Demographic Patterns in Seating Position Among Crash-Involved Front-Row Occupants in Ohio, USA.

Angela L. Harden and Mary E. Cole

I. INTRODUCTION

Interpretation of sex- and age-based differences in motor vehicle crash injury outcomes often relies on comparisons across demographic groups without accounting for differences in the underlying occupant population. Prior research has evaluated injury risk by sex, crash characteristics, and occupant factors, including seating position and restraint use [1–2]. Some studies have described occupant characteristics within specific seating positions or crash contexts, but these analyses are narrower in scope and do not characterise the broader composition of crash-involved occupants across seating positions, demographic groups, and vehicle types [2–3].

Crash-involved occupants are not uniformly distributed within vehicles; seating position, vehicle type, and occupant demographics may co-vary in ways that influence observed injury patterns. Without this context, differences in injury outcomes by sex or age may reflect variation in exposure rather than intrinsic risk. Studies using licensed-driver denominators further show that crash involvement varies by age and sex relative to the underlying driving population, underscoring the importance of population context in interpreting these patterns [4–5]. These distributions represent a key component of exposure and may shape how risk is manifested across users and environments. The objective of this research was to characterise the distribution of crash-involved front-row seat occupants by sex, age group, and vehicle type using statewide Ohio crash data from 2017–2024. A secondary objective was to examine whether these distributions differed by crash severity per unit (vehicle severity).

II. METHODS

Aggregated tabulations from the Ohio statewide crash database were examined for 2017–2024. Analyses were restricted to front-row occupants, defined as front-left (driver) and front-right positions. Occupants were categorised by sex (male, female), age group (teen [13–20], young adult [21–40], middle adult [41–60], older adult [61–79], elderly adult [80+]), seating position (driver, front-right), vehicle type (passenger car, multipurpose passenger vehicle [MPV], truck, other), and injury severity (no apparent injury, possible injury, suspected minor injury, suspected serious injury, fatal). Youth occupants (0–12) were excluded due to low representation in front-row positions and different seating constraints.

Seating distributions were summarised by sex and age group. Cross-tabulations examined how seating position varied by sex, age group, and vehicle type, including joint distributions across these factors. Parallel analyses replaced vehicle type with vehicle severity to examine severity patterns by seating position and demographics. Counts and proportions were summarised within groups, and patterns were compared across years. For 2019–2022, crash-involved driver counts were compared with licensed driver counts from the Ohio Bureau of Motor Vehicles to provide population-level context by sex and age.

III. INITIAL FINDINGS

Across 2017–2024, 3,471,434 front-row occupants were included after excluding youth (0–12), of whom 2,980,015 (85.8%) were drivers and 491,419 (14.2%) were front-right occupants. This distribution was stable across years, with drivers comprising approximately 86% annually. Among females (n=1,581,764), 82.1% were drivers and 17.9% were front-right occupants, compared with 89.0% and 11.0%, respectively, among males (n=1,889,670). These distributions varied by age within each sex (Fig. 1). Among females, driver/front-right proportions ranged from 69.9%/30.1% (teens) to 85.6%/14.4% (middle adults) and declined in older groups. Among males, driver proportions increased with age, peaking at 93.3% among older adults, with consistently lower front-right representation across all age groups compared to females.

Female occupants were more frequently represented in passenger cars and MPVs, whereas male occupants also had high representation in trucks, contributing to differences in vehicle type distributions (Fig. 2). Among female drivers, 0.13% were in vehicles with a fatal outcome and 1.15% in vehicles involving a suspected serious injury, compared with 0.30% and 1.60%, respectively, among male drivers. Comparison with licensed driver data

A. L. Harden is Assistant Research Professor in the Injury Biomechanics Research Center (IBRC) at The Ohio State University in Columbus, OH, USA (angela.harden2@osumc.edu, +1 614.685.2203). M. E. Cole is Assistant Professor in the Division of Radiologic Sciences and Therapy at The Ohio State University in Columbus, OH, USA.

(2019–2022) indicated that while licensed drivers were approximately balanced or increasingly female-dominant across age groups, crash-involved drivers were disproportionately male, particularly among younger and middle-aged groups.

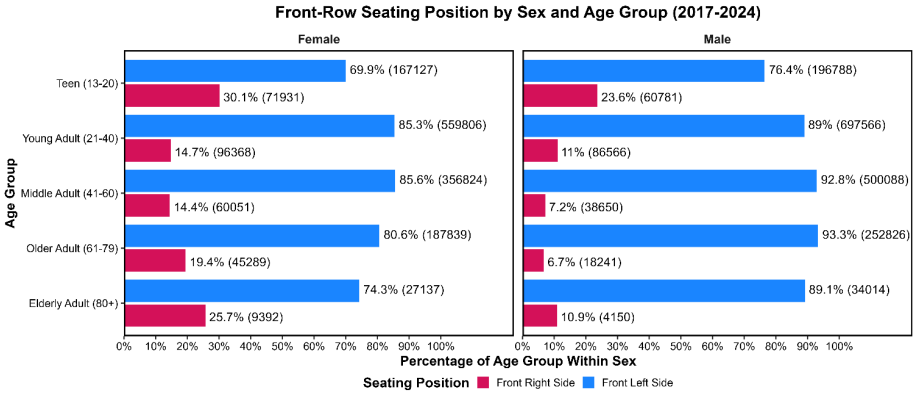

Fig.1. Front-row seating position as a proportion of age group within each sex

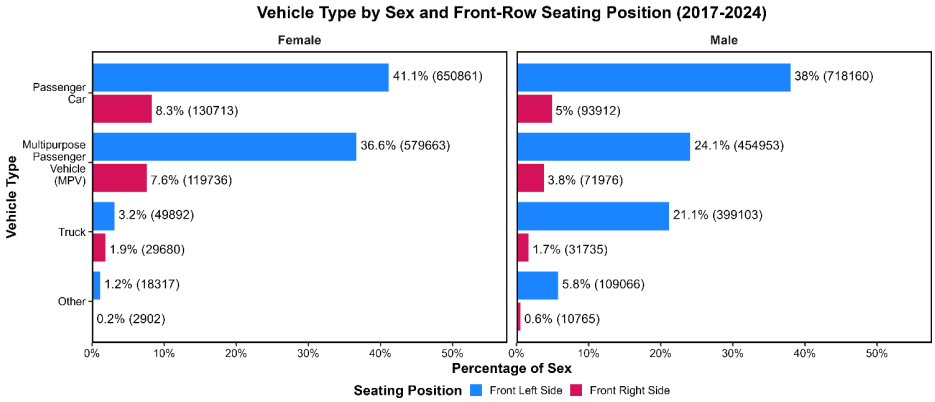

Fig. 2. Vehicle type and front-row seating position as a proportion of sex.

IV. DISCUSSION

Sex- and age-based differences were observed in both crash involvement and seating position, indicating that the crash-involved occupant population is unevenly distributed across demographic groups. Females were more frequently represented in the front-right seating position, while males were overrepresented among crash-involved drivers, particularly in younger age groups. Comparison with licensed driver data further indicates that the crash-involved population differs from the underlying driving population. These findings suggest that differences in injury outcomes across demographic groups may be influenced not only by intrinsic risk factors but also by differences in exposure to seating position, vehicle type, and crash involvement. As a result, analyses that compare injury severity across sex or age groups should consider how occupant distribution and exposure vary within crash-involved populations.

From a Safe System perspective, these results highlight the importance of understanding how risk is distributed across users and environments. Characterising the composition of crash-involved occupants provides critical context for interpreting demographic differences in injury outcomes and may inform more targeted occupant protection and safety strategies. This study is limited by the use of aggregated data and the absence of detailed crash characteristics, including collision type, vehicle interaction, and manner of crash. Future work should examine how these factors interact with occupant distribution to influence injury outcomes.

V. REFERENCES

[1] Craig *et al.*, Accid Anal Prev, 2024
[2] Durbin *et al.*, Accid Anal Prev, 2015.
[3] Parenteau *et al.*, Traffic Inj Prev, 2021
[4] Ratnapradipa *et al.*, J Appl Gerontol, 2021
[5] Walshe *et al.*, JAMA Netw Open, 2022