Socioeconomic Status and the Occurrence of Fatal and Nonfatal Injury in the United States

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A B S T R A C T

Objectives. This study examined the contribution of socioeconomic status (SES) to the risk of injury mortality and morbidity among working-age adults.

Methods. The sample consisted of respondents to the National Health Interview Survey (1987–1994), and separate analyses were conducted for injury deaths to respondents by linking to the National Death Index. Proportional hazards regression models were used to analyze mortality. Logistic regression models were used to analyze morbidity.

Results. The effects of SES varied substantially by cause of injury mortality and indicator of SES. In the multivariate models, blue-collar workers were at significantly increased odds of nonfatal injury. Education was unrelated to total injury morbidity, although associations were observed after stratification of the outcome by severity and place of occurrence. Black persons were at increased risk for homicide, and Black and Hispanic persons were at decreased risk for suicide and nonfatal injuries, after adjustment for SES.

Conclusions. SES is an important determinant of injury, although the effect depends on the indicator of SES and the cause and severity of injury. (*Am J Public Health.* 2000;90:70–77)

Injuries are increasingly recognized as leading causes of premature morbidity, death, and disability.[1–3] Social factors, such as socioeconomic status (SES), are viewed as fundamental determinants of illness and death for other health outcomes.[4] However, much of the research on the relationship between SES and injury risk uses arbitrary measures of SES, aggregate measures to proxy individual SES, or SES as a confounder[5,6] rather than as a determinant of injury outcomes.[7]

Studies suggest that SES is an important risk factor for injury mortality. Baker et al.[1] found that low per capita income of the county of residence is significantly related to higher fatal injury rates due to homicide, motor vehicle–related injuries, and other unintentional injuries. Several studies have also shown substantial income and education gradients in all-cause injury mortality for children and youth.[8–10] A similar but more accentuated trend for education also was found for young adults aged 20 to 24 years.[9] Finally, blue-collar workers have been shown to be at increased risk for fatal occupational injuries[11,12] and motor vehicle crashes.[13]

The relation between SES and nonfatal injuries is less clear. Data from the National Health Interview Survey (NHIS) showed that nonfatal injury incidence rates are reported to be higher for persons who have low income, who have high educational attainment, and who are employed.[14] These findings are in contrast to research on other types of nonfatal illness, which found that illness is consistently greater for persons of lower SES.[15] One study found no relation between nonfatal injuries and SES, as measured by poverty level and education, in children and adults.[16] Another study of nonfatal injuries in the working population found that incidence rates were higher for persons with low income, low educational attainment, and blue-collar occupations.[17] This conflicting evidence, as well as the limited findings for injury mortality, suggests that more research is needed to understand this issue.

Previous research also suggested that observed racial differences in injury, especially homicide, may be largely the result of differences in SES.[18–21] However, evidence also suggested that Black workers are overrepresented in hazardous occupations, even after adjustment for education and experience.[22] The lack of adequate measures of SES has made it difficult to confirm the hypothesis that racial differences in injury morbidity and mortality are largely attributable to SES. This study examined the relation between SES and both fatal and nonfatal injuries and evaluated whether race and ethnicity are independent predictors of injury or merely associated with SES.

Methods

Data

The analysis was based on the NHIS from 1987 through 1994 and the NHIS/Multiple Cause of Death Public Use Data file from 1987 through 1995. The NHIS is a continuing annual household interview survey representa-

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This article was accepted August 2, 1999.

tive of the civilian noninstitutionalized population of the United States.[23] Information about health status, health conditions, and sociodemographic characteristics of each household member is collected. For the purposes of this study, the analysis was restricted to adult respondents aged 18 to 64 years, a population at high risk for injury.

The NHIS/National Death Index is a linked file containing information on those who responded to the NHIS and subsequently died. It was produced by matching characteristics common to both the NHIS and the National Death Index, which was searched from the initial date of the NHIS interview to the end of 1995.[24,25] Once matches were identified, death certificates were obtained from the states to ascertain cause of death information. For persons aged 18 to 64 years who participated in the NHIS from 1987 through 1994, 1352 injury-related deaths were identified.

Outcome Variables

For the mortality analysis, we conducted a cohort study that used the date of the interview from the NHIS file and the date of death or censoring time (December 31, 1995) from the NHIS/National Death Index to calculate the total number of person-months of follow-up. An injury death was defined as a successful match in the NHIS/National Death Index file that had an *International Classification of Diseases, 9th Revision* (*ICD-9*)[26] E-code between 800 and 999 as the underlying cause of death. Deaths due to adverse events and medical misadventures (E930–E949, E870–E879) were subsequently excluded (n = 52). Five outcomes were investigated: overall injury mortality, motor vehicle–related deaths (E810–E825), suicide (E950–E959), homicide (E960–E978), and all other external causes (such as poisonings, falls, and drowning; E800–E807, E826–E929, E980–E999). The number of deaths in this last category was insufficient to investigate each cause separately. The final mortality analysis included all injuries (n = 1300) and persons (n = 547 484) in the sample. The percentage distribution of total fatal injuries by cause is as follows: 33% motor vehicle accident, 24% suicide, 17% homicide, and 26% other external causes.

For the nonfatal injury analysis, we conducted a cross-sectional study that used episodes of injury per person for respondents aged 18 to 64 years (n = 547 536) as the outcome. Episodes of injuries differed from numbers of injuries because multiple injuries can result from a single episode. Episodes of injury per person was measured as a dichotomous variable; 1 or more episodes was coded as 1. Only 1.5% of the sample had more than 1 episode in the 2-week recall period (the 2 calendar weeks preceding the date of the interview). An episode of injury was defined as an acute condition that was either medically attended or resulted in at least a half-day of restricted activity during the 2-week recall period from the date of the interview, with an *ICD-9* code between 800 and 999, and that was the first injury listed by the interviewer for that episode. Injuries resulting from adverse reactions, complications of medical care, or an impairment that occurred before the recall period were excluded. The models were also estimated with specific subgroups of nonfatal injury episodes by severity, type of injury, place of injury, and whether the injury was work related.

Individual Level Variables

The independent variables were age, sex, self-reported race/ethnicity, marital status, educational attainment, occupation/employment status, and income-to-needs ratio. The income-to-needs ratio adjusted for family size by dividing the midpoint of the categories for family income by family size. Income-to-needs was measured as a categorical variable to allow for the inclusion of a dummy variable to indicate persons with missing income and because previous research on the effects of income on health outcomes has shown nonlinear effects.[27]

Correlation coefficients between the socioeconomic variables (income-to-needs, educational attainment, occupation/employment status) were examined for evidence of collinearity and found to be low enough to be included in the same model separately. This has the advantage of allowing one to investigate the relation between each variable and the specific cause of death. Previous research has found that it is acceptable to include the 3 measures in the same model.[27–29]

Analytic Method

Death rates for the follow-up period were calculated for the analysis of injury mortality by dividing the number of deaths by the number of person-years of follow-up. Age-standardized death rates and rate ratios are presented by cause (all injuries, motor vehicle injuries, suicide, homicide, other external causes) for both men and women stratified by SES, race, and ethnicity. Confidence intervals were estimated with the Delta method,[30,31] and direct age standardization was used with the full sample as the standard population.[32]

Cause-specific injuries (motor vehicle, suicide, homicide, other external causes) were analyzed separately with continuous time Cox proportional hazards models. For the nonfatal analysis, multivariate logistic regression models were specified. SUDAAN[33] was used in all analyses to account for the complex sample design, and all results incorporated weights to be generalizable to the US population.

Results

Descriptive Analysis

Mortality. The overall injury mortality rates in the follow-up sample for men were almost 3 times higher than those for women (overall rate: 68.7 vs 23.7 per 100 000 person-years) and were very similar to the published mortality statistics for 1990 for the entire United States.[34] The rates stratified by SES and race/ethnicity were much greater for men than for women, and within each sex, rates were generally higher (except for suicide) for persons of low SES, unemployed persons, those not in the labor force, and Black persons (Table 1).

The age-adjusted rate ratios for all-cause and cause-specific injury mortality varied considerably for men and women when stratified by income-to-needs, education, occupation/employment status, and race/ethnicity (Table 2). Men with low income-to-needs were at increased risk for death due to all injury mortality outcomes except motor vehicle–related fatalities (for which lower income resulted in lower risk except for the lowest income level) and suicide (for which no relationship exists). Men with less than a high school degree were at significantly increased risk for death due to all causes except suicide. Blue-collar workers, unemployed men, and those not in the labor force were at increased risk for death due to all injury mortality outcomes.

For women, the patterns were less clear. Compared with women with high incomes, women with the lowest incomes had higher injury rates except for deaths due to suicide (for which their risks were lower). The results were mixed at higher levels of income-to-needs. As with men, women with low educational attainment had higher death rates except for suicide (for which the ratio was not statistically different from zero). Blue-collar workers, unemployed women, and those not in the labor force were at increased risk for death due to all causes except suicide, for which the rates were lower for blue-collar workers and unemployed women.

Black men and women were at higher risk than their White counterparts for death due to all injury outcomes except death due to suicide. Few differences were found for

TABLE 1—Weighted Age-Adjusted Injury Mortality Rates[a] for Respondents Aged 18–64 Years, by Socioeconomic Status and Race/Ethnicity, Followed Up Until 1995 (N = 547 484): National Health Interview Survey, 1987–1994

	Men					Women				
	ALL	HOM	SUI	MVF	OTH	ALL	HOM	SUI	MVF	OTH
Income-to-needs, $										
Missing income	66.1	9.1	14.5	20.4	22.2	26.4	3.7	6.9	10.1	5.8
≤6250	109.5	16.8	20.1	32.1	40.4	35.9	6.0	5.0	15.7	9.1
>6250–11 250	70.0	12.2	19.0	15.1	23.7	18.9	1.0	5.0	8.7	4.2
>11 250–18 750	57.2	6.2	19.1	18.3	13.6	18.0	3.6	4.0	7.6	2.8
>18 750–75 000	52.2	3.4	18.9	18.8	11.0	24.5	2.7	10.7	4.8	6.3
Education										
<High school graduate	114.8	20.4	19.6	34.3	40.5	37.6	10.3	6.8	12.5	8.0
High school graduate[b]	59.4	7.1	17.9	17.5	17.0	21.1	2.4	5.8	8.3	4.6
Occupation/employment status										
Blue collar	71.4	7.9	19.1	23.8	20.6	22.8	2.7	1.7	13.3	5.0
Unemployed	123.4	28.4	25.7	32.6	36.7	37.2	11.8	1.7[d]	19.0	4.6
Not in labor force	176.2	32.1	38.3	33.7	72.1	35.9	5.6	11.5	9.4	9.4
White collar[b]	44.3	5.0	14.0	14.5	10.8	15.2	1.9	4.4	6.1	2.7
Race/ethnicity										
Black, non-Hispanic	106.4	32.2	13.1	32.5	28.5	30.5	9.1	2.1	11.6	7.6
Hispanic	42.4	7.7	0.0	10.2	24.6	24.0	7.2[c]	7.7	9.1	0.0
White, non-Hispanic[d]	65.6	6.4	19.8	19.5	19.9	22.6	2.5	6.4	8.5	5.2
Overall rates	68.7	9.0	18.5	20.3	20.9	23.7	3.5	6.0	8.9	5.3
No. of deaths	939	161	241	280	257	361	63	76	144	78

Note. ALL = all injury deaths, HOM = homicide, SUI = suicide, MVF = motor vehicle–related fatalities, OTH = other external causes.
[a]Rates are per 100 000 person-years and are adjusted for the sample design.
[b]Includes unknown.
[c]Not reliable because of small numbers of deaths (<3).
[d]Includes other race.

Hispanic men or women compared with White adults.

Morbidity. A total of 4189 first injury episodes occurred in the study sample. Only 1.5% of the subjects had more than 1 injury episode during the 2-week recall period, and only the first listed was included in risk analyses. Most injuries (>70%) were minor, resulting in few or no restricted-activity days. Nearly 30% of the injuries were from sprains or strains, 20% were from wounds or lacerations, and only 13% were from fractures or dislocations. Almost 27% of the injuries occurred at work, but the proportion of injuries occurring at work varied greatly by occupation (21% for white-collar workers and 46% for blue-collar workers). Injuries, totaling about half of all nonfatal injuries, were most likely to occur at home (30.3%) and in an industrial place (19.9%).

Persons who experienced a nonfatal injury episode, on average, were younger and more likely to be male, compared with those without an injury (Table 3). In addition, all other demographic and socioeconomic characteristics were associated with nonfatal injury status except for educational attainment.

Multivariate Analysis

Mortality. Table 4 presents the adjusted risk ratios for injury mortality resulting from the Cox proportional hazards analyses. The first model for each cause of death is the demographic model, adjusted for age, sex, and race/ethnicity. To assess the effects of SES on race/ethnicity differences, the second model for each cause adds marital status and the 3 indicators of SES (income-to-needs, education, occupation/employment status) to the demographic model, which is referred to as the full model.

All causes. The results for the demographic and full models for all causes of injury mortality are presented in the first column of Table 4. In the demographic model, Black persons (1.61) were at significantly increased risk compared with White persons. When marital status and SES were added, the hazard rate for being Black was reduced (1.20). Low income, low education, blue-collar occupation, unemployment, and not being in the labor force independently increased the risk of death due to injury.

Homicide. Adjusting for SES attenuated the risk of death due to homicide for Black persons. The hazard ratio decreased to 3.93 from 5.60 for Blacks compared with Whites. Persons who have low income, who have low education, who are unemployed, and who are not in the labor force had between 2 and 2.75 times the risk of death due to homicide as those without these characteristics.

Suicide. In the models for suicide (Table 4, column 3), in contrast to the results for homicide, Black and Hispanic persons were at lower risk. No significant difference was found in the risk of suicide by income or education after adjustment for other characteristics. Those not in the labor force were more than twice as likely to die from suicide compared with employed white-collar workers.

Motor vehicle accident. Men were at more than double the risk for motor vehicle mortality compared with women (Table 4, column 4). In the full model, low SES (lowest income level, low education, blue-collar occupation) and unemployed status predicted motor vehicle–related fatalities.

Other external causes. For other external causes of death, which include unintentional poisoning, suffocation, drowning, and falls, men were about 4 times more likely to die from these causes compared with women (Table 4, column 5). As with motor vehicle–related deaths, low SES and employment status (unemployed, not in the labor force) predicted increased risk of death due to these causes.

Because the data file used to determine vital status and cause of death in this analysis did not include the "injury at work" item from the death certificate, a subset of the deaths excluding E-codes thought to have a high probability of being industrial (n = 46)

TABLE 2—Weighted Age-Adjusted Rate Ratios for Injury Mortality[a] for Respondents Aged 18–64 Years, by Socioeconomic Status and Race/Ethnicity, Followed Up Until 1995 (N = 547 484): National Health Interview Survey, 1987–1994

	Men					Women				
	ALL	HOM	SUI	MVF	OTH	ALL	HOM	SUI	MVF	OTH
Income-to-needs, $										
Missing income	1.27*	2.68*	0.77*	1.09	2.02*	1.08*	1.37*	0.64*	2.10*	0.92*
≤6250	2.10*	4.94*	1.06	1.71*	3.67*	1.47*	2.22*	0.47*	3.27*	1.44*
>6250–11 250	1.34*	3.59*	1.01	0.80*	2.15*	0.77*	0.37*	0.47*	1.81*	0.67*
>11 250–18 750	1.10*	1.82*	1.01	0.97*	1.24*	0.73*	1.33*	0.37*	1.58*	0.44*
>18 750–75 000	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Education										
<High school graduate	1.93*	2.87*	1.09	1.96*	2.38*	1.78*	4.29*	1.17	1.51*	1.74*
High school graduate[b]	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Occupation/employment status										
Blue collar	1.61*	1.58*	1.36*	1.64*	1.91*	1.50*	1.42*	0.39*	2.18*	1.85*
Unemployed	2.79*	5.68*	1.84*	2.25*	3.40*	2.45*	6.21*	0.39[c]	3.11*	1.70*
Not in labor force	3.98*	6.42*	2.74*	2.32*	6.68*	2.36*	2.95*	2.61*	1.54*	3.48*
White collar[b]	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Race/ethnicity										
Black, non-Hispanic	1.62*	5.03*	0.66*	1.67*	1.43*	1.35*	3.64*	0.33*	1.36*	1.46*
Hispanic	0.65*	1.20	…	0.52	1.24	1.06	2.88*[c]	1.20	1.07	…
White, non-Hispanic[d]	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Note. ALL = all injury deaths, HOM = homicide, SUI = suicide, MVF = motor vehicle–related fatalities, OTH = other external causes.
[a]Based on rates per 100 000 person-years adjusted for the sample design.
[b]Includes unknown.
[c]Not reliable because of small numbers of deaths (<3).
[d]Includes other race.
*95% confidence interval of rate ratio not including 1.00.

were tested in the regression models (E846, E881–E882, E916–E919, E923–E926).[35] The relative risk ratios were slightly lower for men and occupation/employment status and slightly higher for marital status (data not shown). However, the differences were not great, and the significance levels were similar in the 2 models.

Morbidity. Table 5 summarizes the results from the logistic regression models for all nonfatal injuries and then the results stratified by severity as measured by days of restricted activity. Black and Hispanic persons were at decreased risk for nonfatal injuries compared with White persons. Blue-collar occupation significantly increased the odds of experiencing a nonfatal injury episode. No differences were found for educational attainment or income (except for missing income).

The adjusted odds ratios varied by injury severity as measured by days of restricted activity. The odds of being in a blue-collar occupation appeared to increase as injury severity increased. Black and Hispanic persons were at decreased risk for minor injuries, but this effect disappeared for injuries resulting in more restricted days of activity. Low education was a risk factor for only the most severe injuries.

The work-related models (not shown) are included as a secondary analysis to remove the effect of the job hazards for occupational injuries, because among blue-collar workers, almost half of all their injuries occurred at work. Compared with all injury episodes, the odds ratios for men and blue-collar workers increased for injuries that occurred at work, and no significant differences were seen for Blacks or Hispanics. In the full model of the non–work-related injuries, the odds ratios were similar to those in the model of all injury episodes, except that unemployed persons and those not in the labor force were at significantly increased risk and the odds for blue-collar workers were not increased.

The analysis by type of injury (not shown) indicated that the odds for each indicator of SES did not appear to vary substantially by type of injury. For injuries occurring in or near the home, men and blue-collar workers were not at increased risk, but unemployed persons and those not in the labor force were at increased risk (data not shown). In contrast to all episodes combined, Black persons were at increased risk for injuries occurring on a street or highway. The only statistically significant odds ratio found for low educational attainment was for injuries occurring at an industrial place (1.24) and for recreational or sports-related injuries, in which those with less than a high school degree were at half the risk than their more highly educated counterparts.

Discussion

This analysis represents an important step in understanding how socioeconomic disadvantage can operate to increase injury risk. The contribution of SES varies substantially by external cause of death and severity. For instance, SES (income-to-needs, education, occupation/employment status) has essentially no relation to the risk of suicide, whereas educational attainment and income are significant predictors of all other causes.

To summarize the multivariate analysis, race/ethnicity differences were eliminated with the addition of SES in the models for motor vehicle–related deaths and other external causes, which confirms the results of other studies.[18] Black adults are still more likely to die from homicide (but the differences are reduced considerably), and Black and Hispanic persons are less likely to die from suicide (after differences in SES are accounted for). This variability would be masked if one looked only at all injury causes combined.

The findings for income and educational attainment appear consistent with the existing literature.[10] The increased relative risk ratios for blue-collar occupation also were found in other studies[11–13] and suggest that occupational risks for fatalities, especially motor vehicle–related fatalities, are higher for lower status jobs and are likely to

TABLE 3—Comparison of Persons Aged 18–64 Years With and Without a Nonfatal Injury During the Recall Period[a] (N = 547 536): National Health Interview Survey, 1987–1994

	≥1 Episodes	0 Episodes	Test, P[b]
Age, y (mean)	35.2	38.1	.0001
Sex, %			
Female	43.3	51.3	.0001
Male	56.7	48.7	
Race/ethnicity, %			
Black, Non-Hispanic	10.3	11.5	.0001
Hispanic	2.5	3.9	
White, Non-Hispanic	87.2	84.6	
Marital status, %			
Divorced/separated	12.1	10.1	.0001
Never married	26.4	21.8	
Widowed	1.8	2.1	
Currently married	59.7	66.1	
Income-to-needs, %			
Missing income	12.5	14.5	.0001
≤$6250	23.6	20.8	
>$6250–$11 250	23.5	22.2	
>$11 250–$18 750	22.0	22.9	
>$18 750–$75 000	18.4	19.7	
Education, %			
<High school graduate	18.3	17.1	.0965
High school graduate	81.7	82.9	
Occupation/employment status, %			
Blue collar	41.2	30.3	.0001
Unemployed	3.7	3.7	
Not in labor force	17.7	21.6	
White collar	37.5	44.4	
Total observations	4189	543 347	

[a]Means and percentages are weighted and adjusted for the sample design.
[b]For age, t statistic for general linear contrast; for percentages, overall χ^2 test of association.

reflect higher rates of driving exposure for work. The high risk of motor vehicle–related deaths in the lowest income group may reflect that these persons are less likely to be able to afford newer, more crashworthy vehicles or that they are more likely to live in inner-city areas (with increased pedestrian risk) or in remote rural areas (which results in greater distances traveled by car).

The risk of suicide, however, was largely unrelated to SES. This finding is in contrast to those of Kellermann et al.,[36] which showed an increased risk for all suicides in persons with low education. Our findings may differ because of different age groups, sample designs, or study populations.

The risks for nonfatal injuries generally showed very different patterns from those for fatal injuries. Even the crude sex differences in injury incidence ratios (male vs female) were much greater for fatalities (2.90) than for nonfatal injuries (1.31). Differences in exposure and effectiveness of prevention strategies may account for these results.

Income and education in the multivariate models were largely unrelated to overall injury morbidity, and blue-collar workers were at increased risk compared with white-collar workers, presumably because of greater hazards in blue-collar jobs. This outcome is confirmed by the larger proportion of work-related injuries for blue-collar workers (46%) compared with white-collar workers (22%). Furthermore, compared with the odds ratios for all injury episodes combined, odds ratios for blue-collar occupation were not significantly different and odds ratios for unemployed persons and those not in the labor force were higher for the non–work-related injuries, reflecting higher exposure to this type of injury.

The results also suggested that social inequality may explain the findings. Blue-collar occupations are generally considered lower status jobs, so for combined and work-related injuries, lower SES, based on occupation/employment status, leads to higher risk. Furthermore, as severity increases, low educational attainment becomes a significant risk factor for nonfatal injury, and the protective effect for Black and Hispanic persons becomes nonsignificant. In addition, Black and Hispanic persons are not at lower risk for work-related injuries as is the case with all nonfatal injuries combined. Both exposure and social inequality are probably operating to increase the risk of nonfatal injuries.

This study raises an important question: Why do Black and Hispanic persons appear to be at lower risk for injury morbidity? In addition, why do income and education bear little relation to nonfatal injuries? Examining injury morbidity in children, some have argued that it is a matter of definition in the NHIS.[2,37] That is, injuries are defined as resulting in a half-day of restricted activity or as requiring medical attention. If access to care is limited, as has been shown for minorities and low-SES groups, then injury incidence rates may be lower. This interpretation is supported in the current analysis, wherein the protective effect for Blacks and Hispanics becomes nonsignificant and an increased risk for low educational attainment becomes significant with increasing severity.

Although the severity measure is imperfect, this finding is intriguing and suggests that Whites are at higher risk only for minor injuries. More severe injuries are less likely to be affected by access-to-care differences. In addition, differential recall bias may be involved, especially for minor injuries, in which Whites or higher SES groups report more injuries. Evidence supports this claim: after adjusting for recall bias, researchers found that the increased rate of injuries among wealthier and more educated persons was no longer statistically significant.[2] Alternatively, the effects may be real and may simply reflect differences in exposure, such as outdoor or recreational activities or hobbies.

We were not able to examine occupational injury fatalities. This is important because people working in high-risk occupations and industries have different risk profiles from the rest of the population.[13] However, use of Stinson and colleagues'[35] method to identify probable work-related causes indicated that a very small proportion of other external causes (14%) were likely to be work related, although some of the homicides and motor vehicle–related deaths were probably occupational fatalities.

In the data sources used here, person–years (denominators) were accurate, unlike mortality statistics in which population counts are underestimated for minority groups and persons of low SES. The NHIS does have some nonresponse bias, but we followed up actual individuals identified in the survey. However, because the link between the NHIS and the National Death Index is based on a probabilistic matching methodology, all deaths (numerators) must be considered as "assumed" deaths. Moreover, all population subgroups do not have

TABLE 4—Weighted Age-Adjusted Hazard Ratios[a] for Injury Mortality for Respondents Aged 18–64 Years Followed Up Until 1995 (N = 547 484): National Health Interview Survey, 1987–1994

	All Injuries		Homicide		Suicide		Motor Vehicle		Other External Causes	
	Demo[b]	Full[c]	Demo	Full	Demo	Full	Demo	Full	Demo	Full
Age, y	0.99*	1.00	0.96***	0.97**	1.00	1.00***	0.99	1.00	1.01*	1.01**
Sex										
Male	2.92***	3.22***	2.72***	2.98***	3.53***	4.07***	2.22***	2.17***	3.77***	4.63***
Female	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Race/ethnicity										
Black, non-Hispanic	1.61***	1.20*	5.60***	3.93***	0.55**	0.47**	1.30	1.01	1.36	0.91
Hispanic	0.86	0.80	1.76	1.60	0.35*	0.34*	0.95	0.92	0.89	0.79
White, non-Hispanic	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Marital status										
Divorced/separated		1.84***		2.22**		1.79**		1.59**		2.08***
Never married		1.55***		1.86**		1.45*		1.46**		1.41*
Widowed		2.00**		1.12		3.19**		2.09*		1.50
Currently married		1.00		1.00		1.00		1.00		1.00
Income-to-needs, $										
Missing income		1.08		1.83		0.75		1.17		1.30
≤6250		1.31*		2.08*		0.71		1.50*		1.79*
>6250–11 250		1.10		2.25*		0.81		0.98		1.39
>11 250–18 750		1.02		1.82		0.83		1.15		0.90
>18 750–75 000		1.00		1.00		1.00		1.00		1.00
Education										
<High school graduate		1.48***		2.72***		1.16		1.53**		1.40*
High school graduate		1.00		1.00		1.00		1.00		1.00
Occupation/employment status										
Blue collar		1.36***		1.12		1.27		1.53**		1.49*
Unemployed		2.26***		2.52**		1.70		1.83**		3.20***
Not in labor force		2.01***		1.98**		2.25***		1.28		2.99***
White collar		1.00		1.00		1.00		1.00		1.00
No. of deaths	1300		224		317		424		335	

[a]Estimates adjusted for sample design.
[b]Demographic model adjusting for age, sex, and race/ethnicity.
[c]Full model adjusting for demographic variables plus marital status and socioeconomic variables (income-to-needs, education, occupation/employment status).
*P < .05; **P < .01; ***P < .0001.

the same probability of being classified as dead.

In the preliminary analysis, we found that the most important source of bias from the probabilistic matching methodology between the NHIS and the cause-of-death information (which includes matching on social security number) is that the risk of death for Hispanics is likely to be underestimated, as has been found in previous research that used the same data sources.[31,38] In addition, mortality for Black and White persons may be slightly overestimated, and persons with missing income are less likely to be classified as dead. Caution should be exercised when making inferences to the Hispanic population.

In addition to bias from the NHIS/National Death Index matching methodology, bias exists in the vital statistics reporting systems. Suicides are underreported, although the extent of underreporting and misclassification is unknown, and certification procedures vary from state to state.[39,40] In addition, a proportion of homicides and motor vehicle–injury deaths may be occupational fatalities,[1] and some injuries listed as "undetermined intent" are likely to be intentional. These caveats should be considered when making inferences from results based on national mortality statistics.

Because E-codes are not available for the nonfatal injury episodes, injury causes cannot be determined. For instance, a fracture could be caused by a fall or an assault. Also, as stated earlier in this article, restricted activity is an imperfect measure of severity. However, interesting differences were found, so the results are useful for generating hypotheses for future possible investigations. Finally, the analysis of injury morbidity was based on a cross-sectional design that imposes limits on interpreting causality.

The strengths of this research are that it is comprehensive and uses national, reliable data that are generalizable to the adult noninstitutionalized US population younger than 65 years. By restricting the study to this age group, we were more likely to obtain clear diagnoses for injuries. For the mortality analysis, this research linked 2 national and reliable data sets in a longitudinal design. Linking vital status to individual characteristics in a population-based sample allows death rates stratified by SES to be calculated. This is significant because the United States reports vital statistics by race and not by SES.

Because hazards for Black homicide victims remained significantly increased even after adjustment for SES, future research should examine other factors to explain these differences. A multilevel framework should be used in which indicators of the social environment (e.g., neighborhood characteristics) can be examined.

This research clearly showed that SES is an important determinant of injury. Perhaps the main reason socioeconomic factors are neglected in epidemiologic research is that they are not considered real causes.[41] It has been argued that social factors are not merely proxies for real causes but are themselves

TABLE 5—Weighted Age-Adjusted Odds Ratios[a] for Injury Morbidity, All Episodes and by Severity, for Respondents Aged 18–64 Years (N = 547 536): National Health Interview Survey, 1987–1994

	All Episodes		Days of Restricted Activity							
			0		1–2		3–4		≥5	
	Demo[b]	Full[c]	Demo	Full	Demo	Full	Demo	Full	Demo	Full
Age	0.98***	0.98***	0.98***	0.98***	0.97***	0.98***	0.98***	0.99***	0.98***	0.98***
Sex										
Male	1.37***	1.27***	1.38***	1.32***	1.38***	1.26**	1.18	1.05	1.47***	1.33**
Female	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Race/ethnicity										
Black, non-Hispanic	0.85**	0.80***	0.80**	0.77**	0.84	0.81	0.88	0.77	1.00	0.92
Hispanic	0.61***	0.62***	0.61**	0.62**	0.53**	0.54**	0.53	0.53	0.78	0.81
White, non-Hispanic[b]	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Marital status										
Divorced/separated		1.43***		1.36***		1.49***		1.22		1.64***
Never married		1.06		1.07		1.04		1.16		1.01
Widowed		1.43**		1.33		1.34		1.42		1.81*
Currently married		1.00		1.00		1.00		1.00		1.00
Income-to-needs, $										
Missing income		0.87*		0.80**		0.81		0.99		1.12
≤6250		1.05		0.90		1.25		1.33		1.13
>6250–11 250		1.02		0.91		1.12		1.13		1.19
>11 250–18 750		0.97		0.89		1.16		0.98		0.99
>18 750–75 000		1.00		1.00		1.00		1.00		1.00
Education										
<High school graduate		1.03		0.98		0.92		1.18		1.24*
High school graduate		1.00		1.00		1.00		1.00		1.00
Occupation/employment status										
Blue collar		1.46***		1.35***		1.42***		1.87***		1.60***
Unemployed		1.03		1.17		0.80		1.30		0.87
Not in labor force		1.03		1.14		0.86		1.21		0.91
White collar		1.00		1.00		1.00		1.00		1.00
No. of episodes	4189		1986		1008		465		730	

[a]Estimates adjusted for sample design.
[b]Demographic model adjusting for age, sex, and race/ethnicity.
[c]Full model adjusting for demographic variables plus marital status and socioeconomic variables (income-to-needs, education, occupation/employment status).
*P<.05; **P<.01; ***P<.0001.

fundamental causes of death and disability.[4] As such, SES and its association with health outcomes should be investigated in its own right and not merely as a first step toward identifying more proximate causes. This is an important point, because studies that focus on more proximate causes of disease often neglect an understanding of the context that puts individuals at risk. Interventions, therefore, may be only temporary or have smaller effects than anticipated.[4] In the case of external causes of death, the context is noteworthy because the origins of disability and death clearly lie far from the individual's own behavior or biological risks.

In this research, we found that SES is an important structural factor that influences injury. Our objective was to determine the socioeconomic factors that affect the risk of experiencing an injury (a major public health problem). We also attempted to clarify the confusion in the literature regarding racial differences in injury risk. These associations should be considered in future epidemiologic studies. Injuries, especially fatal injuries, not only are predictable and preventable but also occur disproportionately in persons with certain socioeconomic characteristics. The investigator should use multiple measures of SES. Public health researchers and policy analysts will benefit from this attempt to disentangle the microlevel structural effects of SES on the risk of injury as their attention is turned from simple measures of SES and single causes of death to a more complex view. □

Contributors

C. Cubbin planned the study, analyzed the data, and wrote the paper. F. B. LeClere and G. S. Smith assisted with study design, supervised data analysis, and contributed to the writing of the paper.

Acknowledgments

This work was supported in part by a joint fellowship from the Association of Schools of Public Health and the Centers for Disease Control and Prevention to Dr Cubbin and in part by grant R29 AA 07700 from the National Institute of Alcohol Abuse and Alcoholism and grant R49 CCR32496 from the Centers for Disease Control and Prevention to Dr Smith.

Assistance from the University of Auckland Injury Prevention Research Centre to Dr Smith is also acknowledged.

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