

# Abdominal Injury Patterns in Motor Vehicle Accidents – A NASS/CDS Database Analyses

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## INTRODUCTION

- Data available on abdominal injuries in real-world motor vehicle accidents equipped with advanced restraint systems are limited.
- Abdominal injuries rank fourth in risk of AIS 3+ for near-side crashes, and fifth for frontal and far-side crashes [1].
- Existing lateral-impact abdominal response data lack reliable abdominal displacement or compression information for human subjects.
- To investigate the risk of abdominal injury and factors associated with it, analyses using crash databases are required.
- The intent of this study was to perform searches related to the scope and severity of abdominal injuries caused by automobile accidents.
- The study also looks into any changes in past trends reported by Klinich et. al [1] when additional years are added to the database analyses.
- This study aims to identify future research that will provide data for improved crash dummies and computational models.

## METHODS

Familiarize with NASS/CDS database and SAS

Develop SAS codes to conduct basic searches

Validate results with "Klinich et. al" [1]

Run analyses with additional data from recent years

Study the injury patterns and identify areas where further research is required

### Criteria

- NASS/CDS data: 1998-2009 (12 years)
- Vehicle model years: 1985 onwards
- Occupant age:  $\geq 16$  years; No pregnant occupants
- Occupants: Driver and Right Front Passenger only
- Crash types: Frontal, Near-side & Far-side

### Resulting Database

- 53% Male; 47% Female
- 81.5% Drivers; 18.5% RFP
- Belt-use rate: 73.5% (69% Male; 77% Female)

## REFERENCES

- Klinich, Kathleen D., et al. "Abdominal injury in motor-vehicle crashes." (2008).
- Klinich, Kathleen D., et al. "Factors associated with abdominal injury in frontal, farside, and nearside crashes." *Stapp car crash journal* 54 (2010): 73.
- Frampton, Richard, et al. "An In-depth Study of Abdominal Injuries Sustained by Car Occupants in Frontal Crashes." *Annals of Advances in Automotive Medicine/Annual Scientific Conference*. Vol. 56, 2012.

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## RESULTS & DISCUSSION

### How many people sustain abdominal injuries each year?

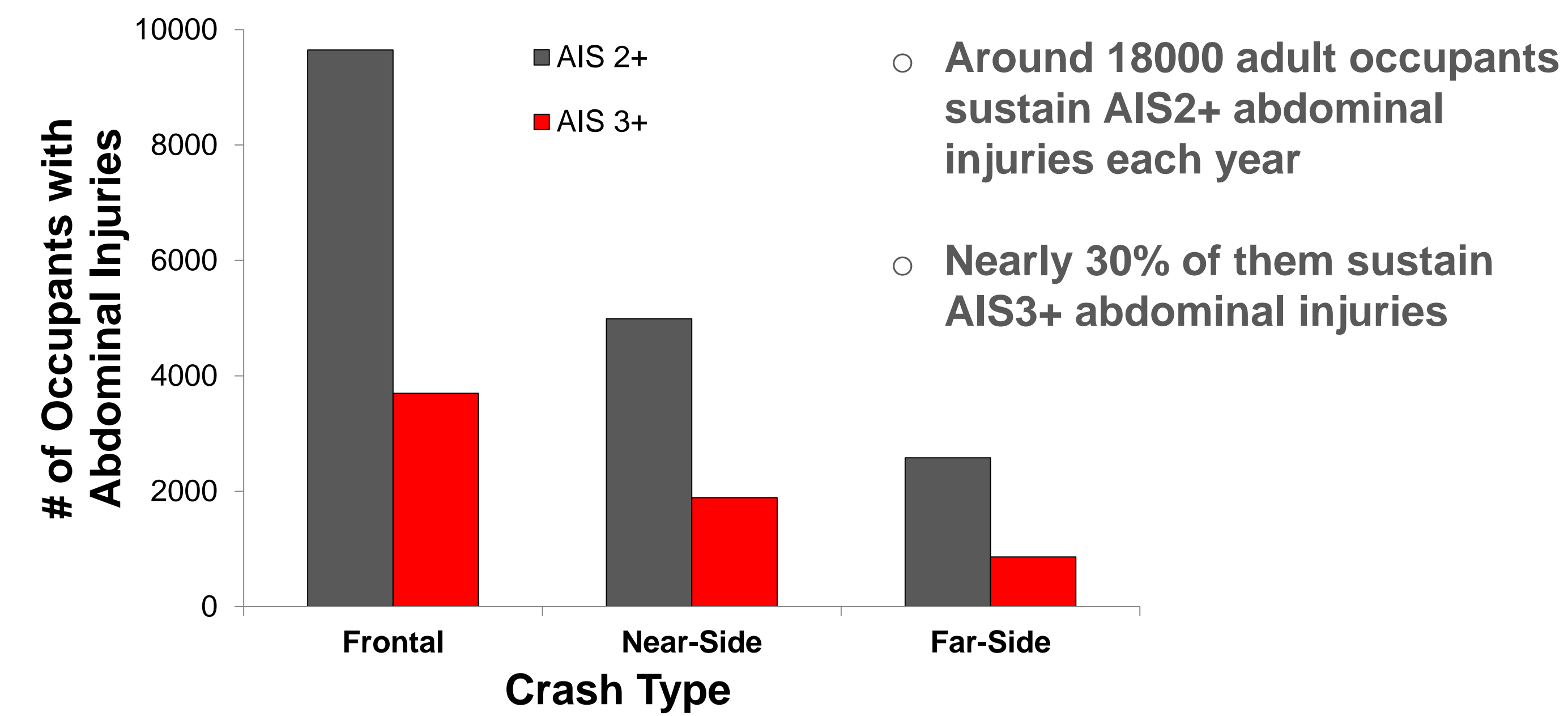


Figure1: Estimated number of occupants with abdomen injuries per year in the US

### Does lap/shoulder belt reduce the risk of abdominal injuries?

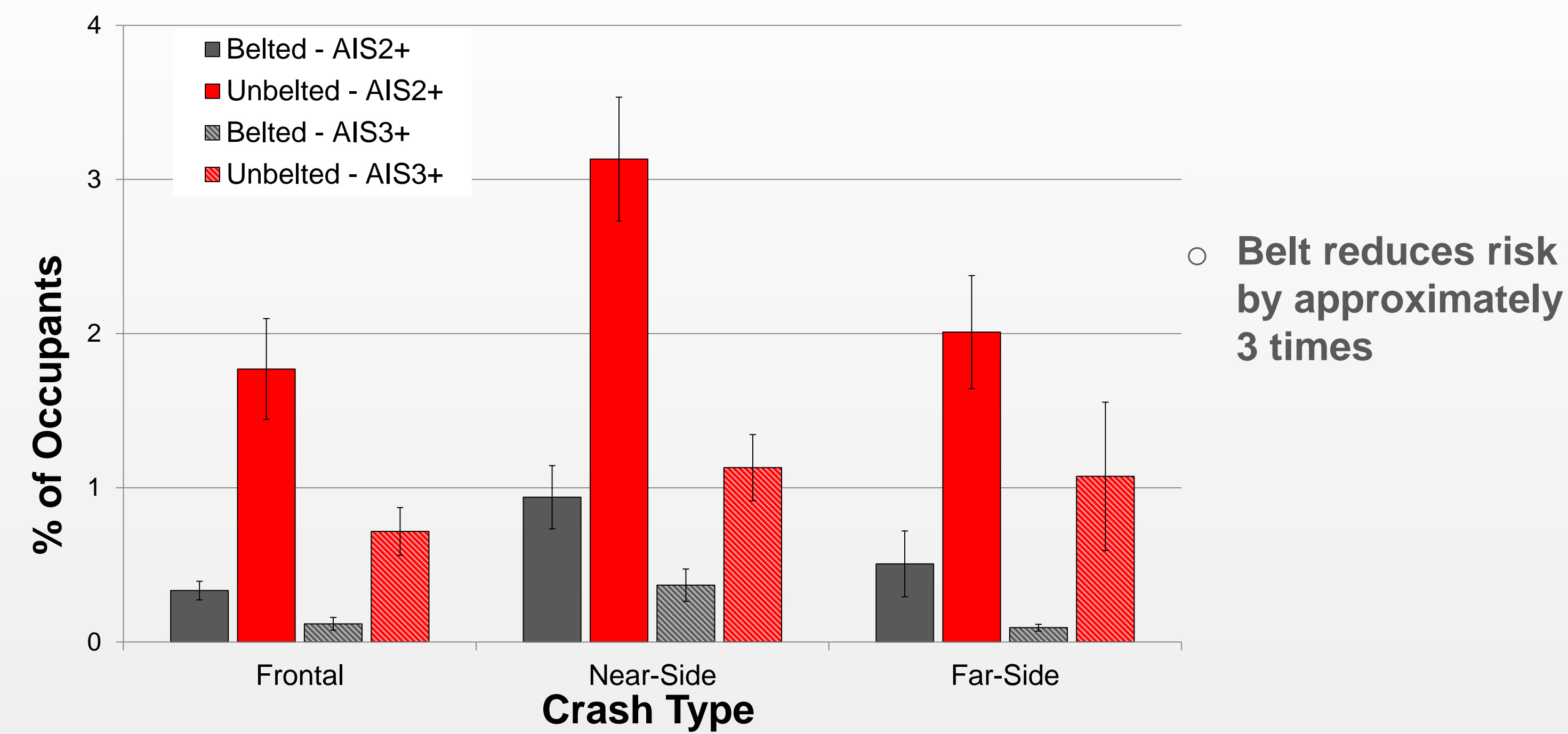


Figure 2: Risk of AIS 2+ and AIS 3+ abdomen injury by belt restraint and crash type

### Which abdominal organs are commonly injured?

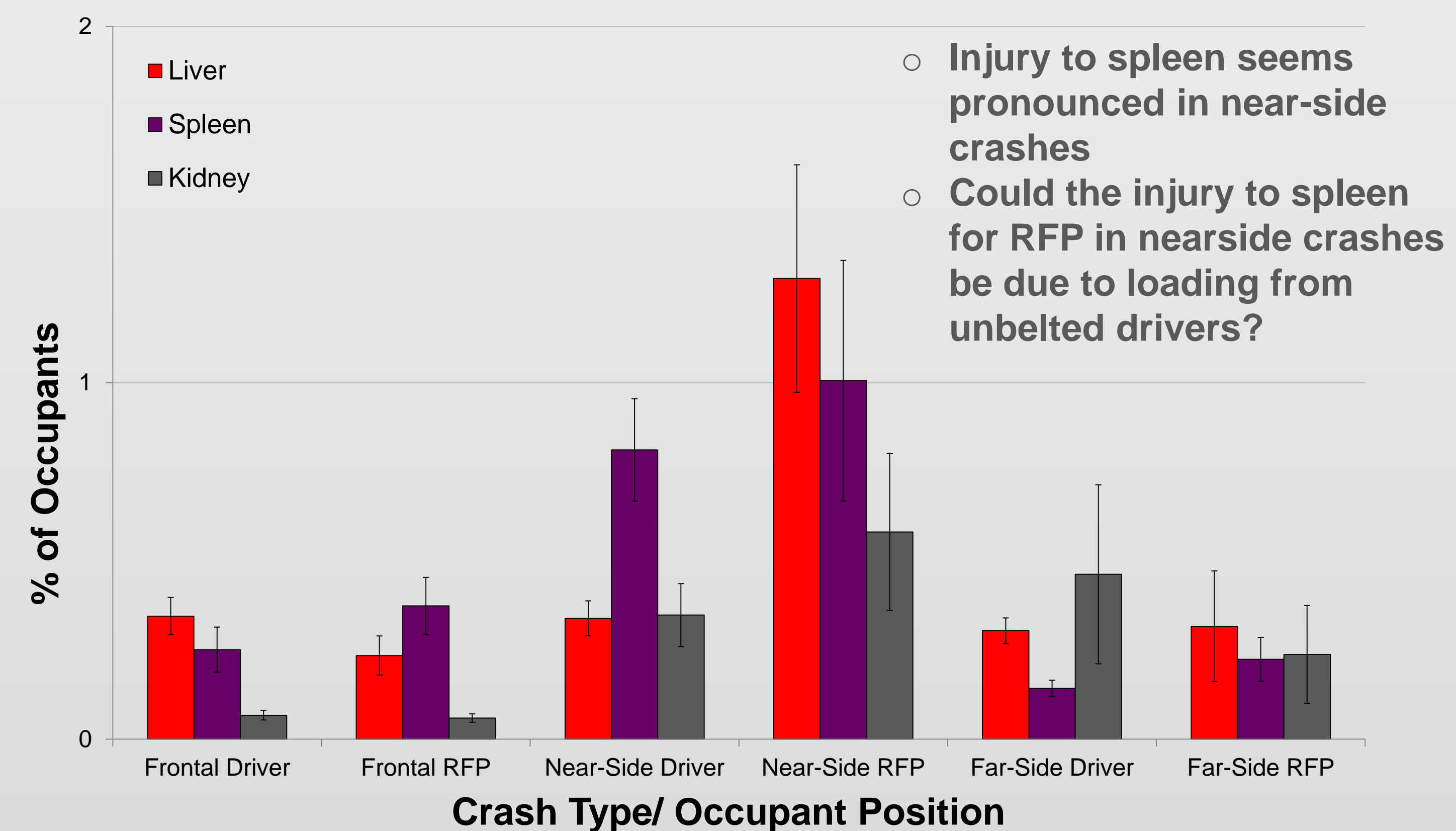


Figure 3: Risk of AIS 2+ injury to liver, spleen and kidney by crash type and occupant position

### Does the risk of abdominal injury increase with crash severity / age?

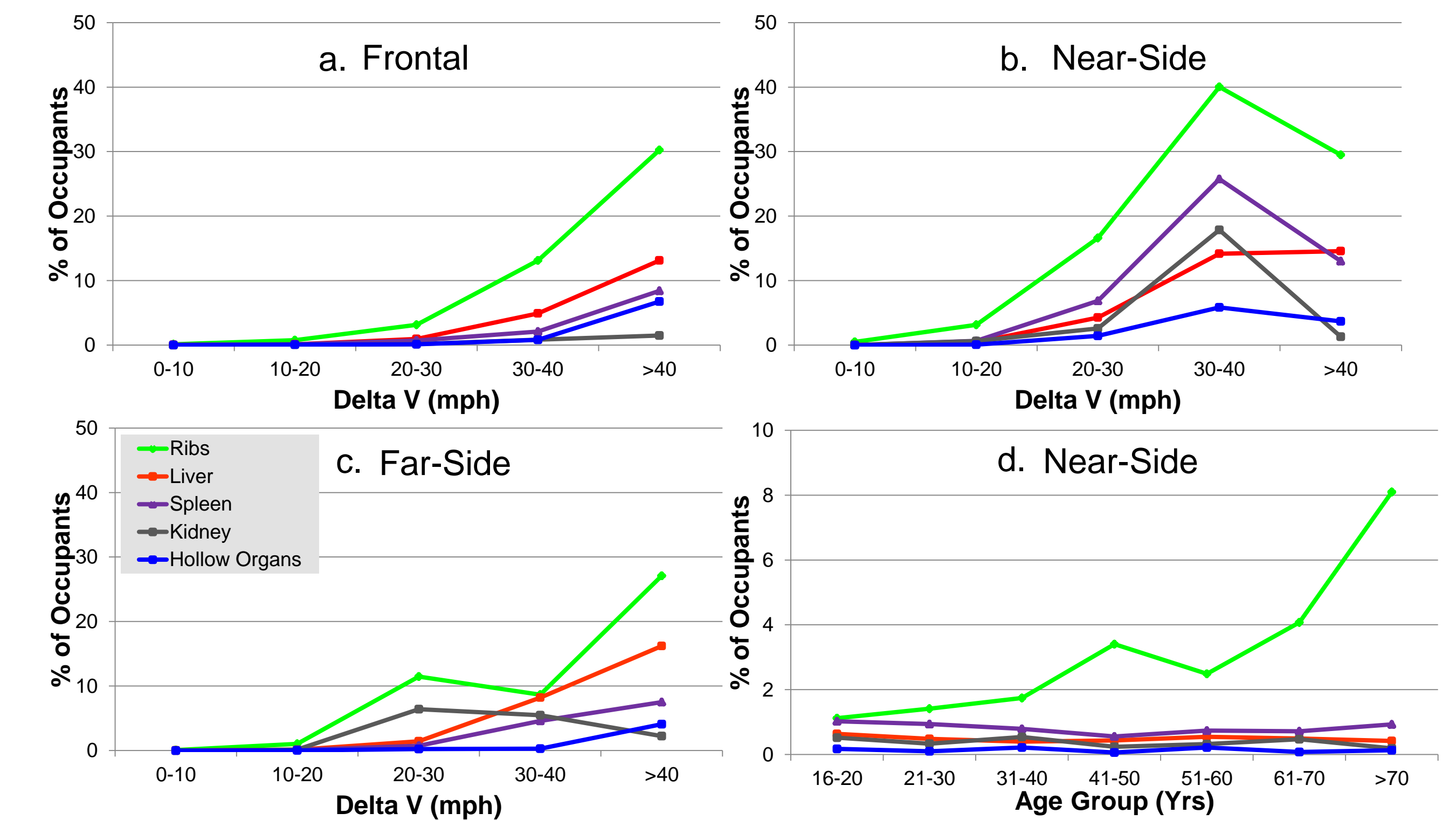


Figure 4: (a-c) Risk of AIS 2+ injury to abdominal organs and ribs by crash severity; (d) Risk of AIS 2+ injury to abdominal organs and ribs by age in near-side crashes

- Injury risk for all abdominal organs increases with crash severity.
  - Spleen is at very high risk in nearside crashes.
- Risk to abdominal organs is constant for all age groups.
  - Slightly higher risk of spleen injury.

### Are ribs the primary cause of abdominal injuries?

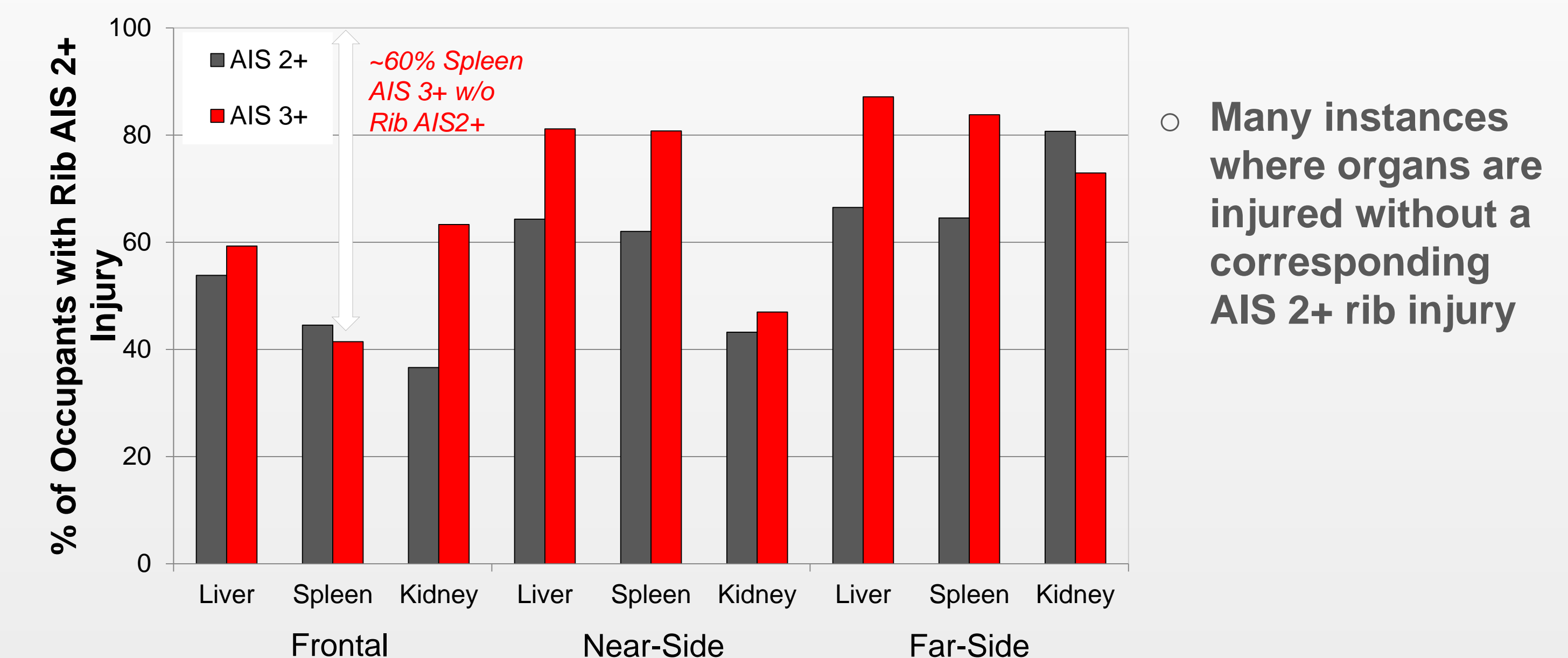


Figure 5: Injuries to liver, spleen and kidney in combination with AIS 2+ rib injury

## CONCLUSIONS

- The findings of this study are consistent with the results reported by Klinich et. al [2].
- Over 50% of abdominal injuries occur in frontal crashes.
- Right front passengers have a high risk of injury to spleen in all 3 types of crashes.
- Moving forward, the results from database searches and literature review can be combined to better analyze loading conditions.
- A more realistic lateral impact study may be required to develop force-deflection characteristics of the abdomen.
- Abdominal injuries do not always occur in conjunction with rib fractures, emphasizing the need for a separate injury criterion for abdominal organs.