Incidence and Costs of 1987–1994 Childhood Injuries: Demographic Breakdowns

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ABSTRACT. *Objectives.* **Injuries pose a threat to health and well-being and are a major source of medical spending in the United States for children and youth 0 to 21 years of age. This study provides national estimates of the incidence of fatal and nonfatal childhood injuries and comprehensive cost estimates by age, gender, race, family income, metropolitan residence, and place of incident.**

Methods. **Eight years of National Health Interview Survey data (1987 to 1994) were used to estimate nonfatal injury incidence rates among children and youth 21 years of age and younger. The survey documents all medically attended or temporarily disabling injuries within the 2 weeks before the interview. Injuries were defined as diagnoses 800–995 in the *International Classification of Diseases, Ninth Revision*, excluding late effects cases. Fatality counts came from 1994 Vital Statistics.**

Estimates of the costs of injuries (1994 US dollars) included medical spending, lost future work, and lost quality of life. Medical payments included spending on hospital and professional services, rehabilitation, prescriptions, home health care, and medical equipment. Lost future work and lost quality of life consisted of the present value of work that children will be unable to do as adults if they are killed or permanently disabled combined with the pain and suffering that children and their families experience because of the injury. Cost estimates excluded parental income losses from work missed, property damage, legal costs, and insurance claims-adjustment costs related to permanent disability and death.

Results. Incidence. **A total of 3073 injury episodes for 3058 children were obtained from 8 years of National Health Interview Survey data. This represents 20.6 million children in the United States who were injured each year, or ~25 per 100 children. This translates to 56 000 nonfatal injury episodes each day that require medical attention or limit children's activity. For fatal injuries, the rate was 38 children per 100 000. The nonfatal injury rate for males (mean: 30; 95% confidence interval [CI]: 29,31) was higher than the rate for females (mean: 20; 95% CI: 19,21); the fatal injury rate for males was more than twice that of females.**

Injury rates increased with age. Children 0 to 9 years of age had the lowest rate of nonfatal injury. Rates for nonfatal injury among children 0 to 4 years of age were lower (mean: 20; 95% CI: 18,21) than those for the 5 to 9 age group (mean: 22; 95% CI: 20,23). However, the rate for fatal injuries (21 per 100 000) among the 0 to 4 age group was higher than the 5 to 9 age group (9 per 100 000). Nonfatal injury rates for children 10 years of age and older were higher, with the highest estimated injury rates in late adolescence (15–19 years; mean: 31; 95% CI: 29,33).

Nonfatal injuries occurred at higher rates among white children (mean: 27; 95% CI: 26,28) than black children (mean: 19; 95% CI: 17,21) or children from other racial backgrounds (mean: 13; 95% CI: 10,16). The reverse was true for fatal injuries, with higher fatality rates among black children (59 per 100 000). Children in families with incomes under $5000 had the highest rate of nonfatal injury (mean: 31; 95% CI: 27,35), followed by those in the $35 000 to $49 999 income range (mean: 25; 95% CI: 23,27). The rate of nonfatal injuries in the other income brackets were fairly similar, with those in the highest income bracket having the lowest rate (mean: 14; 95% CI: 13,15). Fatality rates by family income were not available. The nonfatal injury rate in nonmetropolitan areas (mean: 10; 95% CI: 9,11) was higher than in metropolitan areas (mean: 8; 95% CI: 7,8); the same was true for fatal injury rates (33 per 100 000 in nonmetropolitan areas vs 25 in metropolitan areas).

Males consistently had higher injury rates than females across all places of injury. Youth 15 years of age and older had higher rates for injuries that occur on the public roads, in recreation centers, and in industrial places. With increasing age for both boys and girls, injuries at home declined, whereas injuries at school tended to climb. These trends reflect the developmental changes in time spent in these environments. Injury rates in industrial places by age and gender were initially very low for children 0 to 14 years of age, then predictably increased for the 15 to 19 and 20 to 21 age groups, again caused by the increasing time spent in these places as children grow. Injury on farms had the lowest occurrence, rendering a breakdown by age and gender unreliable.

Costs. **The estimated cost of unintentional childhood injuries was a staggering $347 billion each year. This estimate included $17 billion in medical costs, $72 billion in future work lost, and $257 billion in lost quality of life. Injury accounts for approximately 15% of total medical spending from 1 to 21 years of age. The estimated cost per child injured was approximately $17 000. This included approximately $800 in medical payments alone; the estimated cost of lost future work and quality of life costs amounted to $3500 and $12 400, respectively. The estimated cost per resident child was an estimated $4200. The annual costs of injuries per male child were $1500 higher than those per female, although the costs per injured male and per injured female were roughly similar.**

The total cost of injuries to white children ($283 billion) and higher income children ($48 billion) were the highest compared with those for minority and lower and middle income children. When looking at the cost per child injury survivor, those in higher income families

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also have the highest costs. Children with non-white racial backgrounds had higher costs per injured child than did white children. Injuries to children in metropolitan areas cost $149 billion more than injuries to those in nonmetropolitan areas. However, the costs per injured child in nonmetropolitan and metropolitan areas were relatively similar. Injuries that occurred on farms and industrial places had the lowest costs.

Conclusions. **Approximately 1 in 4 children in the United States are injured each year, with huge corresponding costs. This article demonstrates the potential economic benefits of prevention programs targeted toward reducing childhood injuries.** ***Pediatrics*** **2000;105(2). URL: http://www.pediatrics.org/cgi/content/full/105/2/e27;** ***injury, incidence, cost.***

ABBREVIATIONS. NHIS, National Health Interview Survey; MSA, metropolitan statistical area; ICD-9, *International Classification of Diseases, Ninth Revision*; QALY, quality-adjusted life years; CI, confidence interval.

In the United States, injuries pose a threat to children's health and well-being, and are a major source of medical spending for children and youth ages 0 to 21.[1–3] To guide prevention efforts, national estimates of the incidence and costs of injuries among children and adolescents are needed. Current national data on injury morbidity and mortality exist but published estimates for children lack breakdowns by place or detailed demographics.[4] Scheidt et al[5] provided more detailed estimates based on the 1988 National Health Interview Survey (NHIS) Child Health Supplement. Other recent studies that have looked at the incidence rates of childhood injury have been specific with respect to the type, geographic location, or place of injury, and thereby do not provide comprehensive information on the overall burden of injury morbidity and mortality.[6–9]

Current estimates of the costs of injuries sustained by children and adolescents lack demographic information beyond age group. The costs of medical treatment and loss in future work were estimated at $29 billion (1994 dollars) for children 14 years of age and younger, and $87 billion for youth 15 to 24 years of age.[10] An earlier study estimated the costs at $28.5 billion and $80 billion for the respective age groups (adjusted to the discount rate used in the present article).[2] Other childhood injury cost estimates describe only medical spending[3,8] or costs of selected injury types.[9]

This article provides current estimates of the incidence and corresponding costs of fatal and nonfatal injuries among children and youth. NHIS data were used to provide an accurate national estimate of injury morbidity. Injury mortality rates were obtained from vital statistics. This article's primary aim, however, is to provide a current comprehensive incidence-based estimate of the costs of childhood injuries, which include medical spending, lost future work, and the value of lost quality of life.

METHODS

Injury Morbidity

To estimate the incidence of nonfatal injury among children and youth, we pooled the most recent NHIS data available (1987 through 1994).[11] With the use of a complex multistage probability sampling design, NHIS data are representative of the civilian noninsitutionalized population of the United States. Approximately 43 000–49 000 households are surveyed each year providing information on ~110 000–130 000 individuals. Weights adjusting the data for nonresponse, probability of selection, and bias resulting from the sampling frame undercoverage were applied to make the sample representative of the US population by age, sex, race, and residence in a metropolitan area for each survey year.

Family members 18 years of age and older were interviewed in person, with proxy responses used for absent members, those <18 years of age, and those physically or mentally incapable of responding for themselves. Demographic information from the NHIS used in this article included age, sex, race, family income, and whether the household was in a metropolitan statistical area (MSA) or in a non-MSA.

The NHIS provides data on nonfatal injuries that were medically attended or temporarily disabling within the 2 weeks before the interview. Injuries that resulted in restricted activity and were not necessarily medically attended, ie, those injuries that resulted in missed work days or missed school days, or those injuries that made the respondent cut back his or her usual activities, were included to reduce reporting bias for those with limited access to medical care. Injuries were defined as diagnoses 800 to 995 in the *International Classification of Diseases, Ninth Revision* (ICD-9). This definition included fractures, lacerations, sprains, contusions, burns, poisoning, and impairments caused by unintentional and violent incidents. Injuries that were classified as malpractice cases or late effects were excluded. NHIS records injury diagnosis, place of injury, number of bed days, and number of missed school days (5–17 years of age) or number of missed work days (18 years of age and older). The causes of injuries were not recorded.

We used the Maternal and Child Health Services Block Grant definition of children as anyone 21 years of age and younger. Hence, individuals who were 21 years of age or younger, and for whom an episode of injury occurred, were selected from NHIS data from 1987 through 1994. The sample sizes for each year were small (unweighted n = 359–425). When we examined the 3-year moving average (ie, the rates from all possible 3-year consecutive periods) childhood injury rate, it was stable. Therefore, we pooled the data from these 8 years.

Approximately 2% of cases had multiple injuries per injury episode, with ~.1% of cases with a maximum of 5 injuries in a single episode. The injury with the highest corresponding costs was selected for analysis. A small number of children (n = 15) had 2 injuries in the 2-week reference period. These were treated as separate injury episodes.

The unweighted number of injuries by 1-year age increments was small (range: 79–185). Estimates of injuries by 5-year age groups were used instead. These age groups corresponded to the following developmental stages: 1) preschool: 0 to 4 years; 2) early school: 5 to 9 years; 3) preadolescence and early adolescence: 10 to 14 years; 4) middle and late adolescence: 15 to 19 years; and 5) early adulthood: 20 to 21 years. The categories in the MSA variable were collapsed from 4 to 2 categories: 1) metropolitan areas comprised of MSA-central city and MSA-non-central city and 2) nonmetropolitan areas comprised of non-MSA-non-farm and non-MSA-farm. An adjustment also was made in the number of injuries that occurred on the farm. Injuries that occurred outside the home that were also classified as occurring on a non-MSA-farm were reclassified as occurring on the farm for the variable place of incident. This method increased the unweighted episodes of injury on the farm from 17 to 24.

Standard errors for an aggregate sample from multiple years were not provided in NHIS publications or data tapes.[11] Based on consultations with National Center for Health Statistics staff (I. Shimizu, personal communication, April 29, 1998; J. N. Russell, personal communication July 13, 1998), standard errors were computed by choosing the standard error from each year that yielded the largest value using the recommended NHIS formula,[11] then divided by the number of years (ie, 8) in the aggregate sample. The standard error based on this method of calculation yielded a conservative value. The standard errors did not exceed 10% of the

estimated incidence (see Table 1), except for race other than black or white (relative standard error: 12%), and farm as place of injury (relative standard error: 23%). These were the 2 categories with the lowest unweighted number of nonfatal injuries.

Nonfatal Injury Rates

The number of children and youth by age, sex, income distribution, and metropolitan location for 1994 were obtained from the Statistical Abstract of the United States.[12] The denominator used for calculating the nonfatal injury rates for all categories in the variable place of incident was the population of children and youth 21 years of age and younger. Computation of the standard errors for the rates of nonfatal injuries was similar to the computation of the standard error for estimates of the incidence of nonfatal injury.

Fatal Cases

The incidence and rates for fatal injuries were obtained from the Center for Disease Control and Prevention WONDER Compressed Mortality File,[13] which contained records of US deaths from 1979 to 1995, population estimates from the US Bureau of Census, and corresponding mortality rates. Data from the Compressed Mortality File were available only through external cause codes and not by nature of injury. Hence, ICD-9 external cause codes denoting injuries and poisonings for 1994 were entered in the data request (eg, motor vehicle crashes, falls, burns, firearms, suicides, and sports) for the age, sex, and race breakdowns. Fatal cases by MSA were obtained from National Center for Health Statistics[14] and included counts for children 0 to 21 years of age for 1992.

Costs

We estimated 3 categories of injury costs: payments for medical care, lost future work, and a less direct measure of loss in quality of life. Inclusion of these categories is common in injury cost studies.[2,9,15–20] Medical payments included spending on hospital and professional services, rehabilitation, prescriptions, home health care, and medical equipment. Years of good health lost were measured using survival values. The value of survival was the present value of work that children will be unable to do as adults if they are killed or permanently disabled combined with the pain, suffering, and lost quality of life that children and their families experience because of injury. We separated these costs into future work and quality of life components.

To attach costs to the injuries, we relied on a recent study[21] that estimated permanent disability probabilities and percentage loss

TABLE 1. Estimated Annual Incidence of Childhood Injuries by Gender, Age Group, Race, Family Income, and MSA (Excludes Rape and Sexual Assaults)

	Nonfatal Injuries*				Fatal Cases per 100 000†
	Unweighted *n*	Annual Estimate (Standard Error *n*)	Percent	Rate per 100 (Standard Error *n*)	
All	3073	20 638 451 (448 498)	100%	25 (.43)	33.81
Gender					
Male	1872	12 525 867 (335 133)	61%	30 (.63)	49.35
Female	1201	8 112 583 (263 249)	39%	20 (.57)	17.53
Age group (y)					
0–4	585	3 868 021 (177 722)	19%	20 (.80)	21.35
5–9	636	4 089 470 (182 885)	20%	22 (.84)	9.35
10–14	804	5 185 497 (206 971)	25%	28 (.92)	14.29
15–19	778	5 453 957 (212 593)	26%	31 (.98)	69.48
20–21	270	2 041 506 (128 259)	10%	29 (1.54)	82.47
Race					
White	2590	17 640 223 (408 466)	85%	27 (.49)	29.45
Black	410	2 444 393 (140 552)	12%	19 (.98)	58.61
Other	73	553 835 (66 439)	3%	13 (1.50)	26.62
Family income					
Under $5000	201	1 371 082 (104 852)	7%	31 (1.97)	
$5000–$9999	260	1 652 813 (115 241)	8%	18 (1.10)	
$10 000–$14 999	250	1 685 556 (116 390)	8%	19 (1.16)	
$15 000–$19 999	201	1 331 973 (103 331)	6%	16 (1.13)	
$20 000–$24 999	219	1 466 621 (108 481)	7%	18 (1.20)	
$25 000–$34 999	447	2 869 285 (152 515)	14%	20 (.94)	
$35 000–$49 999	570	3 957 270 (179 819)	19%	25 (.97)	
$50 000 or more	565	3 868 483 (177 733)	19%	14 (.59)	
Unknown	360	2 435 368 (140 288)	12%		
MSA					
Metropolitan	2305	15 472 751 (378 312)	75%	8 (.17)	25.25
Nonmetropolitan	768	5 165 699 (206 552)	25%	10 (.37)	33.38
Place of incident‡					
Inside home	559	3 572 698 (170 621)	17%	4 (.20)	
Outside home§	550	3 671 076 (173 015)	18%	4 (.20)	
Street and highway	370	2 582 824 (144 550)	13%	3 (.17)	
Farm‖	24	150 136 (34 540)	1%	.2 (.04)	
Industrial place	114	833 010 (81 566)	4%	1 (.10)	
School	600	4 002 374 (180 870)	19%	5 (.21)	
Recreation/sports	315	2 150 555 (131 692)	10%	3 (.16)	
Other	213	1 472 773 (108 711)	7%	2 (.13)	
Unknown	328	2 203 005 (133 314)	11%	3 (.18)	

* Incidence rates for nonfatal childhood injuries were estimated from 8 annual National Health Interview Surveys (1987–1994).
† Fatal cases were obtained from the Centers for Disease Control Wonder Compressed Mortality File for 1994. Rates for fatal injuries of infants <1 year was based on 100 000 live births. Fatal cases by MSA were obtained from the National Center for Health Statistics and are based on fatal injuries among children 1 to 19 years of age and population estimates for 1992.
‡ The number of children 21 years of age and younger was used to calculate the rates for place of incident.
§ Injuries that occurred outside the home referred to injuries that occur in areas surrounding the home and not all other areas aside from inside the home.
‖ Injuries that occurred outside the home and in a non-MSA-Farm were classified as occurring in the farm.

of survival value for injuries by primary ICD-9 diagnosis code. We updated the estimated medical spending of that study by using 1987–1992 National Hospital Discharge Survey data, 1992–1994 Civilian Health and Medical Program of the Uniformed Services data describing insurance payments for military dependents and military retirees under 65 years of age, 1987 National Medical Expenditure Survey data, and hospital costs (distinct from charges or payments) per day by diagnosis from 1994–1995 Maryland and 1994 New York data (adjusted from state to national average hospital prices). These data encompassed all injuries and were not limited to children. Details of those estimation methods are documented elsewhere.[22,23] Medical costs by diagnosis were then tailored to children based on the differential patterns of utilization by age in episodes of care computed from longitudinal 1987–1989 Medstat claims data. Medstat pools health care claims for employees and dependents of 70 large corporations.

We applied 1991 life expectancy data to compute years lost per child permanently disabled or killed. Using a method and estimates developed in previous studies,[9,21,24–27] we valued impairment, disability, and death attributable to injury by diagnosis. In the previous work, physicians rated the typical effects of different injuries over time on 6 dimensions of functioning: mobility, cognition, bending and grasping, pain, sensory, and cosmetic.[24] Data on a seventh dimension, ability to work, were added through an analysis of nearly 500 000 occupational injuries. Using surveys on the value people place on different dimensions of functioning, these estimates were combined to obtain estimated quality-adjusted life years (QALY) lost by victim age and diagnosis. We used a published value of $76 000 per QALY, net of impacts on future work.[24] QALYs include the good health lost to injury. The estimates omit parental income losses from work missed. Also excluded are property damage, legal costs, and insurance claims-adjustment costs related to permanent disability and death.

Because money invested now will earn interest until needed, the value of a dollar in a future year is not the same as a dollar today. We applied a discount rate to adjust future losses to their present value. The computations used a 2.5% discount rate, the same rate used in all our other recent injury cost studies.[9,17–20] This rate lies at the conservative end of the 1% to 3% range that the economic evidence has cause the US Supreme Court (1983)[28] to conclude as most appropriate in determining tort liability compensation.

Cost per nonfatal case was applied to each injury according to the 3-digit ICD-9 code. The per-case cost is an average that takes into account the distribution of hospitalization status for that particular ICD-9 group.

RESULTS

Incidence

A total of 3073 injury episodes for 3058 children were obtained from 8 years of NHIS data. This represents 20.6 million children in the United States who were injured each year, or ~25 per 100 children (Table 1). This translates to 56 000 injury episodes each day that require medical attention or limit children's activity. The nonfatal injury rate for males (95% confidence interval [CI]: 29,31) was higher than the rate for females (95% CI: 19,21); the fatal injury rate for males was more than twice that of females.

Injury rates increased with age. Children 0 to 9 years of age had the lowest rate of nonfatal injury. Rates for nonfatal injury among children 0 to 4 years of age were lower (95% CI: 18,21) than those for the 5 to 9 years of age group (95% CI: 20,23). However, the rate for fatal injuries among the 0 to 4 years of age group was higher than the 5 to 9 years of age group. Nonfatal injury rates for children 10 years of age and older were higher, with the highest estimated injury rates in late adolescence (15 to 19 years of age) (95% CI: 29,33). This finding may be an artifact of the NHIS study design, because injuries among youth over 17 years of age were self-reported, whereas injuries for those below 18 years of age were based on proxy reports. However, when we examined injury rates based on proxy reports only, the rate for children 15 to 17 years of age remained high at 31 per 100 children (95% CI: 28,33) and was similar to the rate for youth 18 to 19 years of age (95% CI: 30,33).

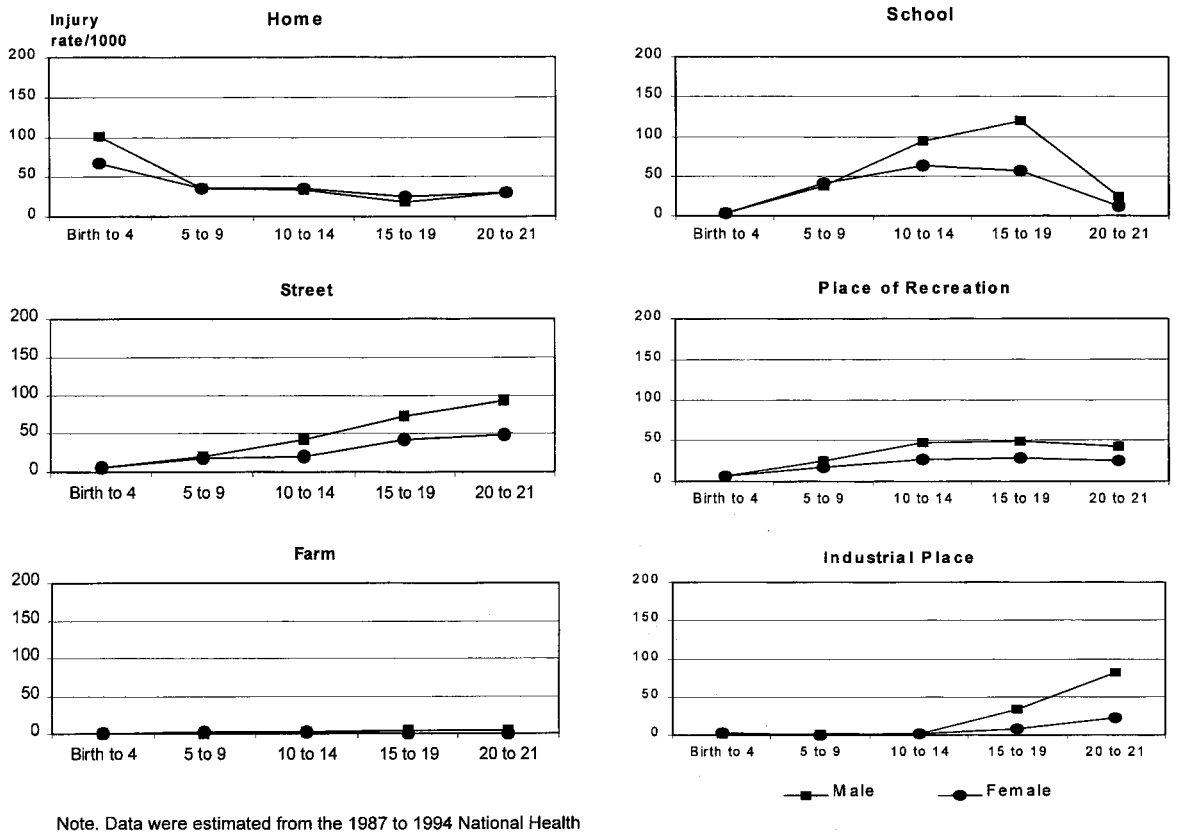
Nonfatal injuries occurred at higher rates among white children (95% CI: 26,28) than black children (95% CI: 17,21) or children from other racial backgrounds (95% CI: 10,16). The reverse was true for fatal injuries, with higher fatality rates among black children. Children in families with incomes under $5000 had the highest rate of nonfatal injury (95% CI: 27,35), followed by those in the $35 000 to $49 999 income range (95% CI: 23,27). The rates of nonfatal injuries in the other income brackets were fairly similar, with those in the highest income bracket having the lowest rate (95% CI: 13,15). Fatality rates by family income were not available. The nonfatal injury rate in nonmetropolitan areas (95% CI: 9,11) was higher than in metropolitan areas (95% CI: 7,8); the same was true for fatal injury rates.

Nonfatal injury rates for selected places where the injury occurred by age group and gender are shown in Fig 1. Males consistently had higher injury rates than females across all places of injury. Youth 15 years of age and older had higher rates for injuries that occur on the public roads, in recreation centers, and in industrial places. With increasing age for both boys and girls, injuries at home declined, whereas injuries at school tended to climb. These trends reflect the developmental changes in time spent in these environments. Injury rates in industrial places by age and gender were initially very low for 0 to 14 years of age, then predictably increased for the 15- to 19- and 20- to 21-year age groups, again attributable to increasing time spent in these places as children grow. Injury rates on farms had the lowest occurrence, rendering a breakdown by age and gender unreliable.

Costs

The estimated cost of unintentional childhood injuries was a staggering $347 billion each year. This estimate included $17 billion in medical costs, $72 billion in future work lost, and $257 billion in lost quality of life (see Table 2). Injury accounts for ~15% of total medical spending from 1 to 21 years of age. The estimated cost per child injured was approximately $17 000. This included approximately $800 in medical payments alone; the estimated cost of lost future work and quality of life costs amount to $3500 and $12 400, respectively (see Table 3). The estimated cost per resident child was an estimated $4200. The annual costs of injuries per male child were $1500 higher than were those per female, although the costs per injured male and per injured female were roughly similar. Total annual costs per US child are presented in Table 3 (separate costs for medical care, lost future work, and lost quality of life are available from the authors on request).

The total cost of injuries to white children ($283 billion) and higher income children ($48 billion) were the highest compared with those for minority and



Note. Data were estimated from the 1987 to 1994 National Health Interview Survey. The denominator for all charts was the same and consisted of the population of males or females for the age group.

Fig 1. Injury rates for selected places of incidents, by age group and gender.

lower and middle income children. When looking at the cost per child injury survivor, those in higher income families have the highest costs. Children with non-white racial backgrounds had higher costs per injured child compared with white children. Injuries to children in metropolitan areas cost $149 billion more than injuries to those in nonmetropolitan areas. However, the costs per injured child in nonmetropolitan and metropolitan areas were relatively similar. Injuries that occurred on farms and industrial places had the lowest total costs, costs per injured child, and costs per resident child.

DISCUSSION

Based on 8 years of nationally representative survey data, this study found that 25 of 100 children experience nonfatal injuries serious enough to require medical attention or restrict activity. This estimate is consistent with the injury rate reported by Scheidt and his colleagues,[4,29] which adjusted for the 12-month recall of injuries from the 1988 Child Health Supplement of the NHIS; by Rice et al[2] from the 1984–1986 NHIS, the National Mortality Detail File, and the National Hospital Discharge Survey; and by Kogan et al[30] based on the 1991 Longitudinal Follow-up to the National Maternal and Infant Health Survey. The nonfatal injury rate reported here is slightly higher than that described by Gallagher et al[31] based on the 1980–1981 Massachusetts Statewide Childhood Injury Prevention Program Surveillance System (22 per 100 children). Although trends in injury rates were not our major focus, these similar injury rates across several surveys for the past 10 to 15 years suggest minimal decline in injury morbidity. A lower rate of decline in deaths among children caused by injury compared with the more sharp decline in the rate of deaths caused by diseases also was noted by a 1990 Centers for Disease Control and Prevention report.[32]

Injury rates by gender and race were also similar to those in previous reports; males and white children have higher nonfatal injury rates than females and minority children.[2,5,29–31] In contrast, higher rates for fatal injuries among black children were noted, suggesting different effects of race and/or socioeconomic status on fatal and nonfatal injuries. The higher nonfatal injury rates for children in families with high income levels have likewise been reported in other studies.[2,5,29–31] These higher rates for children in upper socioeconomic status levels likely reflect reporting bias attributable to higher utilization and better access to care.[2,30] Although high injury rates were found in this study for children in families with high income levels, we also found relatively higher estimated rates of injury for those in the lowest income levels.

The estimated injury rates across age groups in this study were consistent with other population-based studies: the highest rates were found among adolescents 15 to 19 years of age.[2,5,31] Comparisons across studies, however, were complicated by the use of different age groupings and age limits. For

TABLE 2. Total Estimated Costs of Childhood Injuries (in Billion December 1994 Dollars)

	Medical	Lost Future Work	Quality of Life	Overall Cost
All	$17	$72	$257	$347
Sex				
Male	$11	$48	$150	$208
Female	$ 7	$25	$107	$139
Age (y)				
0–4	$ 3	$12	$ 60	$ 75
5–9	$ 3	$11	$ 38	$ 53
10–14	$ 4	$15	$ 55	$ 75
15–19	$ 5	$22	$ 65	$ 92
20–21	$ 2	$12	$ 39	$ 53
Race				
White	$15	$59	$209	$283
Black	$ 2	$12	$ 38	$ 52
Other	$ 1	$ 2	$ 9	$ 12
Family income*				
Under $5000	$ 1	$ 3	$ 14	$ 19
$5000–$9999	$ 1	$ 3	$ 12	$ 17
$10 000–$14 999	$ 2	$ 4	$ 25	$ 31
$15 000–$19 999	$ 1	$ 3	$ 13	$ 17
$20 000–$24 999	$ 1	$ 4	$ 10	$ 15
$25 000–$34 999	$ 2	$ 6	$ 30	$ 39
$35 000–$49 999	$ 3	$ 9	$ 33	$ 45
$50 000 or more	$ 3	$ 9	$ 35	$ 48
Unknown	$ 2	$ 6	$ 16	$ 24
MSA				
Metropolitan area	$13	$51	$179	$243
Nonmetropolitan area	$ 4	$18	$ 71	$ 94
Place of incident*				
Inside home	$ 3	$ 9	$ 39	$ 51
Outside home	$ 3	$10	$ 41	$ 54
Street and highway	$ 3	$ 6	$ 34	$ 42
Farm	$ 0.1	$ 0.2	$ 1	$ 1
Industrial place	$ 1	$ 2	$ 3	$ 6
School	$ 3	$10	$ 34	$ 47
Recreation/sports	$ 2	$ 5	$ 16	$ 22
Other	$ 1	$ 3	$ 9	$ 14
Unknown	$ 1	$ 3	$ 11	$ 15

* Costs based on estimates of nonfatal injury only.

instance, Rice et al[2] used 0 to 4, 5 to 14, and 15 to 24 years of age; Scheidt et al[5] used 1 to 4, 5 to 9, 10 to 13, and 14 to 17 years of age; and Gallagher et al[31] used 0 to 5, 6 to 12, and 13 to 19 years of age. Our uniform 5-year age groups match those used by the Division of Injury Control of the Centers for Disease Control and Prevention.[32]

The estimated costs of nonfatal childhood injuries are considerably larger than previous estimates[2] primarily attributable to adjustments to 1994 dollars, and the computation of 2 indirect costs: lost future work and value of lost quality of life. In contrast, previous estimates have computed only the first of these indirect costs.[2] It is important to note that our estimates of the costs and incidence of nonfatal childhood injuries are conservative, because only those injuries that required medical attention or restricted activity were included. Other injuries that required the time of parents or teachers and resulted in minor discomforts to children were excluded. Moreover, other incidental costs such as loss of parental income attributable to missed work days were excluded from our cost estimates.

The cause of injury was not included in our incidence and cost estimates because of limitations in the NHIS study design. External cause codes were included only in the NHIS supplement focusing on injury, with the last such comprehensive interview conducted in 1988. However, a redesigned NHIS beginning in the 1997 interview includes external cause codes.[33] Moreover, the sources of data for identifying fatal and nonfatal injuries were different and the impact of such differences on the estimates of the incidence of injury cannot be fully ascertained at this time. A related report presents incidence and cost estimates from other data sources (eg, National Hospital Discharge Survey) and includes information about intent.[23]

Although this report utilized currently available data, it is important to note that we relied on hospital cost estimates from Maryland and New York to obtain national cost estimates. Future analyses of the incidence and costs of childhood injuries that rely on cost data from other geographic areas in the United States, which are also more specific to children are thus needed.

The estimated medical costs of childhood injury are comparable to the costs of other major health care problems afflicting children. On a prevalence basis, ~13% of all medical spending on children 1 to 19 years of age during 1996 was used to treat unintentional injuries.[3] Analyses performed for that article suggest that prevalence-based medical spending on unintentional injury during 1996 totaled $13 billion for children 0 to 19 years of age. By comparison, the estimated prevalence-based (or incidence-based)

TABLE 3. Estimated Costs of Childhood Injuries per Injured Child and per Resident Child (in December 1994 Dollars)

	Costs per Injured Child				Total per Child*
	Medical	Lost Future Work	Quality of Life	Total	
All	$ 800	$3500	$12 400	$16 800	$4200
Sex					
Male	$ 800	$3800	$11 900	$16 600	$5000
Female	$ 800	$3100	$13 200	$17 100	$3500
Age (y)					
0–4	$ 800	$3100	$15 500	$19 400	$3800
5–9	$ 800	$2800	$ 9300	$12 900	$2800
10–14	$ 500	$1800	$ 6800	$ 9200	$4000
15–19	$ 900	$4300	$12 500	$17 700	$5200
20–21	$ 400	$2100	$ 7200	$ 9700	$7600
Race					
White	$ 800	$3300	$11 900	$16 300	$4300
Black	$ 800	$4700	$15 600	$21 200	$4100
Other	$ 900	$4300	$16 800	$22 000	$3000
Family income†					
Under $5000	$ 900	$2400	$10 500	$13 800	$ 200
$5000–$9999	$ 800	$1800	$ 7400	$10 000	$ 200
$10 000–$14 999	$ 900	$2300	$15 000	$18 200	$ 400
$15 000–$19 999	$ 800	$2200	$ 9400	$12 400	$ 200
$20 000–$24 999	$ 900	$2500	$ 6500	$10 000	$ 200
$25 000–$34 999	$ 800	$2200	$10 400	$13 500	$ 500
$35 000–$49 999	$ 800	$2300	$ 8400	$11 500	$ 600
$50 000 or more	$ 800	$2400	$ 9100	$12 300	$ 600
Unknown	$ 800	$2400	$ 6500	$ 9700	$ 300
MSA					
Metropolitan	$ 800	$3300	$11 600	$15 700	$1200
Nonmetropolitan	$ 900	$3600	$13 800	$18 200	$1800
Place of incident†					
Inside home	$ 800	$2400	$11 000	$14 300	$ 600
Outside home	$ 900	$2800	$11 100	$14 700	$ 700
Street and highway	$1000	$2200	$13 100	$16 300	$ 500
Farm	$ 700	$1600	$ 5400	$ 7800	$ 10
Industrial place	$ 800	$2100	$ 3700	$ 6600	$ 100
School	$ 800	$2400	$ 8600	$11 800	$ 600
Recreation/sports	$ 800	$2300	$ 7300	$10 500	$ 300
Other	$ 900	$2400	$ 6200	$ 9500	$ 200
Unknown	$ 500	$1200	$ 5000	$ 6700	$ 200

* The denominators used in estimating the costs per resident child were obtained from the Statistical Abstract of the United States, 1995.
† Costs based on estimates of nonfatal injury only. The denominator used in estimating the cost per resident child for each category was the population of children 21 years of age and younger.

medical spending on low birth weight during 1996 was $9 to $10 billion for children from birth through 14 years of age.[34] For all ages, the estimated prevalence-based medical spending on drug abuse in 1996 was $13 billion and the spending on alcohol abuse was $24 billion.[35] Thus, unintentional injuries to children impose a health care burden relatively similar in magnitude to other major health problems.

CONCLUSION

In summary, this study provided current incidence estimates of childhood injuries, which were consistent with previous population-based studies. Approximately 1 in 4 children in the United States is injured seriously enough to require medical attention or restrict activity. The estimated medical costs, costs of lost future work, and value of lost quality of life that accompany these injuries are quite large: an estimated $372 billion (1994 dollars). Although current prevention efforts can be directed to those groups with the highest incidence and cost estimates (eg, males, adolescents, and low income), more specific strategies will need to be developed with more cause-specific injury morbidity data, such as the recently redesigned NHIS. Nevertheless, this article demonstrates the potential economic benefits of prevention programs targeted toward reducing childhood injuries.

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