

Injury Patterns of Elderly Occupants Involved in Side Crashes

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I. INTRODUCTION

It is estimated that 50 million people over the age of 65 will be eligible to drive by 2020 [1] in the United States (US). Previous studies have shown that drivers 65 and older account for approximately 40% of crash involvement [1-2]. Multiple injury risk factors for elderly occupants, such as lower bone density, geometry changes to the pelvis and ribs, and pre-existing medical conditions, may contribute to a higher risk of injury in motor vehicle crashes (MVCs). Additionally, it has been suggested that these age-related risks differ by sex [3]. The goal of this study was to identify the subset of the elderly population most at risk in MVCs and the body region most commonly injured to develop a laboratory test for elderly occupants in side impact crashes.

II. METHODS

The National Automotive Sampling System (NASS) Crashworthiness Data System (CDS) database was used to identify the frequency and patterns of injuries to elderly occupants occurring in MVCs in the US. The analysis was emphasised to be occupant based and the occupants who sustained injuries to a specific body region, e.g., thorax, were compared to the occupants involved in a crash without that specific injury. Data from 2000 through 2011 (12 case years) were used in this study including occupants of passenger vehicles of model years 2000 and later. The risk of injury was defined as the ratio of injured occupants to all the occupants involved in crashes for given scenarios.

Crashes were restricted to near-side impacts based on the primary direction of force (PDOF) of the impact and the occupant's seat position. Near-side crashes included those with left-side damage for drivers as the case occupants, and right-side damage with RFP as the case occupants. Only planar crashes were included with no incidence of rollover. Occupants were restricted to drivers and right front passengers (RFP) of ages 16 and over only. Pregnant occupants were excluded from this analysis. Further, the database was shortlisted to occupants between age 60 and 90 to analyse the risk of injuries to the elderly population.

III. RESULTS

Fig. 1 shows the risk of AIS3+ injuries by age-group and body region for drivers and RFP in a near-side crash. For both the occupant positions, the occurrence of thorax injuries increases for the population age group of 61 to 90. There is also a rapid increase in the risk of head injury for drivers and lower extremity injury for RFP in the age group of 71 to 90.

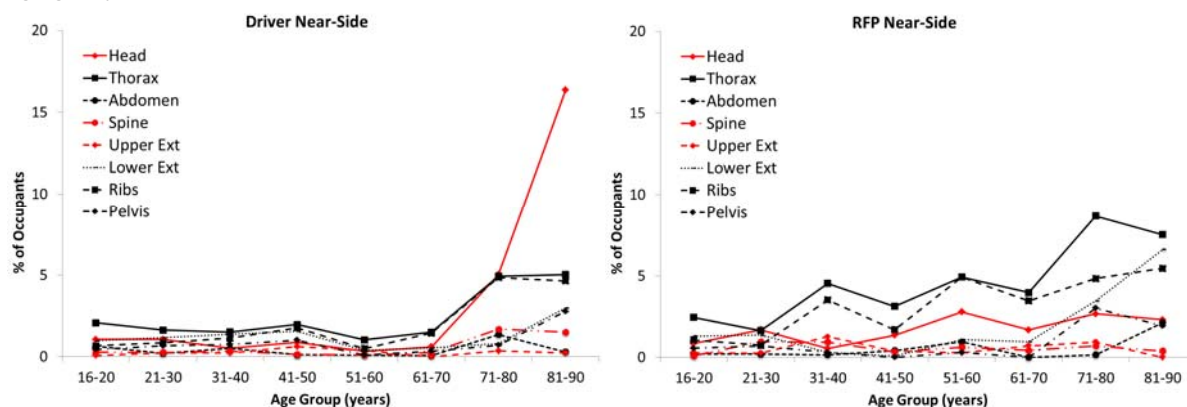


Fig. 1. Risk of injuries to drivers (left) and RFP (right) in near side crashes.

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Fig. 2 shows the risk of AIS 3+ injury separated by occupant sex. For the male population, the risk of injury to the thorax and ribs increases after the age of 60 while risk of injury to all other body regions either increases only slightly or stays constant. The risk of AIS 2+ injury for all females to all body regions increases for the age group over 60 with most noticeable increases in injury risk to the head, thorax, lower extremities, and ribs.

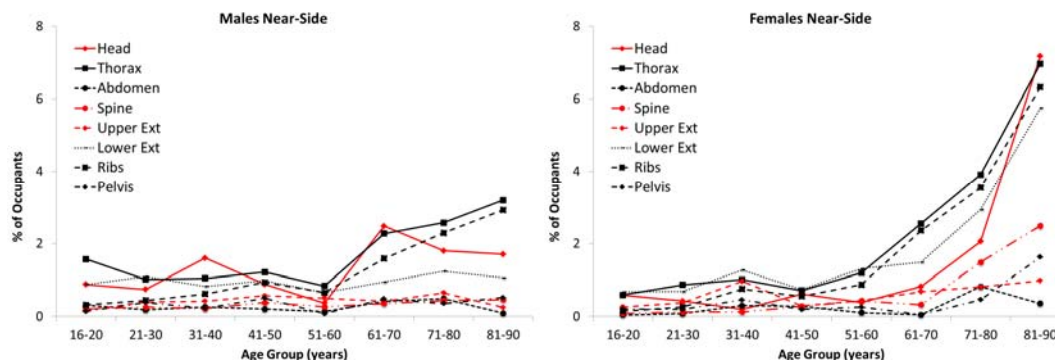


Fig. 2. Risk of injuries to males (left) and females (right) in near side crashes.

The above results show that the age group most at risk for increased injury includes adults 60 years and older. Further analysis was done on occupants between age 60 and 90 to see which body regions were most at risk. Fig. 3 shows the risk of AIS 3+ injuries for both male and female occupants between the ages of 60-90 years based on type and model year of vehicle. For the male occupants, the risk of injuries was more pronounced in passenger vehicles and model year prior to 2006. However, the female occupants were at higher risk of thorax, ribs and spine injuries in model year vehicles 2006 and above, suggesting an increase in possibility of injuries from advanced restraint systems such as side airbags.

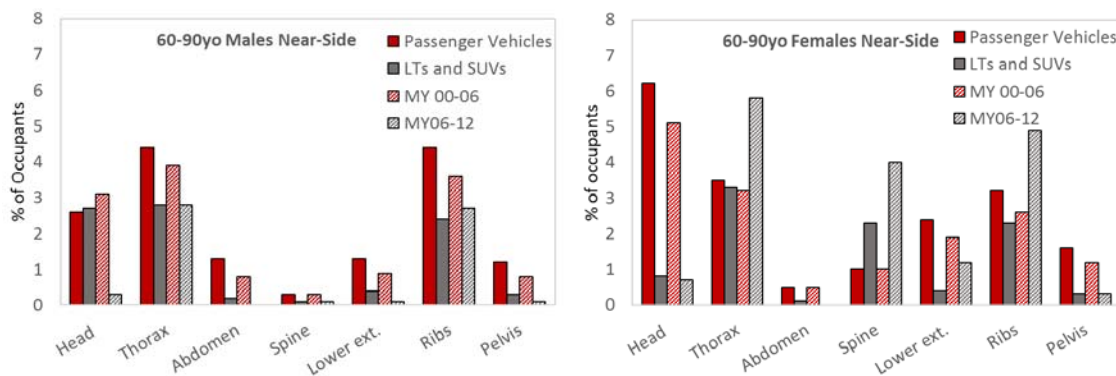


Fig. 3. Risk of injuries to elderly males (left) and females (right) in near side crashes.

Since each variable in the NASS CDS database is weighted to produce a national estimate, the outliers were checked against the raw data. It was determined that the increase in risk of head injury was exaggerated due to the one incidence with a female driver involved in a near side crash in a passenger vehicle. These results show that the age group most at risk for increased injury includes adults 60 years and older. Further analysis was done on occupants between 60-90 years to see which body regions were most at risk.

IV. DISCUSSION

The subset of the elderly population most at risk for injury includes female RFPs in near side collisions. After taking weighting factors into consideration, the body regions most at risk for injury include the thorax, ribs, lower extremities, and pelvis. Additional focus should be placed on the rib injury mitigation in newer model year vehicles with airbags to protect the elderly female frail occupants. The study provides a direction towards performing an in-depth case analysis using CIREN that may be applied towards accident reconstruction to reproduce field injuries in a laboratory test methodology such as airbag loading to the thorax of a human surrogate to investigate injury tolerance and response.

V. REFERENCES

- [1] Yoganandan et al , JBiomech, 2007.
- [2] Lyman et al, TIP, 2002.
- [3] Islam et al, JsafetyResearch, 2006.