Integrating Infant and Child Injury Prevention into Programs and Services for Expectant Parents

Motor Vehicle Safety during Pregnancy

October 1st, 3-4pm ET

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Type any additional questions or comments into the Chat box on the left.
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MOTOR VEHICLE SAFETY DURING PREGNANCY

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Department of Epidemiology
Gillings School of Global Public Health
University of North Carolina at Chapel Hill
A story...
Learning Objectives

- To describe the epidemiology of motor vehicle crashes during pregnancy
- To explain the association between motor vehicle crashes during pregnancy and adverse fetal outcomes
- To describe vehicle safety features and their association with adverse pregnancy outcomes
- To identify interventions that may improve motor vehicle safety during pregnancy
Learning objective: To describe the epidemiology of motor vehicle crashes during pregnancy.
Licensed Women Drivers (in Millions), Ages 18 to 44, 1963 to 2011

Source: Federal Highway Administration, U.S. Department of Transportation
Crashes During Pregnancy

- U.S. pregnant occupant crash rate of 13 per 1,000 person-years
- U.S. non-pregnant occupant crash rate of 26 per 1,000 person-years
- Pregnant occupant crash rate is likely underestimated due to limitations in surveillance and reporting

Source: Weiss & Strotmeyer, 2002
Crash Surveillance

- National data systems:
  - National Automotive Sampling System (NASS/CDS)
  - Fatality Analysis Reporting System (FARS)

- State-level databases:
  - Motor vehicle crash reports
  - Hospital discharge records
  - Emergency Department visits

Link to live birth and fetal death certificates
Percent of Pregnant Women in Crashes

Sources: Hyde et al., 2003 (UT); Schiff et al., 2010 (WA); Weiss et al., 2011 (PA); Vladutiu et al., 2013 (NC)
Pregnant Driver Crash Risk in North Carolina, 2001 to 2008

Source: Vladutiu et al., 2013
Fetal Health

**Learning objective:** To explain the association between motor vehicle crashes during pregnancy and adverse fetal outcomes
Fetal Morbidity and Mortality

- Direct injury
  - Fetal organs and systems
  - Shared organs and systems

- Indirect harm
  - Prematurity
  - Low birth weight
  - Infant death

Photo source: Pritchard et al., 1985
Crashes and Fetal Outcomes

- Crash simulation studies
  - Anthropomorphic devices
  - Computer simulations
- Case reports
- Population-based studies
  - Linkage studies in UT, WA, and NC
## Population-Based Studies (Crashes)

### Pregnancy Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PTB</th>
<th>Stillbirth</th>
<th>LBW</th>
<th>PA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crash vs. no crash [RR (95% CI)]</td>
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<tr>
<td>UT(^1)</td>
<td>1.02</td>
<td>1.03</td>
<td>1.00</td>
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<td></td>
<td>(0.94, 1.11)</td>
<td>(0.94, 1.14)</td>
<td>(0.81, 1.24)</td>
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<tr>
<td>WA(^1)</td>
<td>1.40</td>
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<td>6.00</td>
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<tr>
<td></td>
<td>(1.10, 1.90)</td>
<td></td>
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<td>(4.30, 8.20)</td>
</tr>
</tbody>
</table>

Abbreviations: PTB, preterm birth; LBW, low birth weight; PA, placental abruption

1. Estimates are adjusted risk ratios (Hyde et al., 2003; Schiff et al., 2005)
## Population-Based Studies (Crashes)

### Pregnancy Outcomes

<table>
<thead>
<tr>
<th></th>
<th>PTB</th>
<th>Stillbirth</th>
<th>PA</th>
<th>PROM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First or second crash vs. no crash [RR (95% CI)]</strong></td>
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<tr>
<td><strong>NC¹</strong></td>
<td></td>
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<tr>
<td><strong>First Crash</strong></td>
<td>1.23</td>
<td>1.07</td>
<td>1.34</td>
<td>1.32</td>
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<tr>
<td></td>
<td>(1.19, 1.28)</td>
<td>(0.90, 1.29)</td>
<td>(1.15, 1.56)</td>
<td>(1.21, 1.43)</td>
</tr>
<tr>
<td><strong>Second Crash</strong></td>
<td>1.54</td>
<td>4.82</td>
<td>2.97</td>
<td>1.95</td>
</tr>
<tr>
<td></td>
<td>(1.24, 1.90)</td>
<td>(2.85, 8.14)</td>
<td>(1.60, 5.53)</td>
<td>(1.27, 2.99)</td>
</tr>
</tbody>
</table>

Abbreviations: PTB, preterm birth; PA, placental abruption; PROM, premature rupture of the membranes

¹ Estimates are adjusted rate ratios (Vladutiu et al., in press)
Learning objective: To describe vehicle safety features and their association with adverse pregnancy outcomes
Seat Belts

- Designed to secure vehicle occupants against harmful movements from collisions or sudden stops

- Reduce occupant injury and death during crashes in the general population
  - 15,147 lives were saved by seat belts in 2007

- Evidence suggests that seat belts, if worn properly, may minimize injury from crashes during pregnancy

Source: (1) NHTSA, 2009 (DOT HS 811 206)
Seat Belts During Pregnancy

- Always wear a safety belt
- Lap belt should be below abdomen and across hips
- Shoulder belt should be above abdomen and placed diagonally across chest and between breasts
- Seat belt should not be behind back or under arm

Source: NHTSA, 2002 (DOT HS 809 506) with input from ACOG
# Population-Based Studies (Seat belts)

## Pregnancy Outcomes

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<thead>
<tr>
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<th>PROM</th>
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<tbody>
<tr>
<td><strong>Unbelted vs. belted [RR (95% CI)]</strong></td>
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<tr>
<td><strong>WA</strong>&lt;sup&gt;1&lt;/sup&gt;</td>
<td></td>
<td>4.10 (0.80, 20.30)</td>
<td>1.90 (1.20, 2.90)</td>
<td>0.90 (0.40, 2.20)</td>
<td></td>
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<tr>
<td><strong>UT</strong>&lt;sup&gt;1&lt;/sup&gt;</td>
<td>1.00 (0.78, 1.29)</td>
<td>2.80 (1.40, 5.60)</td>
<td>1.18 (0.89, 1.56)</td>
<td>0.88 (0.44, 1.76)</td>
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<tr>
<td><strong>NC</strong>&lt;sup&gt;2&lt;/sup&gt;</td>
<td>1.13 (0.86, 1.51)</td>
<td>2.77 (1.22, 6.28)</td>
<td></td>
<td>1.06 (0.34, 3.31)</td>
<td>1.18 (0.65, 2.15)</td>
</tr>
</tbody>
</table>

Abbreviations: PTB, preterm birth; LBW, low birth weight; PA, placental abruption; PROM, premature rupture of the membranes

1. Estimates are adjusted risk ratios (Wolf et al., 1993; Hyde et al., 2003) with the exception of the unadjusted RR for stillbirth in UT
2. Estimates are adjusted rate ratios (Vladutiu et al., in press)
Airbags

- Designed to deploy in moderate-to-severe frontal and near-frontal crashes
- Reduce occupant injury and death during crashes in the general population
  - 2,788 lives were saved by frontal air bags in 2007
- Mixed evidence regarding the effect of airbags on adverse maternal and fetal outcomes in crashes during pregnancy

Source: (1) NHTSA, 2009 (DOT HS 811 206)
Airbags During Pregnancy

- Airbag switch should **not** be turned off
- Maintain a **10-inch distance** between the breastbone and steering wheel
- Angle steering wheel towards breastbone (if tilt wheel)

Source: ACOG, 2011 (Photo source: NHTSA, 2009)
<table>
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<tr>
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<tr>
<td><strong>Airbag deployed vs. not deployed [RR (95% CI)]</strong></td>
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<tr>
<td>WA(^1)</td>
<td>0.80</td>
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<td>(0.30, 1.90)</td>
<td>(0.30, 2.00)</td>
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<tr>
<td><strong>Airbag available vs. not available [RR (95% CI)]</strong></td>
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<td>WA(^1)</td>
<td>1.10</td>
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<tr>
<td></td>
<td>(0.80, 1.60)</td>
<td>(0.70, 1.60)</td>
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<tr>
<td><strong>Unequipped vs. equipped [RR (95% CI)]</strong></td>
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<td></td>
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<tr>
<td>NC(^2)</td>
<td>1.03</td>
<td>0.91</td>
<td>1.58</td>
<td>0.95</td>
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<tr>
<td></td>
<td>(0.92, 1.14)</td>
<td>(0.58, 1.44)</td>
<td>(1.08, 2.30)</td>
<td>(0.75, 1.20)</td>
<td></td>
</tr>
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Abbreviations: PTB, preterm birth; LBW, low birth weight; PA, placental abruption; PROM, premature rupture of the membranes
1. Estimates are adjusted risk ratios (Schiff et al., 2010); 2. Estimates are adjusted rate ratios (Vladutiu et al., in press)
Learning objective: To identify interventions that may improve motor vehicle safety during pregnancy
Potential Interventions

- Seat belt practices
- Behavior modification
- Protective garments and devices
- Vehicle design
- Legislation
Seat Belt Practices

- Increase the prevalence of seat belt use during pregnancy
  - Prevalence of 84% in the U.S.\(^1\)
  - Prevalence of 75% - 96% across individual studies\(^2-5\)

- Minimize concerns and correct misconceptions
  - Women hindered by fear of injury, potential harm to fetus, belief that belts are unnecessary, discomfort\(^3,5\)

- Increase proper seat belt use
  - Proper belt use occurs in 47% - 73% of pregnant women\(^2-5\)

Sources: (1) Beck et al., 2005; (2) Jamjute et al., 2005; (3) Pearlman & Phillips, 1996; (4) Tyroch et al., 1999; (5) McGwin et al., 2004a
Seat Belt Practices

- Educational interventions
- Prenatal care counseling

Example brochures:

- http://www.trafficsafetymarketing.gov/newtsm/tk-bua/PregnantWomenSeatBeltFlyer.pdf (left)
- www.nhtsa.gov/.../pregnancybrochure/BUA_PregnancyNHTSAchange.p... (above)
- http://www.acog.org/~/media/For%20Patients/faq018.pdf?dmc=1&ts=20130929T132291724 (Not shown)
Driving Behaviors

- Modify driving behaviors to decrease crash risk
- Consider driving during safer conditions
  - Good weather conditions
  - Well-maintained roads
  - Average speeds
- Reduce driving frequency and distances
Protective Garments

Protective Devices

Protective Devices

For more information: http://www.dreambaby.com.au
Protective Devices

For more information: http://www.pregnancyseatbeltharness.com
**Vehicle Design**

- Performance standards based on male occupant of average weight and height
- Women may adjust devices in the vehicle
  - Seat belts
  - Steering wheel
- Auto manufacturers should consider pregnant women when designing and testing vehicles
Legislation

- Seat belt use is higher in “primary law states” vs. “secondary law states” (90% vs. 78%)\(^1\)

- Primary seat belt laws\(^2\)
  - 33 states and the District of Columbia (front seat)
  - 16 states and the District of Columbia (rear seat)

- Secondary seat belt laws\(^2\)
  - 16 states (7 states include rear seats)

- Some states may allow medical exemptions for pregnancy

Sources: (1) Pickrell & Ye, 2012; (2) Governors Highway Safety Association, 2013
Summary

- Motor vehicle crashes during pregnancy are not uncommon.
- Crashes during pregnancy are associated with an increased risk of several adverse pregnancy outcomes.
- Seat belts appear to be effective at minimizing the risk of crash-related adverse fetal outcomes.
- Airbags do not appear to increase the risk of crash-related adverse pregnancy outcomes.
- Interventions are needed to improve motor vehicle safety during pregnancy.
Public Health Implications

- Improve surveillance of crashes during pregnancy
- Encourage safe driving behaviors and practices
- Develop effective programs for improving belt use
- Improve crash protection systems for pregnant women and fetuses
20 y/o 2nd trimester
Unbelted rear passenger
Dead on arrival

25 y/o 1st trimester
Belted front passenger
Hospitalized

20 y/o 3rd trimester
Belted driver
Hospitalized

18 y/o 1st trimester
Unbelted driver
Dead on arrival

Photo source: NHTSA, 2008
Questions?
Contact Information

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Phone: (919) 966-6651


Additional References

Educational Interventions:


Prenatal counseling:

Thank you for your participation!

Please take a moment to fill out our evaluation:

https://www.surveymonkey.com/s/expectant_cop100113

Questions or Comments? Contact:

Rhunt@edc.org

617-618-2178