Severe Injury Among Hispanic and Non-Hispanic White Children in Washington State

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SYNOPSIS

Objectives. The authors' anecdotal experience at a regional Level I trauma center was that Hispanic children were overrepresented among burn patients, particularly among children with burns due to scalding from hot food. This study describes injury incidence and severity among Hispanic and non-Hispanic white infants, children, and adolescents with serious traumatic injuries in Washington State.

Methods. Data from the Washington State Trauma Registry for 1995–1997 were used to identify injured individuals aged ≤19 years. Ratios of overall and mechanism-specific injury incidence rates for Hispanic children relative to non-Hispanic white children were calculated using denominator estimates derived from U.S. Census Bureau population data. Hispanic children and non-Hispanic white children were also compared on several measures of severity of injury.

Results. In 1995–1997, serious traumatic injuries were reported to the Registry for 231 Hispanic children aged ≤19 years (rate: 54 per 100,000 person-years) and for 2,123 non-Hispanic white children (56 per 100,000 person-years), yielding an overall rate ratio (RR) of 1.0 (95% confidence interval [CI] 0.8, 1.1). Motor vehicle crashes and falls accounted for one-third to one-half of the injuries for each group. Infants, children, and adolescents identified as Hispanic had higher rates of injuries related to hot objects (i.e., burns) (RR=2.3; 95% CI 1.3, 4.1), guns (RR=2.2; 95% CI 1.5 to 3.3), and being cut or pierced (RR=3.5; 95% CI 2.2 to 5.5). The Hispanic group had a lower injury rate for motor vehicle accidents (RR=0.7; 95% CI 0.5, 0.9). Mortality rates were similar (RR=1.1; 95% CI 0.7, 1.7). The mean length of hospital stay was 5.5 days for the Hispanic group and 8.8 days for the non-Hispanic white group (difference=3.3 days; 95% CI –0.7, 7.4).

Conclusions. The study found little difference between Hispanic and non-Hispanic white infants, children, and adolescents in the burden of traumatic pediatric injury. However, burns, guns, drowning, and being pierced/cut appeared to be particularly important mechanisms of injury for Hispanic children. More specific investigations targeted toward these injury types are needed to identify the underlying preventable risk factors involved.

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Unintentional injury represents the leading cause of death for individuals ages 1–21 years in the U.S.[1] Differences in injury rates and mechanisms of injury across racial and ethnic groups have been reported for selected samples.[2–5] However, the majority of past data have been on fatal injuries, the epidemiology of which can differ from that of non-fatal trauma. Our anecdotal experience at a regional Level I trauma center was that Hispanic children were overrepresented among our burn patient population. These were mostly children ages 6–36 months whose parents were immigrant farmworkers and who had scald burns from hot food. Because Hispanic identifiers have not been routinely or consistently available in many health-related databases such as hospital records, little focused data on injury morbidity among Hispanic children are available. According to 2000 U.S. Census data, approximately 7.5% of the Washington State population is Hispanic.[6]

This study took advantage of a statewide, population-based registry of serious injuries. Our goal was to compare Hispanic and non-Hispanic white children in Washington State in the incidence of injury and the relative importance of different injury mechanisms, which might help in the development of targeted prevention programs.

METHODS

Identifying injury cases

Injuries resulting either in death or in hospitalization for at least two days during the years 1995–1997 for individuals ≤19 years of age were identified from the Washington State Trauma Registry. This computerized registry contains data from hospitals in the state of Washington that are designated as trauma centers and includes information on virtually all serious cases of trauma involving children, unless the child died at the scene of the injury or died at a non-trauma hospital prior to transfer to the trauma center.

Variables available to assess severity included data on mortality (dead on arrival or death during hospitalization), whether the hospitalization involved an intensive care unit (ICU) stay, overall length of hospitalization, and scores on trauma severity scales such as the Injury Severity Score (ISS)[7] and the Revised Trauma Score (RTS).[8]

The ISS is a summary score for traumatic injuries. It is based on the Abbreviated Injury Scale (AIS), which assigns a severity rating to each of several hundred types of injuries. The ISS is calculated as the square of the AIS. If a patient has more than one AIS rating, the highest AIS value is selected from each of up to six body regions (head/neck, face, thorax, abdominal and pelvic contents, limbs, and skin), and the three highest of these are squared and summed to obtain the ISS rating.

The RTS is a physiologic severity score widely used in prehospital triage, which is based on measurement of vital signs (systolic blood pressure, respiratory rate) and consciousness (Glasgow coma scale). The RTS is coded as a whole number from zero to four, representing increasing severity.

For this study, mechanism of injury was determined based on International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) E-codes[9] and grouped according to categories recommended by the Centers for Disease Control and Prevention (CDC).[10]

Determining Hispanic ethnicity

An ethnic origin variable (Hispanic vs. non-Hispanic) is included as a separate field in the trauma registry. However, this variable was missing for 47% of the records. The source of ethnicity and race data was self-identification (or identification by parent or caregiver) at time of hospital admission. To identify the ethnicity of patients with missing data, we linked surnames from the trauma registry to a list of Hispanic surnames developed by the U.S. Census Bureau.[11] The list includes more than 12,000 names for which 75% or more of responders with that name in a sub-analysis of the 1990 Census self-identified as Hispanic. For their purposes, the Census Bureau categorizes individuals with these names as "heavily Hispanic." In this study, if a patient record in the trauma registry did not contain information on ethnic origin and the surname matched a surname identified by the Census Bureau as heavily Hispanic, the child was classified as Hispanic. For data in which ethnicity was provided, a comparison to the surname list suggests that the list is 67% sensitive and 98% specific in identifying individuals self-identified (or identified by parents/caregivers) as Hispanic.

Denominators for calculating incidence rates were derived from U.S. Census Bureau estimates of the Washington State population for 1995, 1996, and 1997, provided by the Washington State Department of Health, Center for Health Statistics. These data were available by gender, Census Bureau age classifications, ethnicity (Hispanic, non-Hispanic), and race (Asian/Pacific Islander, black, Native American, white).

Analysis

Calculation of RRs allowed us to compare the overall and mechanism-specific incidence of injury for children identified as Hispanic vs. children identified as non-Hispanic white. Age and sex were considered potential confounding variables. We used the Mantel-Haenszel test of homogeneity to test whether RRs were statistically similar across groups in our data.[12] To assess severity, incidences of fatal injuries, injuries requiring an ICU stay, and injuries requiring an ICU stay for longer than three days were similarly evaluated. In addition, the proportion of Hispanic vs. non-Hispanic white patients in the registry with regard to severity measures such as hospitalization stay exceeding four days, any ICU stay, or an ICU stay for longer than three days were compared. We also used *t*-tests to compare the two groups on mean number of ICU days, mean length of stay, mean ISS rating, and mean RTS rating.

RESULTS

During the three-year study interval, 231 children identified as Hispanic were admitted to a trauma center for a serious injury (rate 54 per 100,000 person-years), while 2,123 children identified as non-Hispanic white were admitted (56 per 100,000 person-years), yielding an overall RR of 1.0 (95% confidence interval [CI] 0.8, 1.1). Adjustment for gender and age did not change the RR.

Gender-specific incidence rates were also not significantly different for Hispanic vs. non-Hispanic white children (not shown). Highest rates were observed at the extremes of the age spectrum (<1 year and 15–19 years) (Table 1). A homogeneity

Table 1. Age-specific rate of severe injuries per 100,000 person-years among children and adolescents ≤19 years of age, Washington State Trauma Registry, 1995–1997

	Hispanic		Non-Hispanic white			
Age in years	Number	Rate	Number	Rate	Rate ratio	95% CI
<1	24	95	107	62	1.5	1.0, 2.4
1–4	39	39	221	29	1.3	0.9, 1.9
5–9	34	29	306	31	1.0	0.7, 1.4
10–14	25	25	422	44	0.6	0.4, 0.9
15–17	54	99	617	112	0.9	0.7, 1.2
18–19	55	164	450	138	1.2	0.9, 1.6

CI = confidence interval

test suggested that the age-specific RRs were not similar (p=0.007). In one age group (10–14 years), the RR was statistically different from 1.0. The rate of admission for serious injury was lower among Hispanic children than among non-Hispanic white children in this age group (RR=0.6; 95% CI 0.4, 0.9).

The distribution of the 10 leading mechanisms of injury differed somewhat between Hispanic and non-Hispanic white children (Table 2). Motor vehicle crashes accounted for the largest proportion of injury in both groups. Falls ranked second among non-Hispanic white children and third among Hispanic children. Other important injury types for both groups included pedestrian and bicycle-related traffic injuries, injuries related to other forms of transportation, injuries attributed to fire or hot objects (i.e., burns), and injuries involving being struck by or against an object. A significantly higher proportion of gun and cutting/piercing injuries were noted among Hispanic children than among non-Hispanic white children.

Differences in incidence by mechanism of injury were also identified (Table 3). Children identified as Hispanic had significantly higher rates of injuries related to hot objects (RR=2.3; 95% CI 1.3, 4.1), guns (RR=2.2; 95% CI 1.5, 3.3), or being cut/pierced (RR=3.5; 95% CI 2.2, 5.5) than children identified as non-Hispanic white. In contrast, Hispanic children had significantly lower rates of injury attributed to motor vehicle crashes (RR=0.7, 95% CI 0.5, 0.9).

Measures of severity did not differ significantly between the two groups. Mortality rates were similar (RR=1.1; 95% CI 0.7, 1.7). Mean length of hospital stay was 5.5 days for those identified as Hispanic, and 8.8 days for those identified as non-Hispanic white (difference=3.3 days; 95% CI −0.7, 7.4). Mean length of ICU stay was 1.2 for Hispanic children and 2.3 days for non-Hispanic white children (difference=1.1 days; 95% CI −1.4, 3.7). Mean RTS values were 6.9 and 6.8 (difference=0 days; 95% CI −0.4, 0.3), and mean ISS values were also similar: 11.6 for Hispanic children and 12.5 for non-Hispanic white children (difference=1.0 days; 95% CI −0.8, 2.7). However, injured Hispanic children were less likely to have a hospitalization exceeding four days (45% of Hispanic children vs. 59% of non-Hispanic white children; RR=0.6; 95% CI 0.5, 0.8) or to have part of their hospitalization involve an ICU stay (34% of Hispanic children vs. 42% of non-Hispanic white children; RR=0.7; 95% CI 0.5, 0.9).

DISCUSSION

The strength of this study is the use of a population-based state-wide registry to evaluate and compare severe injury in Hispanic and non-Hispanic white children. Two other published studies have attempted a similar evaluation in California,[2,3] and related national data are available for comparison as well.[4] It is instructive to review how our findings fit with these observations.

Table 2. Leading mechanisms of severe injury among children and adolescents ≤19 years of age, Washington State Trauma Registry 1995–1997

	Hispanic (n=231)			Non-Hispanic white (n=2,123)		
Rank	Mechanism of injury	Number	Percent	Mechanism of injury	Number	Percent
1	Motor vehicle accident	53	23	Motor vehicle accident	688	32
2	Gun	31	13	Fall	330	16
3	Fall	26	11	Transport	137	7
4	Cut/pierce	25	11	Pedestrian vs. car	128	6
5	Fire/hot object	18	8	Struck-by/against	121	6
6	Pedestrian vs. car	18	8	Gun	121	6
7	Transport	10	4	Fire/hot object	95	5
8	Struck-by/against	6	3	Bicycle vs. car	76	4
9	Bicycle vs. car	5	2	Bicycle	74	4
10	Drowning	4	2	Cut/pierce	63	3

Table 3. Mechanism-specific rate of severe injuries per 100,000 person-years among children and adolescents ≤19 years of age, Washington State Trauma Registry, 1995–1997

	Hispanic		Non-Hispanic white			
Mechanism of injury	*Number*	*Rate*	*Number*	*Rate*	*Relative risk*	*95% CI*
Cut/pierce	25	5.81	63	1.67	3.5	2.2, 5.5
Drowning	4	0.93	11	0.29	3.2	1.0, 10.0
Hot object	15	3.49	56	1.49	2.3	1.3, 4.1
Gun	31	7.21	121	3.21	2.2	1.5, 3.3
Machinery	4	0.93	16	0.43	2.2	0.7, 6.5
Pedestrian, other	2	0.46	11	0.29	1.6	0.4, 7.2
Pedestrian vs. car	18	4.18	128	3.40	1.2	0.8, 2.0
Natural[a]	7	1.63	60	1.59	1.0	0.5, 2.2
Fall	26	6.04	330	8.77	0.7	0.5, 1.0
Fire	3	0.70	39	1.04	0.7	0.2, 2.2
Motor vehicle accident	53	13.48	688	20.19	0.7	0.5, 0.9
Bicycle vs. car	5	1.16	76	2.02	0.6	0.2, 1.4
Struck by, against	11	2.56	151	4.01	0.6	0.4, 1.2
Transport, other	11	2.32	137	3.64	0.6	0.3, 1.2
Motorcycle	2	0.46	61	1.62	0.3	0.1, 1.2
Bicycle (non-traffic)	2	0.47	74	1.97	0.2	0.1, 1.0

[a]Includes natural/environmental, bites/stings, poison, overexertion, suffocation.

CI = confidence interval

Overall incidence of injury

Our analysis of Washington State Trauma Registry data for 1995–1997 shows similar overall severe injury rates for Hispanic and non-Hispanic white infants, children, and adolescents. Similarly, no differences in the overall incidence rates for these groups were found in a San Diego study that compared 1,164 blunt and penetrating trauma injuries for Hispanic children aged ≤14 years from a regional trauma system for 1985–1990 with 2,560 such injuries among non-Hispanic white children.[3] However, an analysis of 859 severe or fatal injuries identified among Hispanic children aged ≤14 years in eight Orange County cities during 1991–1992, compared with 352 such injuries identified in non-Hispanic white children in the same age range, revealed a higher risk for Hispanic children (RR=1.6; CI 1.4, 1.9).[2] In contrast, morbidity data available from the 1997 National Health Interview Survey report lower injury rates (including poisoning) for Hispanic children than for non-Hispanic white children.[4] The rates for children <12 years of age were 78.8 per 1,000 population for Hispanic children and 133.4 per 1,000 population for non-Hispanic white children. For ages 12 to 21 years, the corresponding rates were 109.7 per 1,000 and 208.6 per 1,000.

There are several potential explanations for these contrasting findings. For example, the Orange County data may have suffered from upward bias in the rate ratio. Surveillance data from eight designated hospitals accounted for 81% of the injury hospitalizations in the base population. However, injured Hispanic children were somewhat more likely to be hospitalized in these facilities than their white counterparts. Specifically, according to the authors, 86% of injured Hispanic children were hospitalized in the designated hospitals, compared with 74% of injured non-Hispanic white children. Our study and the San Diego study were more similar in design, as both utilized computerized trauma registries that captured nearly all traumatic injuries that resulted in hospitalization for the base population.

Unlike our data, the national data were based on interviews with a representative population sample regarding the occurrence of a medically attended injury or poisoning in the three-month period prior to the interview. This included injuries of minimal severity, and the results may have been influenced by differential access to care or cultural differences in the use of care. Such influences are less likely to influence hospitalization for severe injuries, which were the focus of our study.

While other age categories did not differ significantly, we calculated a significantly lower incidence of injury for Hispanic children aged 10–14 than for non-Hispanic white children in this age group (RR=0.6; 95% CI 0.4, 0.9). This contrasts with evidence of a higher incidence rate in this age group reported from the Orange County data (RR=1.4; 95% CI 1.1, 1.8)[2] and no difference reported from the San Diego data (RRs or incidence rates not provided).[3] As there was no clear pattern in our data across age groups, and given the discrepancy with other studies, our finding may be due to chance.

Mechanism of injury

The two leading mechanisms of injury identified in our data were motor vehicle crashes and falls, together accounting for about one-third to one-half of the burden of injury for each group (Table 3). This is comparable to the findings in San Diego and Orange County. In the San Diego study, which included only blunt and penetrating injuries, motor vehicle crashes (Hispanic 36%, non-Hispanic white 33%), pedestrian injuries (Hispanic 30%, non-Hispanic white 22%), and falls (Hispanic 19%, non-Hispanic white 25%) were

among the leading mechanisms of injury.[2] In the Orange County analysis, which like our study included data on all types of injuries, falls were clearly first (Hispanic 35%, non-Hispanic white 31%) with pedestrian, bicycle, and motor vehicle crashes next (range 8% to 15%).[2]

Our analysis of incidence of injury by mechanism revealed differences between Hispanic and non-Hispanic white children that may be instructive in prevention efforts (Table 3). We identified significant excesses of hot object-related injuries (i.e., burns), gun-related injuries, and cutting/piercing injuries among Hispanic children in our data. In addition, although the difference was not statistically significant, we found higher rates of drowning among Hispanic children than among non-Hispanic white children.

We found the incidence rate of motor vehicle crash-related injury to be significantly lower in Hispanic children than in non-Hispanic white children. This may reflect differences in time at risk (Hispanic children may spend less time in motor vehicles). Motor vehicle accidents still account for the greatest number of injuries in both groups.

Severity of injury

For the most part, measures of injury severity assessed in this study did not differ for Hispanic and non-Hispanic white children. Several measures were also assessed in the San Diego study; no significant differences in injury severity score, Glasgow coma scale, or mortality were found.[3] The San Diego study, however, found that Hispanic children had, on average, longer inpatient stays as well as more days in the ICU.

National mortality data from the National Center for Health Statistics for 1998 revealed overall mortality rates from injuries and adverse events that are generally higher in Hispanic children and adolescents than among their non-Hispanic white counterparts.[5] For example, the mortality rate in Hispanic children <1 year of age was 624.7 per 100,000, compared with 599.4 per 100,000 for non-Hispanic white children in this age group. The mortality rate for Hispanic children aged 1–4 years was 30.4 per 100,000, compared with 29.4 per 100,000 for non-Hispanic white children. Only for children aged 5–14 years were rates higher for non-Hispanic white children (17.2 per 100,000 vs. 18 per 100,000 for Hispanic children). For children 15–24, rates were 83.3 per 100,000 for Hispanic children and 72.3 per 100,000 for non-Hispanic white children. These data were derived from death certificates and Census population estimates. Death certificate data are inherently much less sensitive to issues of access to and use of medical services than morbidity data. The report does note that Hispanic mortality is somewhat understated due to underreporting of Hispanic origin on death certificates. An estimate of 7% underreporting is provided. However, the authors also note that undercounting of the Hispanic population in the Census and in population estimates based on the Census somewhat mitigates the bias in rates derived from these estimates.[5]

Study limitations

Identifying Hispanic ethnicity in injury cases and the underlying population is imperfect, and thus some misidentification of individuals in our numerator and denominator were likely. The Census Bureau's experience with the surname list used in this study estimates that this method will understate incidence of Hispanic disease by approximately 10% (Personal communication, David L. Word, Population Division, U.S. Census Bureau, November 2000). We assessed the sensitivity and specificity of surnames in our data for the records for which ethnicity was provided and found a sensitivity of 67% and a specificity of 98%. This suggests that we were likely to undercount Hispanic injuries using these surnames. The net effect would bias our estimated RRs toward zero.

In addition, the ethnicity-based denominators used in this study are also likely to suffer from this undercount problem, although the magnitude is unknown. The Hispanic population in Washington State was undercounted in the 2000 Census by an estimated 4%.[13,14] If the numbers of injured Hispanic children were undercounted in our data, the RRs relative to white children would be biased downward. With both numerator and denominator potentially affected in the same direction, the effect of such bias is lessened.

The Washington State Trauma Registry includes children from neighboring states (Alaska and Idaho) who were transported to Washington trauma centers. If these children were more or less likely than children living in Washington State to be of Hispanic origin, the rate estimates could be biased accordingly. For example, Census data from 2000 identify 7.5% of Washington residents, 4.1% of Alaskans, and 7.9% of the Idaho population as Hispanic.[15] These children from other states could not be identified and removed from our analysis. The magnitude and net effect are unknown.

Finally, the data available in our trauma registry represent only those children whose injuries were severe enough to cause hospitalization for more than two days or who died before reaching an emergency department. While these likely represent the severest injuries, these rates may still be influenced by potential bias from differences in the decision to hospitalize or not hospitalize. These data do not include children who were discharged from the emergency department.

Implications for prevention

The higher incidence of burns in Hispanic children is most likely related to cooking and heating. The next step toward prevention may be for public health researchers to conduct focus groups with Hispanic families to better understand the risk factors for burns, and test these hypotheses with case-control studies. This can then lead to targeted interventions, such as the successful burn prevention program in rural Maine.[16]

The higher rate of injuries due to cutting may be related to the fact that many Hispanic families in Washington State live in their workplace, i.e., on farms. Of Hispanic adults in the labor force, 21% worked in agriculture in 1997.[17] Farms expose children to workplace hazards,[18] and the higher incidence in Hispanic children with these injuries may indicate the need for accessible child care arrangements for young children, and a change in the child labor laws for older children.[19]

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