



## Young females at risk while driving with a small child



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### ABSTRACT

**Introduction:** Previous research suggests that young mothers with little driving experience are at risk when driving with a small child passenger. In this study we examined the prevalence, characteristics and risk of fatal motor vehicle crashes involving an infant passenger under the age of one among female drivers of different ages. **Methods:** We used crash data from the US Fatality Analysis Reporting System for 1994–2013. The prevalence of fatal crashes involving infants was examined by age of female drivers and compared to the number of births among mothers of a similar age. The essential characteristics of the crashes were described, and the odds of being at fault were determined for young (16–24-year-olds) and older female drivers (25–39-year-olds) with an infant passenger or with no passengers.

**Results:** The prevalence of fatal crashes involving infant passengers was higher among young female drivers in relation to the number of births among mothers of a similar age than among older females. Young female drivers with an infant passenger were more often at fault than older drivers (aOR = 1.83, 95% CI = 1.52, 2.20). Their vehicles were older and smaller and they used proper safety seats for infants less often than the older drivers. In addition, young female drivers with an infant passenger but with no adult passenger in the vehicle were more often at fault than young female drivers with no passengers (aOR = 1.27, 95% CI = 1.06, 1.51).

Both young and older female drivers' crashes involving an infant passenger typically occurred in ordinary driving conditions, but these drivers with infant passengers were more often reported as having fallen asleep or inattentive than those with no passengers. The presence of an adult passenger in addition to an infant passenger lowered female drivers' odds of being at fault, regardless of the driver's age.

**Conclusions:** Young females driving with an infant passenger, probably most often mothers, are at an elevated risk of a fatal crash, especially when they drive alone with an infant. The protective effect of an adult passenger suggests that another adult in the vehicle can assist the driver by taking care of the infant and enabling the driver to focus on driving.

### 1. Introduction

Road traffic crashes are the leading cause of injury-related deaths of children across the world. (Peden, 2008) In order to reduce the deaths of child passengers, previous research has mainly investigated how children's injuries and deaths can be prevented by restraint systems and safety seats. (Rice and Anderson, 2009; Macy and Freed, 2012; Zaza et al., 2001) Although it is important to mitigate the consequences of traffic crashes involving children, it is also important to study why these crashes occur in the first place.

According to previous research, parents of small children seem to be motivated to drive responsibly and are unlikely to take risks on the road. (Taubman-Ben-Ari and Noy, 2011) Crashes involving child passengers usually occur during daylight under normal driving circumstances (Chen et al., 2005a; Scherz, 1981) and drivers in crashed

involving children less often speed or are under the influence of alcohol. (Kelley-Baker and Romano, 2014; Maasalo et al., 2016) The results of a study based on naturalistic driving data suggested that children being in the rear seats reduces drivers' risk of crashing. (Dingus et al., 2016)

However, child passengers themselves may present a source of distraction, by competing with the driving task for the driver's attention. (Koppel et al., 2011; Stutts et al., 2005) Our recent analysis of fatal crashes indicated that the risk among female drivers is especially elevated when they drive with small 0–4-year-old children compared to similar drivers with no child passengers. (Maasalo et al., 2016) However, this was not the case among male drivers, suggesting that females are more vulnerable to small child-related distraction. A crying infant in the vehicle might be a significant distracting factor for a mother, as the primary function of crying is to get attention from caregivers. (Zeifman,

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2001) The mothers of small children may also be exposed to sleep disruption and fatigue (Parks et al., 1999; Filtness et al., 2014) and preliminary results suggest that new mothers' sleep problems might be linked to a higher crash risk (Livingstone et al., 2009; Malish et al., 2016). In addition, over 10% of mothers suffer from postpartum depression. (O'hara and Swain, 1996) Consequently, they may be less careful with their children by for example, using safety seats in vehicles less frequently than non-depressed mothers. (McLennan and Kotelchuck, 2000; McLearn et al., 2006) Depression might also have an impact on drivers' crash risk. (Wickens et al., 2014)

As far as we know, no research exists on the association of the crash risk with a small child passenger and the age of the driver. Earlier studies have shown that infants of young mothers are at a higher risk of motor vehicle-related deaths than infants of older mothers (Scholer et al., 1999; Emerick et al., 1986), but the reason for this is not clear, and it is not known whether this difference still exists today. If it is assumed that infants mostly travel with their parents, the higher risk of motor vehicle-related deaths among the infants of young mothers might be linked to drivers' inexperience or an age-related less safe driving style. (Williams, 2003; Deery, 2000; McKnight and McKnight, 2003) In addition, the consequences of young drivers' crashes are more often serious than those of older drivers' crashes (Everett et al., 2001) and the results of Chen et al.'s study (2005b) suggests that in young drivers' crashes, child passengers are at an elevated risk of injuries than in older drivers' crashes. It is also known that young drivers with little driving experience are more vulnerable to distractions in terms of their capacity to control and share their attention and time properly between driving and in-car tasks. (Wikman et al., 1998; Young et al., 2007) Curry et al. (2012) showed that it is common for young female drivers to become distracted by their passengers and to look at them while driving. This may particularly concern young mothers driving with infant passengers.

Although existing research suggests that mothers, especially if they are young with little driving experience, might be at risk as drivers, no previous studies have examined female drivers' risk of crashing when they have an infant under the age of one in the vehicle. In this study we analysed the prevalence, characteristics and risk of fatal motor vehicle crashes involving an infant passenger under the age of one by the age of the female driver in the US in 1994–2013.

## 2. Methods

We used crash data from the Fatality Analysis Reporting System (FARS) for 1994–2013 in this study. FARS contains information regarding motor vehicle crashes on US public roads that have led to the death of at least one person within 30 days of the crash. Our analysis covered only drivers of passenger vehicles (passenger cars, minivans, utility or pickups, truck-based pickups and pickups with chamber excluded) which were not in special use (e.g. taxi or police). The selected age range for female drivers was 16–39 years, as this is the typical maternal childbirth age. In addition, this age range seems to be reasonable, as 87.8% of all female drivers with an infant passenger were in this age category. After these exclusions, the number of female drivers with an infant passenger was 3883, which was 2.7% of all female drivers aged 16–39 involved in a crash ( $n = 142\,408$ ) over the examined period, regardless of the number and age of the passengers.

### 2.1. Prevalence of fatal crashes involving an infant

The number of fatal crashes involving an infant aged under one was examined by the age of the female drivers. The number of crashes

involving an infant also depended on the number of babies born in each age group. Therefore, we related the number of crashes ( $n = 3883$ ) to the number of births ( $n = 78\,225\,770$ ) among each age group of mothers. As the FARS database does not include information on passengers' relations to drivers, it was assumed that female drivers travelling with an infant passenger under the age of one are mostly the mothers of these infants, and that these two measures thus approximately correspond to each other.

Information regarding births by year and age of the mother for 1994–2013 was acquired from the Birth Data Files of the National Center for Health Statistics.

We analysed the number of crashes involving an infant in relation to births for young versus older mothers/female drivers with risk ratios (RR) and their 95% confidence intervals. To check for long-term trends in the data, we also calculated RRs and their confidence intervals in five year periods. We defined 16–24 year-old drivers as young drivers/mothers and 25–39 year-old drivers as older drivers/mothers, because several studies have shown that drivers aged under 25 have higher crash rates than older drivers. (Ryan et al., 1998; Preusser et al., 1998) While these age groups are not equal (16–24 year-olds consist of 9 years and 25–39 year-olds consist of 15 years), we used only ratios, rather than absolute numbers, to compare these age groups.

Finally, we also calculated the number of crashes involving an infant in relation to the number of crashes involving no passengers among young and older female drivers using RRs and their 95% confidence intervals. This was done in order to check whether the number of crashes among young and older females involving an infant differ from the number of crashes among the general population.

### 2.2. Crash characteristics

The essential characteristics of the drivers, vehicles and crashes were examined among young (16–24-year-old) and older (25–39-year-old) female drivers with an infant passenger and with no passengers. In this analysis, 3883 drivers had an infant passenger and 73 692 had no passengers. We explored the characteristics of crashes among different groups by percentages and compared them using the Pearson Chi square test.

### 2.3. Crash risk estimation

The ratio of at-fault drivers to not-at-fault drivers was used as the crash risk estimate for each examined driver/passenger group. We assumed that not at fault drivers involved in a crash are selected randomly and thus the number of not at fault drivers in one group represents the exposure of that group (Carr, 1969) (for the quasi-induced exposure method, see (Chandraratna and Stamatiadis, 2009; Stamatiadis and Deacon, 1997)).

We defined drivers' probable culpability for crash occurrence (being at fault) using 'driver-related factors' (up to three or four (since 1997) coded for every driver), which are based on the police reports in the FARS database. For at fault vs. not at fault drivers' allocation, we adapted the method which was used in the Braitman et al. (2014) study. An involved driver was defined as being at fault if she was estimated to have fallen asleep/been fatigued, been inattentive/careless, been ill/blacked out or if she had been speeding or made traffic-related operating errors at the time of the crash. Otherwise she was not at fault (see Table A1 in Appendix A for a detailed definition of at fault drivers). In some crashes, the police reports considered multiple drivers (or none) culpable, so we only included crashes with one at fault driver in order to correctly define the driver's culpability. We also excluded single-

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