Risk factors for serious injury to child occupants 0-3 years in motor vehicle crashes

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Background
Children in car crashes

- Significant cause of morbidity and mortality
- NSW - 1130 injured and 17 killed each year\(^1\)
- Restraint usage over 99\%\(^2\)

\(^{1}\)5 year average from 2005-2009 obtained from NSW Centre for Road Safety
\(^{2}\)Brown et al., Accident Analysis & Prevention 2010, 42(6):2144-2148
Child occupants

• Not a homogenous group
• Require different restraints
• Variations in anatomy and biology

Need to look specifically at children aged 0-3 years!
Crash factors

- Rear seat offers protective effect\textsuperscript{3,4}
- Increased risk of serious injury in side-impact\textsuperscript{5,6}

\textsuperscript{3}Berg et al., Pediatrics 2000, 105(4):831-835
\textsuperscript{4}Smith & Cummings, Injury Prevention 2006, 12(2):83-86
\textsuperscript{5}Arbogast et al., The Journal of Trauma 2001, 51(3):469-477
\textsuperscript{6}Orzechowski et al., The Journal of Trauma 2003, 54(6):1094-1101
The Henderson study

- Correctly restraint usage = high level of protection
- Premature graduation
- Did not look at 0-3 years as population subset
- No other crash factors analysed

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Henderson et al., 38th Annual Proceedings, Association for the Advancement of Automotive Medicine 1994, 75-87
What risk factors are associated with serious injury following a motor vehicle crash in children aged 0-3 years?
Methods
Data collection

• Retrospective medical record review
• Children's Hospital at Westmead (80)
• Department of Forensic Medicine (10)
Variables

- Age
- Restraint status
- Estimated vehicle speed
- Impact direction
- Crash location
- Seating position
- Occupant ejection
- Injury Severity Score (ISS)
Data analysis

LOGISTIC REGRESSION

Models 1 & 2
• Age, restraint, speed, crash location/impact direction

Models 3 & 4 (excl. unspecified restraint status)
• Age, restraint, speed, crash location/impact direction
Results
Study population

- Age: mean 15 months, range 1-35 months
- 14.4% fatally injured
Injury Severity Score

- Mean 8.3
- Range 0-75
Restraint use

Study population

- Restraint use: 85.6%
- Inappropriate restraint use: 17.8%
Restraint use

Seriously injured cases

- Restraint use: 80.0%
- Inappropriate restraint use: 25.7%
Impact direction

Serious injury (ISS >8) occurred in:
- 41.1% of side/rollover impacts
- 28.6% of front/rear impacts
Crash location

Serious injury (ISS >8) occurred in:
- 72.7% of rural crashes
- 34.2% of metropolitan crashes

![Bar chart showing frequency of serious injury (ISS >8) by crash location and severity.]
Ejections

- 4 out of 8 ejections were complete
- 75% of complete ejections occurred in rollovers
Logistic regression 1

Age, restraint status, estimated speed, crash location

• Serious injury 6x as likely in rural crashes
  • OR increased to 9.0 with exclusion of unspecified restraint status
• Serious injury 3x as likely for inappropriately restrained
Logistic regression 2

Age, restraint status, estimated speed, impact direction

- Serious injury 4x as likely for inappropriately restrained
- OR increased to 4.7 with exclusion of unspecified restraint status
- Serious injury 3x as likely for side/rollover impacts
Discussion
Key findings

• Inappropriate restraint use appears to increase the risk of serious injury

• Side/rollover impacts may pose the greatest injury risk to young children

• Serious injuries appear to be more likely in rural crashes

• There may be an association between rollovers and complete ejections
Implications

Restraint use

• Premature graduation from child restraints needs to be addressed

• Need to investigate the protection provided by forward- and reward-facing restraint systems

• Role of restraint misuse?
Implications

Impact direction
• Better understanding of injury mechanisms in side & rollover impacts needed

Crash location
• Need to investigate why children are at a significantly greater risk for serious injury in rural crashes
Implications

Ejections

• May be related to restraint misuse but this needs further investigation
• May also be related to restraint design
• Small numbers means observations need further confirmation
Limitations

• Sample biased towards seriously injured children
• Retrospective nature
• Use of ISS as a measure of serious outcome
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