THE INCREASE IN OCCUPANT WEIGHT AND ITS AFFECT ON THORACIC INJURIES

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INTRODUCTION

From a biomechanical standpoint, it is logical to assume that as an occupant's weight increases, the resulting change in body habitus will alter an occupant's interaction with a vehicle restraint system and interior. This change in the relationship between the restraint and the bony structures of the body may influence thoracic injury potential. The purpose of this study was to examine the relationship between occupant weight and thoracic injury potential.

METHODOLOGY

The data for this study were obtained from the National Automotive Sampling System Crashworthiness Data System (NASS CDS) database for years 1993 to 2005. All data processing and statistical analyses were performed using the Statistical Analysis Software (SAS, SAS Institute, Cary N.C.). Accident data were selected to include frontal impacts (PDOF 11 to 1 o'clock) in which a rollover did not occur. Occupant data were selected to include those seated in the driver or right front positions, were over the age of 18 and females who were not pregnant. An individual with a BMI less than 25 was regarded as lean and a BMI equal to or greater than 30 was defined as obese. Since the CDS weighting factors are not sensitive to occupant weight they were not applied because they would alter the distribution of occupant weight within the injured and uninjured categories. Risk ratios were calculated to demonstrate the change in risk of incurring a thoracic injury of AIS ≥ 2 or AIS ≥ 3 based on BMI category and restraint status.

RESULTS

Overall, obese occupants had a 33% higher risk of AIS ≥ 3 thoracic injury than lean occupants, with the difference being higher for obese males (9% vs. 13%) than females (8% vs. 9%). The risk of AIS ≥ 2 thoracic injury was also higher for obese occupants (RR: 1.26) for both males (12% vs. 16%) and females (10% vs. 13%). All risk ratios provided are significant to the 0.05 level (Table 1).

Table 1: Risk ratios for obese versus lean occupants
(Values greater than one indicate an increase in risk for obese occupants).

Thoracic Injury	**AIS ≥ 2**		**AIS ≥ 3**	
Data Segment	**RR**	**Obese Risk**	**RR**	**Obese Risk**
Delta - V (35 to 43) km/h	1.47	21%	1.69	17%
Delta - V (60 to 66) km/h	2.47	64%	2.13	46%
Delta – V 66+ km/h	1.32	60%	1.36	55%
Belted (w/wo Airbag)	1.13	10%	1.22	8%
Unbelted (w/wo Airbag)	1.40	21%	1.41	18%

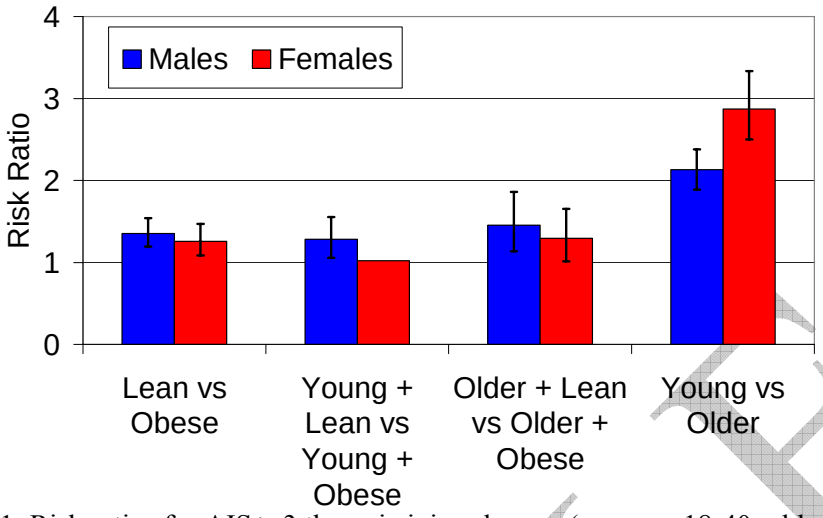

Figure 1: Risk ratios for AIS ≥ 3 thoracic injury by age (young = 18-40; older = 60+) and BMI groups (95th Confidence intervals shown for significant risk ratios).

CONCLUSIONS

Using the developed dataset, calculated risk of serious (AIS ≥ 3) thoracic injury was similar to those determined by Prasad *et al.* (2004) for belted occupants. The results of this analysis suggest that an increase in BMI is associated with an increase in thoracic injury risk and the increase is more pronounced in older occupants (Figure 1). The increased risk of serious chest injury between the lean and obese groups is approximately equivalent to an increase in age of 9 years, which is in accord with the well-established effects of age.

REFERENCES

Prasad P, Laituri TR, Sullivan K: Estimation of AIS 3+ Thoracic Injury Risks of Belted Drivers in NASS Frontal Crashes, *Proc. Instn. Mech. Engrs.*, 218(D): 591-609; 2004.