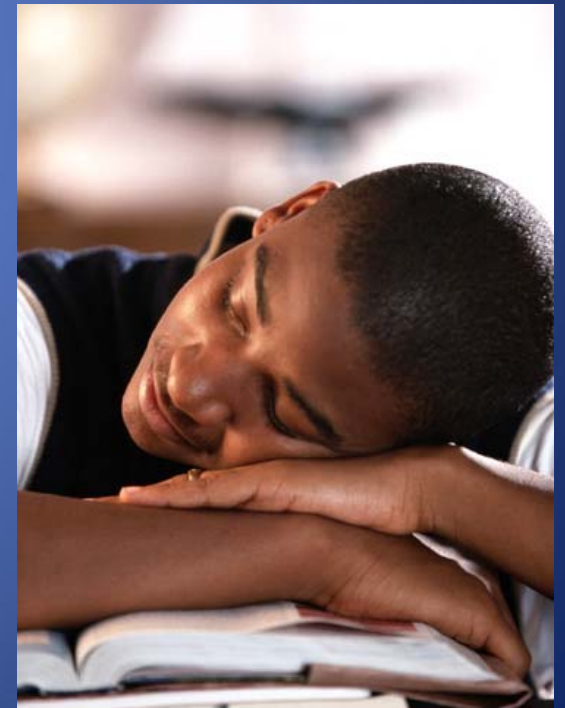


# Sleep Patterns and Risk of Injury among Rural Minnesota Adolescents



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# SIGNIFICANCE

- **Adolescence is a time of great change, from a physical, psychological and social perspective (Richardson and Tate, 2002)**
- **The sleep patterns of adolescents have generated significant community concern (Carskadon 1993, Carskadon 2002)**
- **Injury is the leading cause of death among children (National Center for Health Statistics, 2004)**
- **Nonfatal injuries occur at least 1,000 times more often than fatal (Gallagher S., 1996)**

# AIM

- To examine the association between the quantity and patterns of sleep and injury events among rural Minnesota adolescents, both during the school year and the summer months.

# STUDY DESIGN

- **Analyses based on data from the Youth at Work program (Minnesota Department of Health, 2000-2005)**
  - **Adolescent safety and health intervention, evaluation, and surveillance study within public high schools in rural Minnesota.**

# STUDY POPULATION

**TARGET POPULATION:** 190 public high schools with at least 20 students in each grade, located in one of 67 Minnesota counties, designated as rural according to US Department of Agriculture criteria, were eligible for inclusion.

**STUDY POPULATION:** 41 schools participated in the open cohort over two years and four questionnaire cycles.

# DATA COLLECTION

- **September 2001: self-reported scannable questionnaires administered to all students in grades 9-11. Based on school rosters, each student was given a unique identification code to match questionnaires over the four administration cycles.**
- **May 2002, September 2002 and May 2003: Questionnaires given to all identified students. All new students received an ID code for continued follow-up.**
- **All data were scanned and edited for consistency and missing data.**

# DEFINITIONS

***Injury:*** An event that led to one or more of the following:

- Restriction of normal activities for 4 hours or more
- Loss of consciousness, loss of awareness, or amnesia for any length of time
- Treatment by a health care provider

***Farm:*** Any place that would produce or sell at least \$1000 or more of agricultural products.



# ANALYSES

- Adolescents' risk of injury was calculated for:

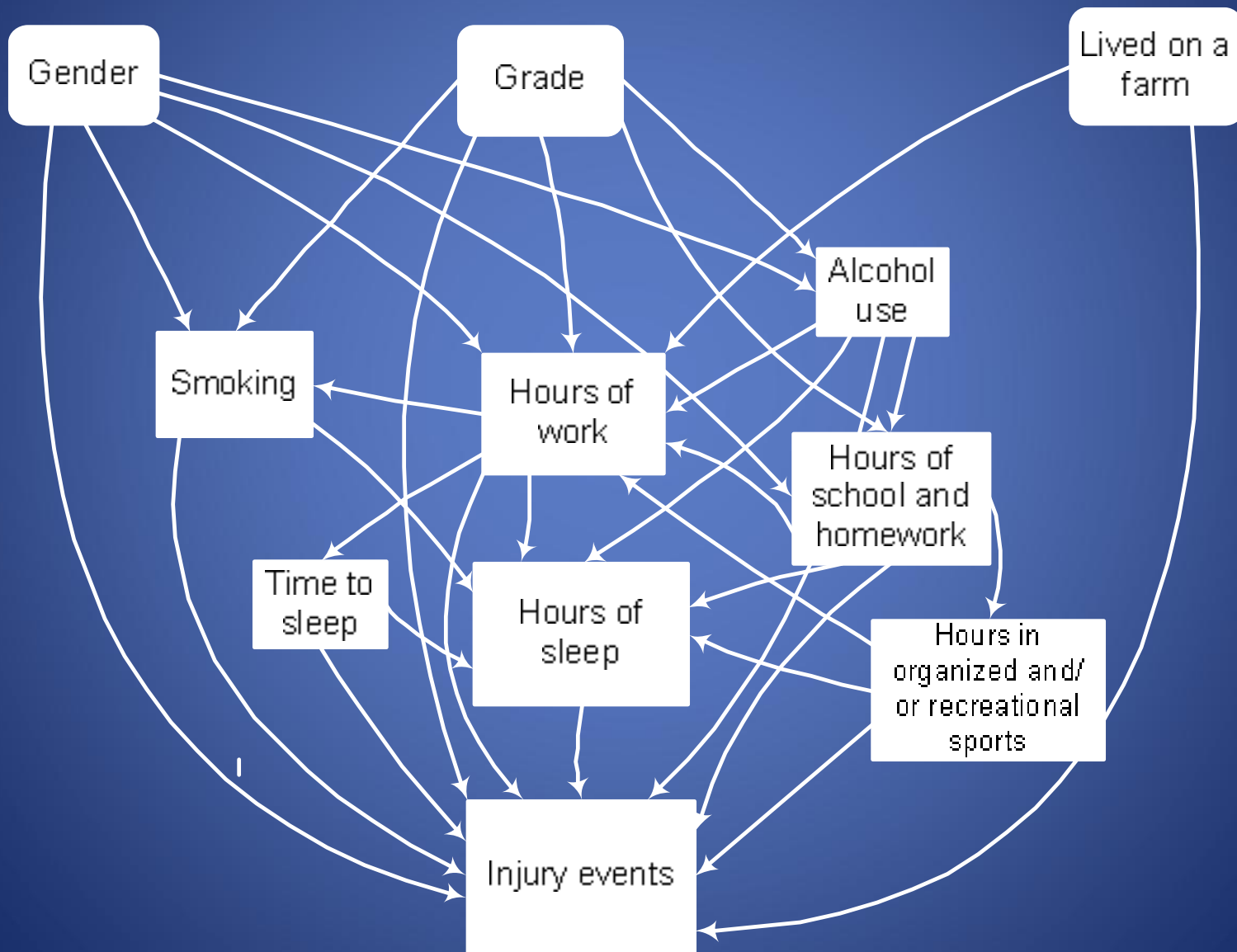
Events during summer months (June, July, August).

Events during school months (September-May).

# ANALYSES

- **Multivariate logistic regression models were used to estimate risk ratios**
  - **Directed acyclic graphs, based on an *a priori* causal model, were used to select potential confounders (Greenland et al., 1999)**
  - **Estimates were adjusted for intra-personal correlation, using Generalized Estimating Equations (Liang & Zeger, 1986)**

# CAUSAL MODEL



# PARTICIPATION

- 41,272 eligible questionnaires were completed during the four administration cycles
- 15,002 individuals participated during the two year period, representing 41 schools and all four high school grades
  - 5,922 students completed all four questionnaires

# ADOLESCENT INJURIES

- 2,473 individuals (16.5%) reported experiencing at least one injury event.
  - *1,112 of 7,175 girls (15.5%)*
  - *1,299 of 7,453 boys (17.4%)*
  - *62 of 374 gender unknown (16.6%)*
- The youngest students (freshmen in year 1 progressing to sophomores) reported the greatest proportion of injuries.
  - *Summer injuries: 37.6% (fall 2001) and 38.8% (fall 2002)*
  - *School year injuries: 36.9% (spring 2002) and 40.1% (spring 2003)*

# RISK OF ADOLESCENT INJURY\*

## BY SLEEP PATTERN AND SLEEP QUANTITY

Characteristics	< 6 hours during summer Risk Ratio (95% CI)	< 8 hours during summer Risk Ratio (95% CI)	< 6 hours during school Risk Ratio (95% CI)	<8 hours during school Risk Ratio (95% CI)
Slept less on weekend nights than week nights	1.3 (1.1, 1.6)	1.2 (1.0, 1.4)	1.2 (0.9, 1.6)	1.1 (0.8, 1.4)
Slept less on week nights than weekend nights	1.4 (0.9, 2.1)	1.2 (0.9, 1.5)	<b>1.9 (1.2, 3.0)</b>	<b>1.5 (1.1, 1.9)</b>
Always had reduced sleep	1.3 (0.9, 1.8)	1.3 (1.1, 1.6)	1.1 (0.6, 2.0)	1.3 (1.0, 1.7)
Always slept > 9 hours per night	<i>Referent</i>	<i>Referent</i>	<i>Referent</i>	<i>Referent</i>

\*Adjusted for gender, grade in school, farm residence, smoking status, alcohol consumption, hours in school/doing homework, hours in sports, hours at work, and time to sleep

# RISK OF ADOLESCENT INJURY BY GENDER

Characteristics	< 6 hours during summer Risk Ratio (95% CI)	< 8 hours during summer Risk Ratio (95% CI)	< 6 hours during school Risk Ratio (95% CI)	<8 hours during school Risk Ratio (95% CI)
<b>GIRLS</b>				
Slept less on weekend nights	1.8 (1.4, 2.3)	1.5 (1.2, 1.8)	1.3 (0.8,1.9)	1.2 (0.8, 1.6)
Slept less on week nights	2.3 (1.4, 3.8)	1.3 (0.9, 1.7)	2.4 (1.5, 3.7)	1.3 (0.9, 1.8)
Always had reduced sleep	2.0 (1.4, 2.9)	1.6 (1.3, 2.0)	1.8 (1.1, 2.9)	1.3 (0.9, 1.9)
Always slept > 9 hours per night	<i>Referent</i>	<i>Referent</i>	<i>Referent</i>	<i>Referent</i>
<b>BOYS</b>				
Slept less on weekend nights	1.3 (1.1, 1.7)	1.1 (0.9, 1.4)	1.4 ((1.0, 2.0)	1.1 (0.8, 1.6)
Slept less on week nights	1.1 (0.7, 1.7)	1.0 (0.8, 1.3)	1.8 (1.1, 2.9)	1.7 (1.2, 2.4)
Always had reduced sleep	1.3 (0.9, 1.8)	1.1 (0.9, 1.4)	1.0 (0.6, 1.7)	1.2 (0.9, 1.7)
Always slept > 9 hours per night	<i>Referent</i>	<i>Referent</i>	<i>Referent</i>	<i>Referent</i>

# RISK OF ADOLESCENT INJURY BY FARM RESIDENCE

Characteristics	< 6 hours during <b>summer</b> Risk Ratio (95% CI)	< 8 hours during <b>summer</b> Risk Ratio (95% CI)	< 6 hours during <b>school</b> Risk Ratio (95% CI)	<8 hours during <b>school</b> Risk Ratio (95% CI)
<b>FARM RESIDENT</b>				
Slept less on weekend nights	2.0 (1.3, 3.1)	1.6 (1.1, 2.3)	3.7 (1.6, 8.7)	2.6 (1.1, 6.2)
Slept less on week nights	3.6 (1.8, 7.1)	1.5 (0.9, 2.6)	6.3 (2.3, 17.5)	2.4 (1.0, 5.9)
Always had reduced sleep	3.0 (1.7, 5.3)	2.2 (1.5, 3.2)	4.1 (1.5, 11.0)	3.4 (1.5, 8.0)
Always slept > 9 hours per night	<i>Referent</i>	<i>Referent</i>	<i>Referent</i>	<i>Referent</i>
<b>NOT FARM RESIDENT</b>				
Slept less on weekend nights	1.5 (1.2, 1.8)	1.2 (1.1, 2.3)	1.1 (0.8, 1.5)	1.0 (0.8, 1.3)
Slept less on week nights	1.2 (0.8, 1.8)	1.1 (0.9, 1.4)	1.8 (1.3, 2.5)	1.3 (1.1, 1.7)
Always had reduced sleep	1.3 (1.0, 1.8)	1.2 (1.0, 1.4)	1.0 (0.7, 1.6)	1.0 (0.8, 1.4)
Always slept > 9 hours per night	<i>Referent</i>	<i>Referent</i>	<i>Referent</i>	<i>Referent</i>



# LIMITATIONS

- ***Information bias:*** Results are limited by the accuracy of respondents' reports of their sleep patterns and injury events.
- ***Selection bias:*** School attrition occurred more frequently with large schools than smaller schools, and teachers in smaller schools were better able to manage the questionnaire administration than those in larger schools.

# LIMITATIONS

- ***Confounding:*** Missing data for exposures of interest and covariates may have affected some results.
- ***Limited generalizability:*** This population of adolescents in rural Minnesota does not reflect the circumstances of all adolescents.

# CONCLUSIONS

- After adjusting for confounders, an increased risk of injury was found for any decrease in sleep hours, compared with the minimum of nine hours per night .
- Girls appeared to have a greater risk of injury than boys when sleep quantity and sleep patterns were evaluated.
- Rural adolescents who lived on farms and slept less than the suggested nine hours per night had an increased risk of injury compared with their peers who were not farm residents.
- Further research is needed to address intervention efforts among sleep-restricted adolescents at risk for injury.

# ACKNOWLEDGMENTS

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