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Analysis of Data from the Iowa Child Passenger Safety Survey

Children and Motor Vehicle Accidents

- National Kids Coalition
  - Leading cause of death in US for children from 3 to 14 years
- Iowa Department of Public Safety, 2004
  - 40 children killed statewide each year
- National Highway Traffic Safety Administration, 2004
  - Reduced risk of death:
    - 71% for infants
    - 54% for children aged 1 to 4 years
- Durbin et al., 2003
  - Booster seats reduce injury risk by 59% compared to seat belts alone for children 4 to 7 years
- The proper use of child safety seats, booster seats, and seat belts is the best protection available to keep children safe in motor vehicles.

Outline

- Survey Background
- Methods
  - Data collection
  - Statistical methods
- Results
- Conclusions

Iowa Laws

- Since 1985, children required to be properly protected through the use of child safety seats, booster seats and/or seat belts
- In 2004, the law was revised to require the following:

Ages of Children	Restraint Use
0 – 1	Rear-Facing Child Safety Seat
2 – 5	Child Safety Seat or Booster Seat
6 – 10	Booster Seat or Seat Belt

- 18-month education phase

Rear-Facing Safety Seat

Front-Facing Safety Seat

Booster Seat/Seat Belt

Child Passenger Safety Survey Project

- Conducted by University of Iowa Injury Prevention Research Center
- Contracted by Iowa Governor's Traffic Safety Bureau
- Principal Investigator: John Lundell
- Results reported to Iowa state legislature

Data Collection

- Design before 2005
  - Based on drive-by observation
  - Underrepresented rural communities
- Target sample size for entire state is n = 3,000
- New objective:
  - Survey data to resemble the composition of urban and rural areas of the state

Data Collection

- Current Design
  - Three surveyors
  - A card is given to the driver explaining the study
  - The driver is asked the age of each child
  - The restraint status of each child is directly observed
  - The restraint status of the driver and the vehicle type are also recorded
  - No identifying information is collected

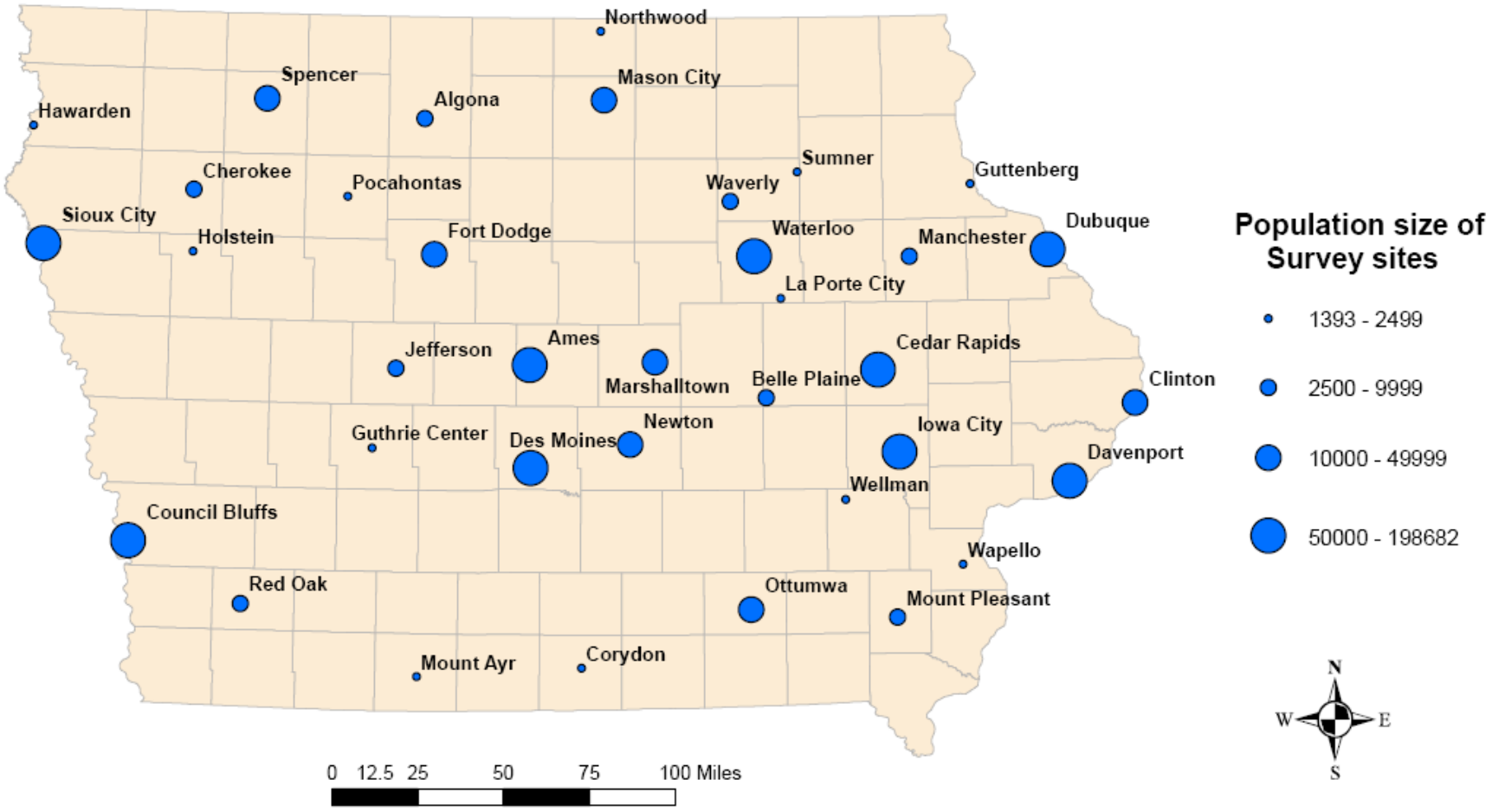
Data Collection

- Rural Communities 1,000 – 2,499
  - n = 50
  - Corydon, Guthrie Center, Guttenburg, Hawarden, Holstein, Laporte City, Mount Ayr, Northwood, Pocahontas, Sumner, Wapello, and Wellman
- Towns 2,500 – 9,999
  - n = 75
  - Algona, Belle Plaine, Cherokee, Jefferson, Manchester, Mount Pleasant, Red Oak, and Waverly

Data Collection

- Suburban Communities 10,000 – 49,999
  - n = 100
  - Clinton, Fort Dodge, Marshalltown, Mason City, Newton, Ottumwa, and Spencer
- Urban Communities 50,000+
  - n = 125
  - Ames, Cedar Rapids, Council Bluffs, Davenport, Des Moines, Dubuque, Iowa City, Sioux City, and Waterloo

Data Collection



Variables

- Outcome Variable
  - Proper restraint (binary)
- Explanatory Variables
  - Age of child (ordinal)
  - Community type (ordinal)
  - Vehicle size (ordinal)
  - Driver belted (binary)

Preliminary Analyses

- Univariate:
  - Descriptive statistics of individual variables
- Bivariate:
  - Tabular summaries of two variables:
    - Independent/dependent
    - To illustrate conditional associations
  - Chi-Square tests to assess dependence

Modeling Analyses

- Models a response probability, p, by a given set of explanatory values, X.
- Regular logistic function:

$$p = \frac{e^{\alpha+\beta x}}{1 + e^{\alpha+\beta x}}$$

- Our logistic function:

$$p = \frac{e^{\alpha+AGE+COM+CAR+DB}}{1 + e^{\alpha+AGE+COM+CAR+DB}}$$

- Why not simply a linear regression model?

Within Vehicle Clustering

- To assess dependence between the proper restraint status of children in vehicle with 2 or 3 child passengers
- Chi-square test
- Conditional on the restraint status of the younger child

Univariate Results

Proper Restraint	Frequency	Percent
0	534	11.01
1	4316	88.99

Age Type	Frequency	Percent
Infant	522	10.76
Toddler	1984	40.91
Young Child	2344	48.33

Driver Belted	Frequency	Percent
0	556	11.46
1	4294	88.54

Car Type	Frequency	Percent
Large	2221	45.79
Medium	2425	50.00
Small	204	4.21

Community Type	Frequency	Percent
Rural	976	20.12
Town	943	19.44
Suburban	1130	23.30
Urban	1801	37.13

Bivariate Results

Proper Restraint by Age Type		
	Proper Restraint	
Age Type	0	1
Infant	2.49	97.51
Toddler	15.02	84.98
Young Child	9.51	90.49
$X^2(2)$:	Value = 76.5891	p-value < 0.0001

Proper Restraint by Community Type		
	Proper Restraint	
Community Type	0	1
Rural	16.91	83.09
Town	12.20	87.80
Suburban	8.58	91.42
Urban	8.72	91.28
$X^2(3)$:	Value = 52.4254	p-value < 0.0001

Bivariate Results

Proper Restraint by Restraint Use		
	Proper Restraint	
Restraint Use	0	1
Belted	11.48	88.52
Booster	0.48	99.52
Child Safety Seat	0.37	99.63
$X^2(2)$:	Value = 2723.4631	p-value < 0.0001

Proper Restraint by Driver Belted		
	Proper Restraint	
Driver Belted	0	1
0	33.81	66.19
1	8.06	91.94
$X^2(1)$:	Value = 333.2618	p-value < 0.0001

Proper Restraint by Car Type		
	Proper Restraint	
Car Type	0	1
Small	26.96	73.04
Medium	12.37	87.63
Large	8.06	91.94
$X^2(2)$:	Value = 77.2927	p-value < 0.0001

Modeling Results

Situation	Odds Ratio	95% Confidence Interval
Infant vs. Toddler	3.2598	(1.8289, 5.8101)
Urban vs. Rural	1.4728	(1.1429, 1.8978)
Large vs. Small	3.3263	(2.2851, 4.8418)
Belted vs. NOT Belted	5.3309	(4.2686, 6.6577)

Modeling Results

Situation	Probability	95% Confidence Interval
Infant in urban area in large car with the driver belted	0.9871	(0.9770, 0.9928)
Toddler in rural area in small car with driver not belted	0.2936	(0.2168, 0.3843)
Toddler in urban area with driver not belted	0.5394	(0.4673, 0.6099)
Infant in large car	0.9669	(0.9425, 0.9811)
Infant with driver not belted	0.8792	(0.8012, 0.9293)
Young child in a small car and in a suburban area	0.7743	(0.6979, 0.8360)

Within Vehicle Clustering

Vehicle with Two Children		
	Older Child Proper Restraint Status	
Younger Child Proper Restraint Status	**0**	**1**
0	47.06	52.94
1	5.34	94.66
$X^2(1)$:	Value = 145.789	p-value < 0.0001

Vehicle with Three Children			
	Number of Older Children Who Are Properly Restrained		
Youngest Child Proper Restraint Status	**0**	**1**	**2**
0	20.00	20.00	60.00
1	1.56	7.29	91.15
$X^2(2)$:	Value = 24.0856	p-value < 0.0001	

Conclusion

- This methodology could be applied to any state, with data is analyzed the same for every state but with different methods of conducting the survey.
- Toddlers have the lowest probability of being properly restrained.
- The highest proper restraint probability situation is an infant in an urban area in a large car with the driver belted.
- The lowest proper restraint probability situation is a toddler in a rural area in a small car when the driver is not belted.
- There is a strong dependence of proper restraint between the children within a vehicle.
- More education is needed in the rural areas of Iowa on proper restraint use for children.

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  - Dr. Cavanaugh
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- References:

  - 2009 and 2010 Iowa Child Passenger Safety Survey Project (https://iprc.public-health.uiowa.edu/resources/)
  - July 7th and 8th 2011. ISIB Lecture. Dr. Jacob Oleson.