Seat belt fit and body position of pregnant female automobile occupants: an exploratory study

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Introduction: While motor vehicle crashes (MVCs) are a leading cause of injuries and trauma-related fatalities for pregnant individuals, automotive safety research within the pregnant population is rare and poses many challenges to undertake. This is due to characteristics unique to the pregnant population, such as difficult participant recruitment, rapidly changing body shape, and a relatively short time period and age range to study. Previous research has investigated seat belt fit and usage via self-report surveys. However, no prior study has assessed seat belt fit and body position for pregnant individuals in a natural (real-world) vehicle environment.

Objective: This study aims to address the dearth of automotive safety research on pregnant individuals by measuring belt fit and body position among expecting mothers of varying gestational ages. Our long-term goal is to help determine and overcome the physical and/or perceptual barriers to 1) increasing habitual belt use and 2) achieving optimal in-vehicle belt fit during pregnancy.

Methodology: This ongoing study involves pregnant females between 18-45 years old at any gestational age. Measurements are taken during a one-time visit that takes about an hour to complete. Data are collected while the participant is seated in their own vehicle as either the driver or passenger. During the visit, 15 anthropometric and vehicle-related measurements (e.g., abdomen circumference and distance between the sternum and steering wheel) of the participant are taken. A Principal Component Analysis (PCA) was performed on these measurements to identify the leading principal components that represent important aspects of body shape and seating position. The observed belt fit will be coded to determine whether it is consistent with the official National Highway Traffic Safety Administration (NHTSA) guidelines for pregnant occupants. A logistic regression will be estimated to determine how the leading principal components are associated with sub-optimal seat belt fit.

Results: 60 pregnant individuals participated in the study, with ages ranging from 23 – 41. Three principal components (PCs) were identified, which explained 62.15% of total variance in the measurements. PC1 (36.55% of variance explained) represented “abdomen size”; PC2 (14.50% of variance explained) represented “torso height”; and PC3 (11.09% of variance explained) represented “proximity to steering wheel and dashboard.” An exploratory clustering analysis revealed two clusters of participants according to “abdomen size.”

Conclusions: This study will contribute to the knowledge base around the optimality of seat belt fit in a vulnerable population consisting of pregnant individuals. The planned analyses will identify the ways in which body shape and seating position contribute to sub-optimal belt fit, which, in turn, may help the development of safety improvements for pregnant vehicle occupants.