Elderly Fatality in CIREN Cases: A Matched Case Review

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Introduction: Elderly fatalities in automobile crashes remain a public health concern. While prior studies have primarily relied on large-scale databases such as the Fatality Analysis Reporting System (FARS), the Crash Injury Research and Engineering Network (CIREN) database provides detailed crash, vehicle, and occupant information for in-depth case comparison. Given that crash severity does not always explain injury outcomes, matched-case analysis provides an opportunity to isolate age-related differences in injury tolerance and physiological response.

Objective: The goal of this study was to identify younger, non-fatal match cases within the CIREN database that correspond to elderly fatality cases, enabling comparisons of crashes. These comparisons aim to provide insight into factors contributing to fatal outcomes in elderly occupants.

Methodology: Elderly fatality cases were identified in CIREN as case numbers 116, 117, 157, 658, and 1034. Younger match cases were selected using CIREN's filter search tools based on key anthropometric variables, including occupant sex, height, and weight. Crash similarity was further assessed using Delta-V, Maximum Abbreviated Injury Scale (MAIS), Injury Severity Score (ISS) and principal direction of force (PDOF). Matched cases were assumed to represent comparable crash conditions. To evaluate the validity of the match cases, paired sample t-tests were conducted to assess statistical similarity between fatality and match case pairs. Injuries were compared across the cases.

Results: Statistical analyses were performed for the following fatality–match pairs: case 116 with case 145, case 117 with case 977, case 157 with case 11, and case 658 with case 72, and case 1034 with case 194. From the paired t-tests, age was significantly different ($p<0.05$) between the cohort of elderly fatality and matched cases, but height, mass, delta-V, and PDOF were not statistically significant indicating well matched cases. Between the cohorts of CIREN cases, MAIS and ISS were not statistically different, indicating similar overall severity of injuries between the elderly occupants and their matched counterparts. In multiple cases, the types of injuries and the corresponding severities are very similar. For instance, fatality–match pair 116 and 145 shared lumbar vertebral fractures, while cases 117 and 977 both sustained ulna fractures. Similarly, in pairs 157 and 11, as well as 1034 and 194, injuries were predominantly localized to the upper body. In contrast, for cases 658 and 72, the non-fatal case exhibited a greater number and higher severity of injuries compared to the corresponding fatality.

Conclusions: This study demonstrates that crashes with comparable severity, injuries, and characteristics can result in markedly different outcomes depending on the occupant. The findings suggest that age-related factors, potentially including physiological vulnerability and comorbidities, may contribute to increased fatality risk among elderly occupants, consistent with previous studies. Due to the limited number of elderly fatality CIREN cases, these findings may not be generalized to the broader population; however, they highlight the importance of

continued investigation as the elderly population and associated fatalities continue to rise. Continued research on how elderly occupants respond to similar crash situations may inform future safety features, standards, and CIREN data assessments.