Demographic risk factors for injury among Hispanic and non-Hispanic white children: an ecologic analysis

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Abstract

***Objectives*—To determine the effects of neighborhood levels of poverty, household crowding, and acculturation on the rate of injury to Hispanic and non-Hispanic white children.**

***Setting*—Orange County, California.**

***Methods*—An ecologic study design was used with census block groups as the unit of analysis. Measures of neighborhood poverty, household crowding, and acculturation were specific to each ethnic group. Poisson regression was used to calculate mutually adjusted incidence rate ratios (IRRs) corresponding to a 20% difference in census variables.**

***Results*—Among non-Hispanic white children, injury rates were more closely associated with neighborhood levels of household crowding (adjusted IRR 2.36, 95% confidence interval (CI) 1.22 to 4.57) than with neighborhood poverty (adjusted IRR 1.06, 95% CI 0.89 to 1.26). For Hispanic children, the strongest risk factors were the proportion of Hispanic adults who spoke only some English (compared with the proportion who spoke little or no English, adjusted IRR 1.26, 95% CI 1.04 to 1.53) and the proportion who were US residents for <5 years (adjusted IRR 1.20, 95% CI 1.001 to 1.43). Neighborhood levels of household crowding were not related to injury among Hispanic children (adjusted IRR 0.98, 95% CI 0.89 to 1.08), but surprisingly, neighborhood poverty was associated with lower injury rates (adjusted IRR 0.89, 95% CI 0.81 to 0.97).**

***Conclusions*—Cultural and geographic transitions, as well as socioeconomic differences, appear to contribute to differences in childhood injury rates between ethnic groups.**

(*Injury Prevention* 1998;**4**:33–38)

Keywords: Hispanic Americans; socioeconomic factors; crowding; acculturation

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Injury prevention efforts must respond to the changing demographics of populations. In many countries, minority and immigrant populations may face low socioeconomic status, linguistic barriers, cultural differences, and the challenge of adapting to an unfamiliar environment. Children of these groups may have injury risks that are very different from those of the children of ethnic majorities.

In the US, minority ethnic and racial groups have had unprecedented rates of growth, with the Hispanic population predicted to become the second largest ethnic/racial minority in the next decade.[1] The US now ranks sixth in the number of Hispanic residents, exceeded only by Mexico, Spain, Columbia, Argentina, and Peru. Thirty five per cent of the US Hispanic population resides in California.[2] Standard vital statistics reports provide limited injury data that is specific to the Hispanic population, because it is an ethnic rather than a racial group. Focused studies have found little or no difference in the overall rate of injury between Hispanic and non-Hispanic white children, but some differences in the rates for specific causes of injury.[3–6] However, Hispanic children in central Orange County, California (about 170 km from the Mexican border) have a 60% higher rate of hospitalization or death from injury than non-Hispanic white children, controlling for census block group of residence.[7]

Issues related to the Hispanic population in southern California are: (1) the age distribution is young compared with other racial/ethnic groups; (2) they are largely of Mexican origin; (3) the Mexican border is contiguous with the US; and (4) back and forth movement between the two countries is feasible, yet cultural and language differences persist. Immigrants also face a number of challenges and stresses due to physical relocation and cultural change. Similar to other migrant populations, the Southwest US Hispanic population encounters socioeconomic disadvantages and stresses associated with migration.[8 9] These may include separation from their extended families, finding shelter, transportation, food, and clothing in a new environment, as well as obtaining adequate employment and income.[10]

Several indicators of socioeconomic disadvantage have been associated with childhood injury. Poverty, low income, and unemployment are associated with a higher rate of several different types of injuries to children.[11–21] Similarly, both household crowding[13 18] and neighborhood population density[15 16] are associated with specific childhood injuries, as are single parent households,[11 13 21 22] young mothers,[21–22 23] and low levels of education.[11 22 23] In multivariate analyses, the effects of low income[11] or household crowding[13] are independent of the effects of other social variables. Children in families with more children have more injuries than children in families with fewer children.[21 24]

Acculturation is the process by which individuals exposed to a new culture acquire

the traits of the new culture.[25] Commonly, the term is used to indicate the process by which a minority group acquires the traits of the dominant culture.[26] While residency is distinct from acculturation, length of residency has frequently been used to validate measures of acculturation.[27] Because language is the key to functioning in a new culture, it is the single most important indicator of acculturation, and the major focus of many measures of acculturation.[27]

The purpose of this analysis was to determine how neighborhood levels of poverty, crowding, and acculturation affect injury rates among Hispanic and non-Hispanic white children. These variables, which are characteristics of communities as well as of individuals, were chosen in an effort to explain the higher injury rates in Hispanic children than in non-Hispanic white children. Because these variables may have different effects in different ethnic groups, we constructed separate regression models for Hispanic and non-Hispanic white children. An ecologic analysis was used to incorporate data from the US census.

Methods

The analysis was carried out at the level of the census block group because this is the smallest and most homogeneous unit for which most US census data are tabulated.[28 29] Approximately three to 20 city blocks make up each census block group, and one to nine census block groups make up each census tract.

STUDY POPULATION

A population based hospital and coroner's office surveillance system was established in central Orange County, California to identify children less than 15 years of age who sustained injuries resulting in hospitalization or death. The population of the study area is 943 472, of which 213 906 are children.[1] Forty nine per cent of the children are Hispanic, 37% non-Hispanic white, 12% Asian or Pacific Islander, 2% non-Hispanic black, and fewer than 1% Native American or any other race.[1] Eighty seven per cent of the Hispanic population is of Mexican birth or descent.[1] In 1990, 12% of families in the study area had an income less than the federal poverty level.[1]

The number of Hispanic children was obtained from the 1990 US census. However, the census does not provide tabulations by age, race, and ethnicity for census block groups, so the number of non-Hispanic white children in each census block group was estimated by holding constant the odds ratios for being "of Hispanic origin" between racial groups. To check the census block group level estimates of the number of non-Hispanic white children, the estimates were summed to yield estimates at the census tract level and compared with counts of non-Hispanic white children at the census tract level.[30] The correlation coefficient was 0.9997.

CASES

Injury cases were defined as residents of the study area, age 0–14 years, who sustained an injury in 1991 or 1992 resulting in hospitalization or death. Cases were identified from daily monitoring of hospital admissions in eight hospitals and from a review of the county coroner's logbook, as described elsewhere.[7] Unintentional, self inflicted, and injuries inflicted by others were included and injuries as a result of disease or occurring during hospitalization were excluded. Medical records were reviewed to verify that the principal reason for admission was an injury, and that the child resided within the study area. Cases noted in the medical record as being Hispanic, speaking Spanish, requiring a Spanish language translator, or having surnames on the 1980 US census list of Hispanic surnames, were coded as Hispanic. Census tract and block group were identified using the census geographic database[31] and the 1990 census PL 94–171 county block maps.[32]

Hospital discharge data obtained from the California Department of Health Services were used to assess the selection of the eight hospitals for monitoring injuries to children in the study population. Among 1991 discharges of patients with postal codes in the study area, 86% of injured Hispanic children and 74% of injured non-Hispanic white children were from study hospitals.

CENSUS VARIABLES

All independent variables used in this analysis were obtained from the 1990 census and defined at the block group or census tract level. *Poverty* was defined as the proportion of families in each census block group with children less than 18 years who had incomes below the federal poverty level. *Household crowding* was defined as the proportion of households in each census tract with at least one person per room.

Acculturation among Hispanic adults was measured by the use of English language and US residency for less than five years, both measured at the level of the census block group. Each category of English language use was analyzed as a proportion of Hispanic adults, age 18 to 64 years. The number of Hispanic adults who spoke *English at home* was estimated as the number of Hispanic adults minus the number of adults who spoke Spanish at home. We defined *bilingual* as adults who spoke Spanish at home and reported that they spoke English "very well". *Some English* was defined as adults who spoke Spanish at home and reported that they spoke English "well". *Little or no English* was defined as adults who spoke Spanish at home and reported that they spoke English "not well" or "not at all".

STATISTICAL ANALYSIS

A log linear Poisson regression model was used to fit the number of injuries in each census block group during the two year period to the number of children, age 0 to 14 years, and the levels of the census variables for that census block group. Incidence rate ratios (IRRs) were calculated for a difference of 20% in the proportion of the population with the

Table 1 Mean (SD) of proportion of poverty and crowding, and unadjusted IRR and 95% confidence interval (CI) for a 20% change in poverty and household crowding, for total children and by ethnicity, central Orange County, California

	Census block groups	*Mean (SD)**	*IRR*	*95% CI*
Total	594			
Poverty		0.13 (0.11)	1.12	1.03 to 1.23
Household crowding		0.28 (0.22)	1.13	1.08 to 1.19
Hispanic	540			
Poverty		0.16 (0.16)**	0.87	0.80 to 0.95
Household crowding		0.48 (0.23)**	0.93	0.87 to 0.99
Non-Hispanic white	570			
Poverty		0.08 (0.16)	1.10	0.92 to 1.31
Household crowding		0.06 (0.06)	2.46	1.29 to 4.70

*Weighted by the sum of Hispanic and non-Hispanic white children in census block group.
**p Value <0.001, comparing census values for Hispanics and non-Hispanic whites in 538 census block groups with children of both ethnicities.

characteristic of interest. Twenty per cent of residents with incomes below the federal poverty level has been used by other investigators to distinguish poor from non-poor areas.[29 33 34]

The number of injuries was modeled as a multiplicative function of the number of children and the incidence rate ratios. Thus, for the unadjusted analysis:

$$\textit{Expected injuries} = \exp(\log[\textit{children}] + b_0 + b_1 p_1)$$

where b_0 is the log of the rate in the absence of the characteristic, b_1 is the log rate ratio for the characteristic, and p_1 is the proportion of the population with the characteristic. The NLR procedure in SPSS[35] was used to obtain the estimates. Adjusted estimates were assessed in separate log linear Poisson models for Hispanic children and for non-Hispanic white children using census values for poverty and household crowding in each ethnicity. Each regression included all census block groups with one or more child residents of the respective ethnic group. US residency for less than five years and English language use were included only in the model for Hispanic children. The effects of the proportions of Hispanic adults who spoke English at home, were bilingual, or spoke some English, were compared with the effect of the proportion of Hispanic adults who spoke little or no English.

Poisson regression

Poisson regression was used to model the number of injuries in each census block group because it uses the injury count as the outcome and appropriately weights census block groups with widely differing populations. Poisson regression is appropriate for count data when the counts are not normally distributed and are too large to be grouped as 0 and 1. It is distinguished from other forms of regression only by the error term, which requires that the observations be weighted by the inverse of the expected count. Thus, in this study the observations were weighted by the inverse of the modeled number of injuries in a census block group, which was recalculated at each iteration of the regression procedure. This weighting is appropriate for both small and large census block groups. Other reports have used the injury incidence rate,[11] injuries per acre,[13] or injuries per census tract,[15] as the outcome variable. Each of these approaches weights each census tract equally, and, unlike Poisson regression, requires that small census tracts with unstable rates be eliminated.[11]

Results

In the eight cities/communities, 1302 injuries resulting in hospitalization and 59 deaths to children age 0–14 years were identified during the two year study period. Census tract and block group were identified for 1343 of these children (99%), including 848 Hispanic children and 347 non-Hispanic white children.

The annual rate of hospitalization or death from injury was 403/100 000 for Hispanic children and 221/100 000 for non-Hispanic white children. Within census block groups, Hispanics had much higher levels of both poverty and household crowding than non-Hispanic whites (table 1).

Unadjusted estimates of the IRRs for poverty and household crowding among all children are shown in table 1. Five hundred ninety four census block groups with one or more child residents were included in the regression. The IRR for a 20% difference in poverty was 1.12, indicating that the poorer neighborhoods had a 12% higher injury rate. The IRR for crowding was also greater than one.

However, the unadjusted IRRs for ethnic-specific measures of neighborhood poverty and household crowding were different for Hispanics and non-Hispanic whites (table 1). Among Hispanic children, the IRR for a difference of 20% in the poverty level was less than one, indicating that neighborhoods with the higher level of poverty among Hispanic families had a lower injury rate among Hispanic children.

Table 2 Mean (SD) and correlation coefficient for census acculturation variables, central Orange County, California, from US census, 1990 (540 census block groups)*

		Correlation coefficient	
	Mean (SD)	*With poverty*	*With household crowding*
US residency <5 years	0.15 (0.10)	0.45	0.60
English at home	0.12 (0.15)	−0.19	−0.48
Bilingual	0.24 (0.14)	−0.36	−0.60
Some English	0.17 (0.07)	−0.10	0.06
Little or no English	0.47 (0.20)	0.41	0.72

*Weighted by the number of Hispanic children in census block group.
Correlation coefficients with an absolute value >0.08 are associated with a p value <0.05.

Table 3 Mutually adjusted injury IRR (and 95% confidence interval) for a 20% difference in selected variables, by ethnicity, central Orange County, California, 1991–92

	Hispanic (540 census block groups)	*Non-Hispanic white (570 census block groups)*
Poverty	0.89 (0.81 to 0.97)	1.06 (0.89 to 1.26)
Household crowding	0.98 (0.89 to 1.08)	2.36 (1.22 to 4.57)
US residency <5 years	1.20 (1.00 to 1.43)	
English at home	1.12 (1.00 to 1.26)	
Bilingual	1.09 (0.95 to 1.24)	
Some English	1.26 (1.04 to 1.53)	
Little or no English	1.00 (referent)	

Among non-Hispanic white children, the IRR for poverty was slightly greater than one. The IRR for neighborhood levels of crowding among Hispanic households was also less than one, but among non-Hispanic white households a 20% difference in neighborhood levels of crowding was associated with more than a doubling of the rate.

The mean proportions of census values for US residency less than five years and English language use among Hispanic adults are shown in table 2. The proportion of census block group population with US residency less than five years and the proportion of Hispanic adults who spoke little or no English, had the strongest positive correlation with neighborhood measures of poverty and household crowding among Hispanic families.

Mutually adjusted IRRs for injury in each ethnicity are shown in table 3. For Hispanic children, the largest IRR was for the proportion of Hispanic adults who spoke some English compared to the proportion who spoke little or no English. The proportion of Hispanic adults who were bilingual, and the proportion who spoke English at home, had IRRs intermediate between those for little or no English and for some English. US residency for less than five years, as a proportion of population, was also associated with injuries to Hispanic children. The adjusted IRR for poverty (table 3) was similar to the unadjusted IRR (table 1), but the effect of household crowding was largely removed by adjustment. Among non-Hispanic white children, the adjusted IRRs for neighborhood measures of poverty and household crowding (table 3) were similar to the unadjusted IRRs (table 1).

Discussion

Previous studies have reported that areas with higher levels of household crowding[13 18] and poverty[11–21] had higher injury rates for children. In the unadjusted results for the population in this study, similar results were found. However, the relationship between ethnic specific measures of neighborhood poverty and household crowding were quite different for Hispanic and non-Hispanic white children. Furthermore, the strongest risk factors for injury among Hispanic children were the proportion of Hispanic adults who only speak some English and the proportion who were US residents less than five years—neighborhood measures of cultural and geographic transition.

POVERTY

In contrast to the results of previous studies, and in both the unadjusted and adjusted results, injury rates among Hispanic children were lower in neighborhoods with higher levels of poverty among Hispanic families. The effect is not large, and a multivariate model of ecologic data may not adequately control for confounding at the individual level.[36] Poverty may increase exposure to some injury hazards, such as pedestrian injuries, falls, and assaults, but decrease exposure to others, such as motor vehicles and bicycles.

HOUSEHOLD CROWDING

Household crowding has been associated with pedestrian injuries[13] and with injuries in the home.[8] Durkin and her colleagues attributed an inverse relationship between crowding and assaults to confounding by ethnicity.[11] Large family size, which contributes to household crowding, was identified as a risk factor for injury to children in studies in New Zealand[21] and Great Britain.[24] In the results reported here, injury rates among non-Hispanic white children, but not among Hispanic children, were higher in neighborhoods with higher levels of crowding among households of the respective ethnicity.

In traditional Mexican families, older children and extended family members help parents to care for young children.[37] Sharing of space, and maintaining close proximity to relatives, are regarded as positive values.[38] Rather than contributing to family stress, household crowding may thereby provide more opportunities for supervision among traditional Hispanic families, and thus reduce the risk for injury.

ACCULTURATION: CULTURAL AND GEOGRAPHIC TRANSITION

Among Hispanic children, the highest adjusted IRR was for neighborhoods with a high proportion of Hispanic adults who speak some English, a transition group between those who speak little or no English and those who are bilingual or speak English at home. This cultural transition may correspond to other changes in attitudes, beliefs, and behavior. These may include a change from traditional methods of caring for children, with many family members having a role in child care, to more Western methods with predominantly maternal responsibility.[37 39 40]

Injury rates among Hispanic children were also higher in neighborhoods with higher levels of US residency less than five years—a geographic transition representing a move from outside the US to the US. This transition presents a number of economic and psychological challenges to the family, as well as a new environment with different physical hazards.

These transitional groups may be at higher risk because of acculturative stress, which results from the process of adapting to a new culture.[8] Furthermore, different members of the same family may acculturate in different ways, producing conflicting values and behavior within the family.[9 10]

LIMITATIONS

These group level data are appropriate for analyzing social processes that occur at the level of the census block group or neighborhood.[41] However, if the causal processes occur at the family or individual level, the analysis of neighborhood level data may suffer from ecologic bias.[42] The use of small units of analysis, such as census block groups, can reduce this bias.[42] Estimates of the effect of census block group level socioeconomic variables on health outcomes have tended to slightly underestimate the effect of the same variables meas-

ured at the household level.[29] The predictors of childhood injury examined in this study (poverty, household crowding, US residency, and English language use) are variables that are most clearly defined at the level of the family, and further research should examine both neighborhood level and family level effects.

It is not clear how the method of determining Hispanic ethnicity used for the cases compares with the census designation "of Hispanic origin". Children who were misclassified by our method would alter the incidence rates and dilute the true effects in the separate regression models for each ethnicity.

Rates of hospitalization are determined by the nature of the injury, the decision of parents or other caregivers to seek care for an injured child, and the medical decision to admit a child. Parents who have recently moved from another country, or who have limited English skills, may not be familiar with the medical care system, and may fear contact with persons in authority. Thus, we hypothesize that they would be less likely to seek care. On the other hand, we believe that medical personnel would be more likely to admit a child for observation if they feel that the parents have limited support systems or do not understand instructions. Two studies have examined the association of socioeconomic variables with injuries of varying frequency, severity, and treatment.[43 44] Studies of the decision to seek care for an injured child and the decision to admit an injured child are also needed.

The 1991 California hospital discharge data indicate that some child residents of the study area were admitted for injuries to hospitals other than the eight hospitals monitored for this study. Incomplete identification of cases would have altered the regression results if the missed cases had a different distribution by census block group than the cases that were identified because the regression was based on the characteristics of the census block group.

Implications for injury prevention

Researchers need to consider cultural and geographic transitions, as well as socioeconomic differences, as possible explanations for differences in injury rates between ethnic groups. Furthermore, the effects of socioeconomic variables on childhood injury rates may vary in different population groups. In addition to providing culturally and linguistically appropriate interventions, public health practitioners must respond to the particular needs of neighborhoods with many families experiencing cultural change.

This research was supported by Grant Number R49-CCR-904406 from the Centers for Disease Control and Prevention. The contents are solely the responsibility of the authors and do not necessarily represent the official views of the National Center for Injury Prevention and Control. We would like to thank William Gayk, PhD, County Demographer, County of Orange, and his staff for assistance in geocoding street addresses to census tracts and blocks.

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National bicycle helmet drive sought after success in Seattle
"... in this city, where even the buses are equipped with bike racks, about 60% of all children wear helmets, up from only 1% 10 years ago. Child safety advocates credit a strong promotional campaign for the increase, and say they want to see a similar nationwide effort" (*New York Times*, March 1997).

4 month old baby dies in whirlpool
"... all the evidence surrounding the child's death suggests an accident" (*Montreal Gazette*, February 1997).

Avalanche of injuries on fake snow
"A study in the Italian Alps found an increased number of accidents around snow cannons, the machines that produce artificial snow. The injures also tended to be more serious...with a significant number of compound leg fractures" (Jonathan Leake, *Sunday Times*, November 1996).

Slow down, selling speed is a bad idea
"Even with your foot through the (floor)", he lamented, "you can only reach 87 miles per hour". "Forgive me for sounding naive, but I was slightly shocked. After all, the speed limit on British roads is 70 mph. The most sensible way to stop people driving at high speed would be to fit limiters on the engines..." (Jack Shamash, *Guardian*, January 1997).