratio (passengers relative to no passenger)	95% CI Lower	95% CI Upper
16-19	1.31	1.20	1.45
20-29	1.04	0.95	1.14
30-64	0.68	0.64	0.73
65-74	0.57	0.51	0.63
75+	0.62	0.58	0.68

Table V Logistic regression models estimating effect of passenger presence on risk of fatal crash involvement for male and female drivers by driver age group

Driver age	Odds ratio (passengers relative to no passenger)	95% CI Lower	95% CI Upper
Male			
16-19	1.36	1.19	1.55
20-29	1.07	0.95	1.21
30-64	0.64	0.57	0.72
65-74	0.50	0.44	0.57
75+	0.56	0.52	0.61
Female			
16-19	1.21	1.01	1.47
20-29	1.04	0.87	1.24
30-64	0.80	0.68	0.96
65-74	0.76	0.63	0.93
75+	0.76	0.68	0.86

Table VI Logistic regression models estimating effect of passenger presence on risk of fatal crash involvement for male and female drivers 65 and older by passenger gender group

Drivers 65 and older	Passenger gender	Odds ratio (passengers relative to no passengers)	95% CI Lower	95% CI Upper
Male	No passenger	1.00		
	One male passenger	0.73	0.64	0.83
	One female passenger	0.64	0.47	0.88
	Two or more male passengers	0.64	0.61	068
	Two or more female passengers	0.64	0.53	0.76
	Mixed gender	0.61	0.52	0.71
	At least one passenger <13	0.52	0.50	0.63
Female	No passenger	1.00		
	One male passenger	0.83	0.75	0.91
	One female passenger	0.80	0.48	1.33
	Two or more male passengers	0.91	0.81	1.02
	Two or more female passengers	0.73	0.58	0.93
	Mixed gender	0.53	0.41	0.69
	At least one passenger <13	0.75	0.61	0.93

Table VII Logistic regression models estimating effect of passenger presence on risk of fatal crash involvement for male and female drivers 65 and older by passenger age group

Drivers 65 and older	Passenger age	Odds ratio (passengers relative to no passenger)	95.0% CI Lower	95.0% CI Upper
Male	No passenger	1.00		
	<13	0.61	0.43	0.86
	13-19	0.70	0.49	1.02
	20-29	0.66	0.46	0.96
	30-64	0.47	0.43	0.52
	65-74	0.48	0.36	0.52
	75+	1.03	0.96	1.12
	Mixed age	0.59	0.53	0.67
Female	No passenger	1.00		
	<13	0.78	0.59	1.03
	13-19	0.78	0.53	1.15
	20-29	0.83	0.48	1.43
	30-64	0.74	0.62	0.88
	65-74	0.64	0.55	0.74
	75+	1.00	0.90	1.11
	Mixed age	0.60	0.50	0.72

Table VIII Logistic regression models estimating effect of passenger presence on risk of fatal crash involvement at intersection and nonintersection locations by driver age group

Location	Driver age	Odds ratio (passengers relative to no passenger)	95.0% CI Lower	95.0% CI Upper
Nonintersection	16-19	1.22	1.05	1.41
	20-29	1.00	0.87	1.15
	30-64	0.63	0.55	0.72
	65-74	0.46	0.40	0.54
	75+	0.49	0.45	0.54
Intersection	16-19	1.47	1.25	1.71
	20-29	1.15	1.00	1.33
	30-64	0.87	0.76	1.00
	65-74	0.82	0.70	0.97
	75+	0.77	0.71	0.85

Appendix A

Driver-related factors coded in FARS used to establish fault

Description
Drowsy, sleep, asleep, fatigued
Ill, passed out/blackout
Operating the vehicle in a careless or inattentive manner
Aggressive driving/road rage
Leaving vehicle unattended with engine running; leaving vehicle unattended in roadway
Towing or pushing improperly
Failure to dim lights or to have lights on when required
Following improperly
Improper or erratic lane changing
Failure to keep in proper lane
Illegal driving on road shoulder, in ditch, on sidewalk, or on median
Making improper entry to or exit from traffic way
Starting or backing improperly
Opening closure into moving traffic or while vehicle is in motion
Passing where prohibited
Passing on wrong side
Passing with insufficient distance, or inadequate visibility, or failing to yield to overtaking vehicle
Operating vehicle in an erratic, reckless, or negligent manner; Operating at erratic or suddenly changing speeds
Police pursuing this driver or police officer in pursuit
Failure to yield right-of-way
Failure to obey actual traffic signs, traffic control devices, or offices; Failure ot obey safety zone traffic laws
Passing through or around barrier
Failure to observe warnings or instructions on vehicles displaying them
Failure to signal intentions
Driving too fast for conditions or in excess of posted maximum
Driving less than posted minimum
Racing
Making right turn from left-turn lane, left turn from right-turn lane
Making other improper turn
Driving wrong way on one-way traffic
Driving on wrong side of road
Stopped in roadway
Overcorrecting