Side Airbag Effectiveness: A Matched Cohort Study Using CIREN and NASS/CDS

University of Alabama at Birmingham
CIREN Center
Background

• Side-impact airbags (SABs) were first introduced in 1995

  – According to the Insurance Institute for Highway Safety (IIHS), SABs were standard in:
    • Volvo 850, S90, V90 models
    • Mercedes Benz E Class and SL Class models
Background

• SAB types
  – Head-protecting
    • Deploy from roof-side rail
  – Torso-protecting
    • Deploy from door panel or seat back
    • Early SABs only torso-protecting
## Background

### Percent side airbag availability by protection area

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Head/torso</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard</td>
<td>83.1</td>
<td>77.0</td>
<td>64.5</td>
<td>58.9</td>
<td>47.6</td>
<td>38.3</td>
<td>31.9</td>
<td>27.0</td>
<td>22.1</td>
<td>20.3</td>
<td>18.6</td>
<td>10.1</td>
<td>5.4</td>
<td>1.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optional</td>
<td>2.6</td>
<td>0.8</td>
<td>5.3</td>
<td>6.8</td>
<td>11.5</td>
<td>15.3</td>
<td>15.6</td>
<td>12.3</td>
<td>10.3</td>
<td>8.8</td>
<td>9.4</td>
<td>6.9</td>
<td>2.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Head only</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard</td>
<td>7.9</td>
<td>10.4</td>
<td>11.9</td>
<td>9.8</td>
<td>3.7</td>
<td>1.9</td>
<td>1.8</td>
<td>1.7</td>
<td>1.5</td>
<td>0.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optional</td>
<td>1.7</td>
<td>2.2</td>
<td>6.9</td>
<td>9.7</td>
<td>15.1</td>
<td>14.8</td>
<td>13.6</td>
<td>8.4</td>
<td>6.2</td>
<td>3.7</td>
<td>1.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Torso only</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard</td>
<td>1.0</td>
<td>1.1</td>
<td>1.0</td>
<td>2.0</td>
<td>2.3</td>
<td>5.6</td>
<td>5.6</td>
<td>5.4</td>
<td>8.0</td>
<td>13.4</td>
<td>9.6</td>
<td>12.8</td>
<td>12.5</td>
<td>13.7</td>
<td>3.6</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>Optional</td>
<td>0.1</td>
<td>0.1</td>
<td>3.3</td>
<td>5.7</td>
<td>10.8</td>
<td>10.9</td>
<td>4.6</td>
<td>4.3</td>
<td>2.4</td>
<td>2.6</td>
<td>1.9</td>
<td>0.4</td>
<td>1.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Not available</strong></td>
<td>3.7</td>
<td>8.4</td>
<td>10.3</td>
<td>12.6</td>
<td>19.7</td>
<td>20.8</td>
<td>25.8</td>
<td>34.4</td>
<td>41.0</td>
<td>48.9</td>
<td>56.8</td>
<td>67.7</td>
<td>77.3</td>
<td>83.1</td>
<td>96.0</td>
<td>98.7</td>
<td>99.6</td>
</tr>
</tbody>
</table>

Source: Insurance Institute for Highway Safety
## Background

<table>
<thead>
<tr>
<th></th>
<th>No SAB</th>
<th>Optional</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overall</strong></td>
<td>67.8</td>
<td>20.7</td>
<td>11.5</td>
</tr>
</tbody>
</table>

Source: NHTSA General Estimates System
## Background

<table>
<thead>
<tr>
<th>Age</th>
<th>No SAB</th>
<th>Optional</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>16-29</td>
<td>72.3</td>
<td>19.4</td>
<td>8.3</td>
</tr>
<tr>
<td>30-39</td>
<td>66.2</td>
<td>21.7</td>
<td>12.1</td>
</tr>
<tr>
<td>40-49</td>
<td>66.2</td>
<td>21.0</td>
<td>12.8</td>
</tr>
<tr>
<td>50-59</td>
<td>64.3</td>
<td>21.4</td>
<td>14.3</td>
</tr>
<tr>
<td>60+</td>
<td>63.3</td>
<td>22.0</td>
<td>14.8</td>
</tr>
</tbody>
</table>

Source: NHTSA General Estimates System
Background

• SABs have been reported to be effective in reducing side-impact MVC mortality
  – McCartt et al. (2007)
    • 37% reduction for head-protecting SABs
    • 26% reduction for torso-only SABs

  – Braver et al. (2004)
    • 45% reduction for head/torso SABs
    • 11% reduction for torso-only SABs
Background

- Results for non-fatal injuries have been less consistent, varying by injury type
  - McGwin et al. (2003)
    - No difference in overall injury risk during near-side impacts between occupants with and without SAB availability
  - McGwin et al. (2004)
    - 25% reduction in risk for head, 32% reduction in risk of thoracic injury related to SAB availability in near-side impacts
  - McGwin et al. (2008)
    - 2.75-fold increase for AIS 2+ upper extremity injuries
    - 2.45-fold increase for upper extremity dislocation
Background

• Yoganandan et al. (2007)
  - NASS data for 1997-2004
  - Near-side impact collisions included
  - SABs reduce AIS 2+ head, chest and extremity injuries
  - Thorax injuries increased
  - Low sample size prohibited conclusive evidence
  - Suggested future studies combine NASS/CDS data with CIREN data
Background

- Limitations of prior research
  - Relied on SAB availability rather than deployment
  - Focused on near-side impacts, which represent a portion of all SAB deployments in MVCs
  - Limited sample size due to SABs being a newer technology
  - Residual confounding
Objective

• Assess effectiveness of SABs in reducing head and thoracic injury to front-seated occupants of MVCs
  • Prior biomechanical research has reported on the efficacy of SABs in reducing injury (i.e., ability to protect occupants from injury in a controlled environment)
  • Prior epidemiological research regarding SAB effectiveness limited due to reliance of SAB availability and small sample size
Methods

• **Study Design** – Retrospective, matched cohort study

• **Data Sources** – CIREN and NASS/CDS data 2000-2009

  • Pseudo-weights were used to combine data sources according to the technique described by Elliott et al.
CIREN

N=4,199

Model Year < 1998

N=1,351

Not in first row of vehicle

N=287

N=2,848

Missing airbag information

N=7

N=2,561

N=1,446

No side impact

Final N = 1,108

N=2,554
NASS

N=105,822

N=46,806 → Model Year < 1998

N=10,366

N=59,016 → Not in first row of vehicle

N=4,795

N=48,650 → Missing airbag information

N=25,276 → No side impact

Final N = 18,472
N=19,580
Methods

- Front-seated occupants whose SAB deployed were matched to front-seated occupants who had no SAB deployment based on:
  - Gender
  - Age ± 5 years
  - Initial object the vehicle hit (i.e., vehicle, fixed object)
  - Direction of force (±10°) of collision impact
  - Occupant seating position (driver/front passenger)
  - General area of damage (L or R) to vehicle side
  - Vehicle body type (passenger car, SUV/van, truck)
  - Pseudo-sampling weight ± 1500
Example Matched Pair

Exposed

PSU: 13
Case Number: 105
Stratum: E
Weight: 85.306
Crash Date: 05/2009
Vehicle:
  Year/Make/Model: 2009 Subaru Impreza
Example Matched Pair

Unexposed

PSU: 13
Case Number: 012
Stratum: E
Weight: 97.601
Crash Date: 01/2006
Vehicle:

Year/Make/Model: 2005 Pontiac Grand Prix
Example Matched Pair

Exposed Summary

Crash Type: Vehicle to vehicle
Configuration: Angle/sideswipe
PDOF: 300
Delta-V: 18 km/h
Summary: Vehicle 1, traveling south when it was struck in the LF by westbound vehicle 2. The vehicles then side-slapped and vehicle 2 struck a sign before coming to rest.
Example Matched Pair

Unexposed Summary

Crash Type: Vehicle to vehicle
Configuration: Angle/sideswipe
PDOF: 300
Delta-V: 12 km/h

Summary: Vehicle 1, was eastbound in lane 1 of a four lane city street. Vehicle 2 was northbound on a two lane intersecting street. Both streets had a 35 mph speed limit and the intersection is controlled by traffic signals. As Vehicle 1 entered the intersection it was contacted in the right front by the left front of vehicle 2.
Exposed Vehicle
Unexposed Vehicle
Methods

• Statistical Analysis
  – Demographic, vehicle, and collision characteristics compared between SAB deployment groups using McNemar’s and paired t-test for categorical and continuous variables, respectively
Methods

- Conditional logistic regression (adjusted for $\Delta V$) used to estimate the association between SAB deployment and AIS 2+ injury to head or thorax
  - Stratified by object hit in primary impact (i.e., vehicle or fixed object)
  - Further stratified by direction of initial impact (i.e., frontal, near-side, or far-side)
  - Stratified by age
Table 1. Comparison of demographic, vehicle/occupant, and collision characteristics by side airbag deployment

<table>
<thead>
<tr>
<th></th>
<th>SAB Deployment (n=1,199)</th>
<th>No SAB Deployment (n=1,199)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographics</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male, %</td>
<td>52.5</td>
<td>52.5</td>
<td>-</td>
</tr>
<tr>
<td>Age (years), mean</td>
<td>37.3</td>
<td>37.2</td>
<td>-</td>
</tr>
<tr>
<td>Height (cm.), mean</td>
<td>171.0</td>
<td>171.2</td>
<td>0.7121</td>
</tr>
<tr>
<td>Weight (kg), mean</td>
<td>76.3</td>
<td>77.7</td>
<td>0.1060</td>
</tr>
</tbody>
</table>
Table 1 (cont.). Comparison of demographic, vehicle/occupant, and collision characteristics by side airbag deployment

<table>
<thead>
<tr>
<th>SAB Deployment (n=1,199)</th>
<th>No SAB Deployment (n=1,199)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Vehicle/Occupant</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seat Position</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Driver</td>
<td>78.6</td>
<td>78.6</td>
</tr>
<tr>
<td>Front passenger</td>
<td>21.4</td>
<td>21.4</td>
</tr>
<tr>
<td>Seatbelt Use, yes</td>
<td>83.2</td>
<td>80.1</td>
</tr>
<tr>
<td><strong>Vehicle Body Type</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passenger car</td>
<td>75.2</td>
<td>75.2</td>
</tr>
<tr>
<td>SUV/Van</td>
<td>24.3</td>
<td>24.3</td>
</tr>
<tr>
<td>Truck</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Vehicle Model Year</strong></td>
<td></td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>1998-2000</td>
<td>14.8</td>
<td>42.0</td>
</tr>
<tr>
<td>2001-2003</td>
<td>31.9</td>
<td>32.5</td>
</tr>
<tr>
<td>2004-2006</td>
<td>31.8</td>
<td>21.4</td>
</tr>
<tr>
<td>2007-2010</td>
<td>21.6</td>
<td>4.1</td>
</tr>
</tbody>
</table>
Table 1 (cont.). Comparison of demographic, vehicle/occupant, and collision characteristics by side airbag deployment

<table>
<thead>
<tr>
<th>SAB Deployment (n=1,199)</th>
<th>No SAB Deployment (n=1,199)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collision Impact</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frontal</td>
<td>62.3</td>
<td>62.3</td>
</tr>
<tr>
<td>Near-side</td>
<td>30.3</td>
<td>30.9</td>
</tr>
<tr>
<td>Far-side</td>
<td>3.8</td>
<td>3.8</td>
</tr>
<tr>
<td>Rear</td>
<td>3.5</td>
<td>3.1</td>
</tr>
<tr>
<td>Rollover</td>
<td>17.1</td>
<td>15.1</td>
</tr>
<tr>
<td>Ejection</td>
<td>6.8</td>
<td>7.4</td>
</tr>
<tr>
<td>Total ΔV (km/h)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-24</td>
<td>38.3</td>
<td>40.3</td>
</tr>
<tr>
<td>25-49</td>
<td>57.9</td>
<td>54.2</td>
</tr>
<tr>
<td>50+</td>
<td>3.8</td>
<td>5.5</td>
</tr>
<tr>
<td>Vehicle crush (cm.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-39</td>
<td>66.5</td>
<td>62.1</td>
</tr>
<tr>
<td>40-59</td>
<td>19.5</td>
<td>24.3</td>
</tr>
<tr>
<td>60-79</td>
<td>8.9</td>
<td>7.5</td>
</tr>
<tr>
<td>80+</td>
<td>5.1</td>
<td>6.1</td>
</tr>
</tbody>
</table>
NASS CDS Example

PSU: 6
Case Number: 004
Stratum: C
Weight: 18.258
Crash Date: 01/2009
Day Of Week: Thursday
Crash Time: 15:15
Case Summary:

Crash Type: Vehicle to vehicle

Configuration: Head-on

Summary: V1 was traveling northeast when the front came in contact with the front of V2. V2 had been traveling southwest on the same roadway. After the initial impact, V1 then spun counterclockwise and the right rear side came into contact with the left rear side of V2. V2 had spun in a clockwise direction. The driver of V1 was ejected from his vehicle.
<table>
<thead>
<tr>
<th></th>
<th>SAB deployed (n=1,199)</th>
<th>No SAB deployed (n=1,199)</th>
<th>RR (95% CI)†</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Head Injury</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All collisions</td>
<td>19.8</td>
<td>21.3</td>
<td>0.86 (0.70-1.07)</td>
</tr>
<tr>
<td>Vehicle vs. vehicle</td>
<td>14.9</td>
<td>15.6</td>
<td>0.81 (0.60-1.09)</td>
</tr>
<tr>
<td>Vehicle vs. fixed object</td>
<td>31.7</td>
<td>35.6</td>
<td>0.87 (0.62-1.22)</td>
</tr>
<tr>
<td><strong>Thorax Injury</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All collisions</td>
<td>23.2</td>
<td>21.6</td>
<td>1.02 (0.83-1.27)</td>
</tr>
<tr>
<td>Vehicle vs. vehicle</td>
<td>18.3</td>
<td>17.5</td>
<td>0.92 (0.69-1.23)</td>
</tr>
<tr>
<td>Vehicle vs. fixed object</td>
<td>35.3</td>
<td>31.1</td>
<td>1.11 (0.79-1.57)</td>
</tr>
</tbody>
</table>

† Adjusted for ΔV
Table 3. Risk ratios (RR) and 95% confidence intervals (95% CI) for the association between head side airbag (hSAB) deployment and AIS 2+ injury

<table>
<thead>
<tr>
<th>Risk (per 100)</th>
<th>hSAB deployed (n=681)</th>
<th>No hSAB deployed (n=681)</th>
<th>RR (95% CI)†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head Injury</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All collisions</td>
<td>14.2</td>
<td>19.5</td>
<td>0.70 (0.51-0.97)</td>
</tr>
<tr>
<td>Vehicle vs. vehicle</td>
<td>10.6</td>
<td>14.3</td>
<td>0.66 (0.42-1.03)</td>
</tr>
<tr>
<td>Vehicle vs. fixed object</td>
<td>25.3</td>
<td>35.8</td>
<td>0.70 (0.43-1.14)</td>
</tr>
</tbody>
</table>

† Adjusted for ∆V
Table 4. Risk ratios (RR) and 95% confidence intervals (95% CI) for the association between torso side airbag (tSBA) deployment and AIS2+ injury

<table>
<thead>
<tr>
<th></th>
<th>tSAB deployed (n=1,000)</th>
<th>No tSAB deployed (n=1,000)</th>
<th>RR (95% CI)†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thorax Injury</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All collisions</td>
<td>24.6</td>
<td>23.0</td>
<td>0.99 (0.79-1.24)</td>
</tr>
<tr>
<td>Vehicle vs. vehicle</td>
<td>20.7</td>
<td>18.5</td>
<td>0.93 (0.69-1.26)</td>
</tr>
<tr>
<td>Vehicle vs. fixed object</td>
<td>33.4</td>
<td>32.4</td>
<td>0.96 (0.66-1.38)</td>
</tr>
</tbody>
</table>

† Adjusted for ∆V
Table 5a. Risk ratios and 95% confidence intervals for the association between head side airbag deployment and AIS 2+ head injury by direction of initial impact

<table>
<thead>
<tr>
<th>Head Injury</th>
<th>Frontal (n=412 pairs)</th>
<th>Near-Side (n=163 pairs)</th>
<th>Far-Side (n=29 pairs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All collisions</td>
<td>RR (95% CI)†</td>
<td>RR (95% CI)†</td>
<td>RR (95% CI)†</td>
</tr>
<tr>
<td>Vehicle vs. vehicle</td>
<td>0.67 (0.43-1.04)</td>
<td>0.65 (0.33-1.29)</td>
<td>0.61 (0.11-3.53)</td>
</tr>
<tr>
<td>Vehicle vs. fixed object</td>
<td>0.66 (0.36-1.22)</td>
<td>0.68 (0.29-1.58)</td>
<td>0.87 (0.10-7.33)</td>
</tr>
</tbody>
</table>

† Adjusted for ∆V
Table 5b. Risk ratios and 95% confidence intervals for the association between torso side airbag deployment and AIS 2+ thorax injury by direction of initial impact.

<table>
<thead>
<tr>
<th>Thorax Injury</th>
<th>Frontal (n=569 pairs)</th>
<th>Near-Side (n=293 pairs)</th>
<th>Far-Side (n=25 pairs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All collisions</td>
<td>RR (95% CI)†</td>
<td>RR (95% CI)†</td>
<td>RR (95% CI)†</td>
</tr>
<tr>
<td>Vehicle vs. vehicle</td>
<td>1.00 (0.72-1.41)</td>
<td>1.00 (0.66-1.51)</td>
<td>0.36 (0.03-4.67)</td>
</tr>
<tr>
<td>Vehicle vs. fixed object</td>
<td>0.91 (0.58-1.41)</td>
<td>0.99 (0.61-1.61)</td>
<td>Undefined</td>
</tr>
<tr>
<td></td>
<td>0.96 (0.52-1.75)</td>
<td>1.09 (0.49-2.43)</td>
<td>Undefined</td>
</tr>
</tbody>
</table>

† Adjusted for ΔV
Table 6. Risk ratios (RR) and 95% confidence intervals (95% CI) for the association between side airbag (SAB) deployment and AIS 2+ injury according to age

<table>
<thead>
<tr>
<th>Age</th>
<th>Thorax Injury RR (95% CI)†</th>
<th>Head Injury RR (95% CI)†</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;25</td>
<td>0.98 (0.62-1.54)</td>
<td>0.72 (0.43-1.22)</td>
</tr>
<tr>
<td>25-49</td>
<td>0.78 (0.53-1.13)</td>
<td>0.68 (0.37-1.23)</td>
</tr>
<tr>
<td>50+</td>
<td>1.27 (0.84-1.93)</td>
<td>0.91 (0.44-1.90)</td>
</tr>
</tbody>
</table>

† Adjusted for ΔV
<table>
<thead>
<tr>
<th>Physical Component</th>
<th>SAB Deployed (%)</th>
<th>No SAB Deployed (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front (e.g., steering wheel)</td>
<td>1.5</td>
<td>3.8</td>
</tr>
<tr>
<td>Side (e.g., A/B pillar)</td>
<td>17.7</td>
<td>18.3</td>
</tr>
<tr>
<td>Door panel (e.g., armrest)</td>
<td>0.5</td>
<td>0.9</td>
</tr>
<tr>
<td>Roof (e.g., header)</td>
<td>8.9</td>
<td>9.2</td>
</tr>
<tr>
<td>Interior (e.g., seat, console)</td>
<td>1.6</td>
<td>1.8</td>
</tr>
<tr>
<td>Other vehicle or object</td>
<td>17.1</td>
<td>22.3</td>
</tr>
<tr>
<td>Noncontact (e.g., flying glass)</td>
<td>3.7</td>
<td>3.7</td>
</tr>
<tr>
<td>Airbag</td>
<td>0.4</td>
<td>-</td>
</tr>
<tr>
<td>Missing</td>
<td>48.7</td>
<td>40.0</td>
</tr>
<tr>
<td>Physical Component</td>
<td>SAB Deployed (%)</td>
<td>No SAB Deployed (%)</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Front (e.g., steering wheel)</td>
<td>2.2</td>
<td>5.8</td>
</tr>
<tr>
<td>Side (e.g., A/B pillar)</td>
<td>25.7</td>
<td>32.5</td>
</tr>
<tr>
<td>Door panel (e.g., armrest)</td>
<td>8.9</td>
<td>3.8</td>
</tr>
<tr>
<td>Floor (e.g., toe pan)</td>
<td>0.5</td>
<td>0.9</td>
</tr>
<tr>
<td>Roof (e.g., header)</td>
<td>0.5</td>
<td>0.4</td>
</tr>
<tr>
<td>Interior (e.g., seat, console)</td>
<td>4.5</td>
<td>3.6</td>
</tr>
<tr>
<td>Other vehicle or object</td>
<td>4.1</td>
<td>3.1</td>
</tr>
<tr>
<td>Noncontact (e.g., flying glass)</td>
<td>2.5</td>
<td>1.3</td>
</tr>
<tr>
<td>Airbag</td>
<td>0.5</td>
<td>-</td>
</tr>
<tr>
<td>Missing</td>
<td>50.5</td>
<td>48.2</td>
</tr>
</tbody>
</table>
Discussion

• SABs are associated with lower risk of AIS2+ head injuries
  – Effect sizes consistent with prior research
  – Head protection appears similar across collision types
  – Older occupants do not appear to benefit (as much)

• No associations for AIS2+ thorax injuries
  – Smaller (compared to thorax injuries) but meaningful associations observed in prior research
  – Consistent across collision types and age groups
Strengths

• Ability to determine SAB deployment rather than availability

• Combined CIREN and NASS/CDS data = larger sample size

• Inclusion of all impact types (rather than just near-side collisions) provides a more comprehensive assessment of SAB effectiveness on injury risk
Limitations

• Lack of detailed information available in controlled studies
  – Occupant position at time of SAB deployment
  – Knowledge of when, during the impact, the SAB deployed

• Previous research has suggested occupant position in relation to SAB is an important mechanism of injury protection
Next Steps

• Expand study base to capture all currently available data
  – Recalculate pseudo-weights

• Expand study population to include rear-seated occupants

• Calculate risk estimates according to specific SAB types

• Estimate associations for organ-specific injuries (e.g., splenic injury)

• Others…
Side Airbag Effectiveness: A Matched Cohort Study Using CIREN and NASS/CDS

University of Alabama at Birmingham
CIREN Center