

Socioeconomic and racial/ethnic factors affecting non-fatal medically attended injury rates in US children

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Abstract

Objective—Using a representative survey of US children, the purpose was to evaluate separate effects of socioeconomic and racial/ethnic factors, including access to care, on medically attended non-fatal injury rates.

Methods—Multivariate linear regression models were used to determine associations between injuries and health care coverage (insurance or Medicaid), having a place to go for care, race/ethnicity, maternal education, number of adults and children in the household, poverty, and urbanicity. The 1988 Child Health Supplement to the National Health Interview Survey included questions on medically attended injuries, and their cause, location, and effects on the child. Injury categories included total, consequential, occurrence at home or school, falls, and being struck or cut.

Results—Lack of health care coverage was consistently associated with lower medically attended injury rates in non-Hispanic blacks or whites and Mexican-Americans, but affected total rates for each group differently due to unequal distribution of health care coverage. Injuries occurred about 40% more frequently to children and adolescents living in single adult households compared with two adult homes for all injury categories except for injuries occurring at school.

Conclusions—Preventive interventions targeted to specific populations based on assumptions that poverty, lack of education, or minority status result in greater risks for injuries require a closer look. Efficient targeting should address underlying factors such as differences in exposures and environments associated with single adult homes or recreational activities. Data sources used to target high risk populations for interventions need to address bias due to access to care.

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Recent analyses of US data on non-fatal medically attended injury rates among adults and children have shown increased risks reported for higher income families, for children of mothers who are married or have higher education, and for whites compared with blacks.¹⁻⁵ The racial findings are sup-

ported by a national physician office based survey of all ages showing higher injury visit rates for whites than blacks.⁶ While these findings suggest differences due to access to medical care, similar differences occur for both medically attended and unattended activity restricting injury rates as reported by the National Health Interview Survey (NHIS) which is the primary source of nonfatal injury rates for the US.⁷ The association between race and non-fatal injuries is inconsistent with expectations based on fatal injury rates which are generally higher for black adolescents and children than for white.⁸⁻¹⁰ Studies used to efficiently target preventive interventions need better discrimination among population factors that may affect risks.

Many studies show poverty to be associated with higher fatal and hospitalized injury risks,^{9 11-13} although recent local area research shows higher non-fatal risks may disappear after control for access to care and other social factors related to poverty.¹⁴⁻¹⁶ Using a nationally representative survey of children, Child Health Supplement (CHS) to the NHIS, our purpose is to identify underlying family or socioeconomic risk factors amenable to targeting for preventive intervention after adjustment for access to care.

A recent international comparison of medically attended non-fatal injury rates in a school based study of young adolescents showed an extremely wide range across 24 developed countries in Europe and elsewhere.¹⁷ Injury location was presented to demonstrate the family and school context in which events occurred to address the focus for prevention. The authors cautioned about comparing differences in rates among countries due to availability and utilization of medical services and the extent to which people define an injury as requiring medical attention.

Some factors that affect the propensity to seek treatment for acute conditions include health insurance or having a place to go for care when sick or injured.¹⁸ Therefore, the excess non-fatal medically attended injury rates in whites and groups of higher socioeconomic status may partially reflect a greater access to medical care rather than more frequent occurrence of injuries.

Overpeck and Kotch reported that medically attended injury rates were between 30 to 40% lower for children without health care coverage (health insurance or Medicaid) than for children with coverage.¹⁹ The latter analysis did not address variations in injury rates that may be associated with the socioeconomic status and/or race factors affecting differential exposures such as occurrence at home or school.² In

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this analysis, injury rates are analyzed by severity to control for confounding effects from care seeking behavior. Selected injury locations and causes are also addressed to describe the environment and contextual information needed to begin to address modifiable risk factors for prevention.

Methods

SURVEY DESIGN

The NHIS uses a multistage probability sample design of households, resulting in a representative sample of the US civilian non-institutionalized population. In 1988, one child under 18 years of age was selected from each family with children, resulting in a sample of 17 110 children and an overall NHIS-CHS response rate of 91%.²⁰ Final weights adjusted for non-response are applied to all data in the analysis to reflect the injury experience of 64 million US children in this age group.

VARIABLES

Respondents, usually the mother, reported the nature, cause, and severity of each injury event occurring during the previous 12 months that resulted in medical attention. After classification to International Classification of Diseases external causes (E codes), injuries resulting from medical misadventure or complications (E codes 929–949 and 870–879) are excluded.

Besides total medically attended injury rates, injuries are analyzed by subsequent effect. Injuries are considered to be 'consequential' if they resulted in at least one of the following effects: at least one bed day or lost school day, hospitalization, or surgery (including bone setting and stitches). Consequential injuries are analyzed separately to address the differences in propensity to seek care. Consequential injuries comprised 36% of the total. All other injuries are considered minor and are included in totals.

Analysis of causes and locations are limited to categories that occurred in large enough frequencies to produce valid estimates: injuries

due to falls and being struck or cut, or occurring at school and home. The findings by cause are not shown separately but are discussed when significant differences are found.

Race and ethnicity are self reported in the NHIS. Categories are limited to non-Hispanic blacks or whites, and to Mexican-Americans (Mexicans) due to the small numbers for other races or Hispanics. Total estimates include all racial/ethnic categories.

Assessed socioeconomic and demographic variables include access to care, maternal education, number of adults in the household, number of children, urbanicity of place of residence, age, sex, and poverty level. The latter is based on poverty guidelines developed as an official US index measuring effective family income by a ratio of income and family size.²¹ Years of maternal education are grouped in three levels with the unknown level included with the <12 years category. Coverage (health insurance or Medicaid) and having a place to go for care when sick or injured are analyzed separately and in combination because they measure two separate components of overall access.

ANALYSIS

Univariate statistics show whether each socioeconomic status variable is consistently associated with injury rates. Linear regression analyses are used to determine whether health care coverage affects injury rates for each socioeconomic status factor differently. Finally, regression analyses are used to determine the association of each socioeconomic status variable with injury rates after controlling for the effects of health care coverage and other factors.

Significant associations and interactions with injury rates are assessed using the REGRESS modeling procedure of SUDAAN (Software for Survey Data Analysis)²² with a backward stepwise approach. The standard error (SE) and confidence interval (CI) are appropriate for complex survey variance with asymmetrical cumulative incidence ratios and outcomes based on means of multiple event outcomes.^{22–24} All CIs shown are at the 95% probability level. Rate ratios adjusted for the covariates are obtained by standardizing all covariate means to zero.

Age and sex are significant in the regression models and are kept to adjust for effect on the outcome but are not analyzed separately. Urbanicity of place of residence is not kept in the analysis due to lack of significant effect. All other variable effects are shown.

Results

The total US distribution by access to care for socioeconomic status and racial/ethnic groupings shows that the per cent of children without health care coverage or a place to go for care varies greatly across groups (table 1). Those with high maternal education levels, two adults in the household, or non-Hispanic whites are most likely to have either coverage or a place for care when injured. About 17% of the total

Table 1 Distribution of socioeconomic status and racial/ethnic characteristics by access to care, US, 1988

Factor	% (95% CI)	Access to care (95% CI)	
		% without coverage	% without care place
Sample No	17 110	2865	1086
US population	63 539 000	10 757 000	4 130 000
% US total	100.0	16.9 (16.1 to 17.8)	6.5 (6.0 to 6.3)
Adults in home			
1	16.4 (15.6 to 17.2)	19.3 (17.5 to 21.1)	7.8 (6.6 to 9.0)
2	69.2 (68.2 to 70.2)	15.2 (14.3 to 16.1)	5.6 (5.0 to 6.1)
≥3	14.3 (13.7 to 14.9)	22.6 (20.5 to 24.7)	9.6 (8.2 to 11.0)
No of children			
1 – 2	62.2 (61.5 to 63.9)	16.0 (15.4 to 16.6)	5.9 (5.4 to 6.4)
≥3	37.8 (36.6 to 39.0)	18.4 (17.7 to 19.1)	7.5 (6.5 to 8.5)
Maternal education (years)			
<12	21.8 (20.9 to 22.8)	28.7 (26.5 to 30.9)	11.4 (10.0 to 12.8)
12	42.1 (41.1 to 43.1)	15.8 (14.7 to 16.9)	6.0 (5.2 to 6.8)
>12	36.0 (35.0 to 37.1)	11.3 (10.5 to 12.1)	4.2 (3.7 to 4.7)
In poverty			
Yes	22.1 (21.0 to 23.2)	29.7 (27.5 to 31.9)	11.8 (10.4 to 13.1)
No	77.9 (76.8 to 79.0)	13.3 (12.5 to 14.0)	5.0 (4.6 to 5.5)
Race/ethnicity			
Non-Hispanic white	70.2 (68.7 to 71.7)	14.1 (13.3 to 14.9)	5.0 (4.4 to 5.5)
Non-Hispanic black	15.0 (13.7 to 16.3)	19.2 (16.9 to 21.5)	8.3 (6.9 to 9.6)
Mexican-American	7.0 (6.2 to 7.8)	36.1 (32.2 to 40.0)	14.8 (11.7 to 17.9)

population have no coverage, ranging from 11.3% of children whose mothers have more than 12 years of education to 36.1% of Mexicans. Only 6.5% have no place for care with Mexican children least likely to have a place to go (14.8%). Overall, only 2.5% have neither coverage nor a place to go for care. Of the 16% of children living in single adult homes, 37% have a mother with <12 years of education and 52% live below the poverty level (data not shown).

Rates of injuries for children without coverage or with no care place are lower than for those with coverage (table 2). While number of adults in the household, maternal education, poverty level, race/ethnic status, and health care coverage are highly related, the injury rates for these socioeconomic status variables do not follow the same pattern. Injury rates are higher for children from single adult homes compared with homes with two or more adults, with the exception of injuries occurring at school. Children of mothers with the lowest

education levels and those in poverty tend to have fewer medically attended injuries compared with those in the highest maternal education levels or those above the poverty level in each injury category, although comparisons are not always significantly different. Rates are lower for blacks and Mexicans than whites in all injury categories.

Because consequential injuries represent less than half of all medically attended injuries reported, the total rates are predominately a reflection of minor injuries. The associations with access, socioeconomic status, and racial/ethnic factors were similar for total, consequential, and minor injury categories. (Minor injuries are not shown.)

The figure shows per cent increases in total injury rates across the socioeconomic status and race/ethnicity categories that would occur if all children had coverage (insurance or Medicaid). The largest increases are for Mexicans, blacks, maternal education <12 years, three or more adults in the home, and those living below poverty level.

Ratios for total injury rates were adjusted to determine the effect of access to care on the inconsistent comparisons by socioeconomic status or race/ethnicity (table 3). Adjustment for access to care alone (column 2) increases each unadjusted ratio, slightly but not significantly.

Of the two components used to measure access, coverage makes the greatest contribution. Having coverage lessens the discrepancy in injury rate ratios for those with or without a place to go for care (columns 1 and 2). Adjusting coverage for having a place to go for care has essentially no effect, consistent with underlying distributions (table 1).

Since the distributions of each socioeconomic status categorical level and racial/ethnic group vary across the factors and may be measuring similar underlying risk attributes, the associations with injury are evaluated by adjusting the association of each individual factor for the effect of the other factors (column 3). The adjustments have the effect of increasing each rate ratio estimate, except for the comparison between blacks and whites. However, none of the increases are significantly different from the crude associations except for poverty, as shown by the CIs. The ratios for poverty increase from 0.79 (CI 0.66 to 0.91) to 1.04 (CI 0.92 to 1.16) indicating no difference between those below or above the poverty level after adjusting for access to care, maternal education, number of adults or children in household, or race/ethnicity. Children in a household with a single adult still have an increased risk of 40% after adjustment for access to care and all other factors.

Results for the other injury categories (consequential, occurrence at home or school, and the two causes, falls and being struck or cut) are consistent with those shown in table 3. The greater risk found for children in single adult families is consistent across all injury categories except for those occurring at school (rate ratio (RR) 1.03, CI 0.68 to 1.59). Risks for children in single adult families are increased by about

Table 2 Rates of non-fatal medically attended injuries in children by socioeconomic factors for selected injury categories, US, 1988

Socioeconomic factor	Total (95% CI)	Consequential (95% CI)	Home (95% CI)	School (95% CI)
Coverage				
None	11.1 (9.5 to 12.7)	3.6 (2.7 to 4.5)	4.9 (3.9 to 5.9)	2.4 (1.7 to 3.1)
Any	17.3 (16.4 to 18.2)	6.3 (5.7 to 6.9)	7.6 (6.9 to 8.5)	3.1 (2.7 to 3.5)
Care place				
No place	9.8 (7.4 to 12.2)	3.0 (2.9 to 3.1)	4.0 (2.4 to 5.6)	2.5 (1.4 to 3.6)
A place	16.7 (15.9 to 17.5)	6.0 (5.4 to 6.6)	7.4 (6.8 to 8.0)	3.0 (2.7 to 3.3)
Adults in home				
1	18.9 (16.7 to 21.1)	6.9 (5.6 to 8.2)	8.5 (7.2 to 9.8)	2.7 (1.9 to 3.5)
2	15.9 (15.0 to 16.8)	5.7 (5.0 to 6.4)	7.3 (6.7 to 7.9)	2.8 (2.4 to 3.2)
≥3	15.0 (12.8 to 17.2)	5.3 (4.0 to 6.6)	5.1 (3.7 to 6.5)	4.1 (3.1 to 5.1)
No of children				
1 - 2	16.4 (15.5 to 17.3)	5.8 (5.3 to 6.3)	7.0 (6.4 to 7.6)	3.1 (2.7 to 3.5)
≥3	16.0 (14.5 to 17.5)	5.9 (4.8 to 7.0)	7.5 (6.4 to 8.6)	2.9 (2.3 to 3.5)
Mother's education (years)				
<12	12.7 (11.0 to 14.4)	4.5 (3.6 to 5.4)	6.2 (5.1 to 7.3)	2.2 (1.5 to 2.8)
12	16.1 (14.8 to 17.4)	6.1 (5.3 to 6.9)	7.4 (6.5 to 8.3)	2.9 (2.4 to 3.4)
>12	18.6 (16.7 to 21.1)	6.2 (5.3 to 7.1)	7.6 (6.7 to 8.5)	3.7 (3.1 to 4.3)
In poverty				
Yes	13.5 (11.9 to 15.2)	5.1 (4.2 to 6.1)	7.0 (5.8 to 8.2)	1.8 (1.2 to 2.4)
No	17.1 (16.2 to 17.9)	6.0 (5.4 to 6.6)	7.2 (6.6 to 7.8)	3.3 (2.9 to 3.7)
Race/ethnicity				
Non-Hispanic white	19.2 (18.2 to 20.1)	7.1 (6.4 to 7.8)	8.4 (7.8 to 9.0)	3.5 (3.1 to 3.9)
Non-Hispanic black	9.1 (7.9 to 10.3)	3.0 (2.3 to 3.7)	3.9 (2.8 to 4.9)	1.8 (1.2 to 2.4)
Mexican-American	10.6 (7.8 to 13.5)	2.4 (1.0 to 3.7)	6.3 (3.9 to 8.6)	2.0 (0.6 to 3.4)
Total rates	16.3 (15.5 to 17.0)	5.8 (5.3 to 6.4)	4.1 (3.7 to 4.5)	3.8 (3.4 to 4.2)

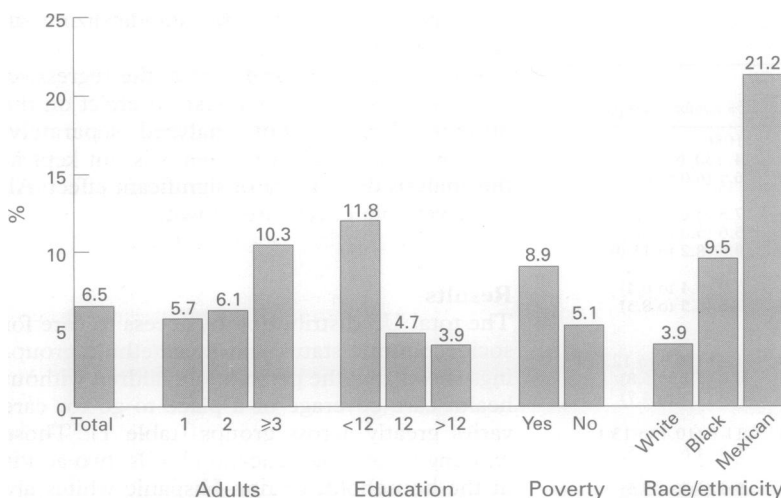


Figure 1 Per cent increase in medically attended injury rates if all children had health care coverage.

Table 3 Total injury rate ratios (RR) by access to care (health insurance/Medicaid or place for care), socioeconomic status and racial/ethnic factors, US, 1988

Access factor	Unadjusted RR (CI)	RR, adjusted for access to care (CI)*	RR, adjusted for all factors (CI)†
Coverage			
No [yes]	0.64 (0.50 to 0.80)	0.67* (0.58 to 0.77)	0.76 (0.66 to 0.88)
Place for care if injured			
No [yes]	0.59 (0.35 to 0.83)	0.67* (0.54 to 0.83)	0.69 (0.55 to 0.85)
No of adults			
1 [2]	1.19 (1.06 to 1.32)	1.21 (1.07 to 1.37)	1.40 (1.24 to 1.58)
≥3 [2]	0.94 (0.79 to 1.10)	0.99 (0.92 to 1.06)	1.03 (0.89 to 1.20)
No of children			
≥3 [1-2]	0.98 (0.87 to 1.08)	0.99 (0.89 to 1.10)	1.08 (0.98 to 1.20)
Maternal education (years)			
<12 [>12]	0.68 (0.53 to 0.83)	0.74 (0.64 to 0.86)	0.75 (0.65 to 0.87)
12 [>12]	0.87 (0.76 to 0.98)	0.89 (0.79 to 0.99)	0.87 (0.78 to 0.97)
In poverty			
Yes [no]	0.79 (0.66 to 0.91)	0.86 (0.74 to 0.98)	1.04 (0.92 to 1.16)
Race/ethnicity			
Black [white]	0.47 (0.41 to 0.54)	0.49 (0.43 to 0.56)	0.43 (0.36 to 0.53)
Mexican-American [white]	0.55 (0.42 to 0.73)	0.63 (0.49 to 0.81)	0.67 (0.53 to 0.85)

* Coverage (health insurance or Medicaid) adjusted by place for injured care; place for injured care adjusted by coverage.

† Adjusted for coverage, place for care, maternal education, number of adults and children in household, age, sex, and race/ethnicity.

[] =reference group.

40% for total or consequential injuries and 50% for injuries occurring at home.

Models were assessed with and without the poverty variable. Controlling for poverty does not change any of the associations of other socioeconomic status or race/ethnicity factors and injury. The underlying racial composition of single adult households has no significant effect on the findings, including those for access to care and single adult homes.

Discussion

The findings of this study imply that access to health care is not primarily responsible for the higher rates of medically attended injuries observed in the white population and in children of mothers with the most educational attainment found in other US studies.^{1-6 8-10} Adjustment for other social characteristics did not attenuate the associations with access to care further.

Other unmeasured access factors may provide barriers to care. Insurance factors in the US include co-payments and deductibles or gaps in coverage.²⁵⁻²⁷ Of international relevance are transportation issues, child care, waiting time, work conflicts, interpersonal social discrepancy with providers, and language barriers that may be important components of the decision to seek care.²⁸⁻³⁰ Cultural factors may affect perception of pain, fatalism and expectation of results from seeking care to diminish recognition of need for care.^{28 31} The burden of day-to-day living with insufficient resources, coupled with discrimination for racial and ethnic minorities, may also serve as barriers to seeking care.³²

The significantly lower rates of non-fatal injuries for children in poverty disappear after control for other social factors related to poverty. Inconsistencies in previous studies may be due partly to definitional differences of poverty.^{9 11-15} Our definition is based on the official poverty level index which varies with family size.²¹ Others have used income^{9 11} or participation in social welfare programs, such as Aid to Families with Dependent Children, Food Stamps or Medicaid,¹² directly linked to

official poverty status. We also found increased rates associated with use of Medicaid in this and another study.¹⁹ Part of the difference may be that the types of injuries occurring to children living in poor, non-supportive environments are more likely to lead to severe outcomes resulting in hospitalization and death.

Limitations of this study include the small number and imprecision of socioeconomic status and racial/ethnic measures available in the NHIS that may be related to injury determinants. Low maternal education levels may function as a proxy for other factors such as early childbearing that are highly correlated with poverty and neighborhood effects. Neighborhood data were not available but also have been shown to be an injury risk factor.^{11-13 33-35} Another limitation is that these analyses focused on total and consequential medically attended injuries rather than on more cause specific exposures (for example motor vehicles, bicycles) due to small numbers.

This analysis has a number of methodological implications. First, analysis of data from provider sources should take into account the socioeconomic status and health care coverage distributions of the population studied.^{18 20 28 36} For example, we estimate that after adjustment for loss due to recall,³⁷ an additional 131 000 black and 161 000 Mexican children would have received medical attention for injuries if all children had coverage. Second, detailed measures of barriers to seeking care would provide much needed information on the components of access to care limiting medical attention for injuries. Third, the data show that research using only the poorly measured racial and/or ethnic identifiers on death certificates, without additional risk factor information (besides age and sex) may result in incorrect inferences.^{38 39} Misleading associations of cultural and residential factors with race and/or ethnicity have been noted by other researchers, leaving unanswered questions on what race and ethnicity are actually measuring.^{40 44}

Almost two thirds of the medically attended injuries in this survey are classified as minor. However, consistency in the results comparing total and consequential injuries indicates that differences associated with access probably are not due entirely to care seeking factors. Some of the increased rates associated with higher socioeconomic status may be due to greater exposure to risk factors such as bicycles, sports, or recreation activities which are usually minor and represent 36% of these injuries at ages 5-17.⁴³ Children in families with lower socioeconomic status may spend equivalent time in lower risk activities, such as watching TV.⁴⁴

Having a single adult in the household increases the risk of a non-fatal injury by 40% compared with homes with two or more adults. This finding is consistent across all categories of injury except for those occurring at school, reinforcing effects from single adult home environments. A Scottish study of adolescents found similar differences by location with increased injuries at home predicted by low family affluence and injuries at school predicted by high affluence and sports participa-

tion.⁴⁵ Single adult households might be at greater risk due to various environmental, traffic, or housing characteristics that are also associated with poor neighborhoods.³³⁻³⁴

In addition, single parenting is highly associated with earlier initiation of childbearing leading to incomplete education, presence of non-related adults in the homes, and potentially lower 'locus of control'. The latter may affect the ability to provide either a protective physical or social environment.¹³⁻¹⁶ Early intervention through nurse home visitation from the prenatal period through early childhood has shown improved child health and injury outcomes with adolescent single parents.⁴⁷

This is the first US study to obtain population characteristics for all medically attended non-fatal injuries in children. Because it incorporates injuries treated in all health care settings with information on severity, cause, location, and other data, the portrait of injuries in children is far different from the portrait based on fatality data or from hospital and emergency room records. This study suggests that some US children are at risk of injury from factors associated with affluence, while others are at risk from underlying exposures stemming from inadequate housing, neighborhoods, or protective families. This is why access to care accounts for only a portion of the higher rates of medically attended injuries for some children. Studies of activities and injury locations associated with socioeconomic status are needed to address injury prevention. Adding more complete information to injury data sources about specific contributing components will improve the focus of future research and interventions.

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