Deaths From Residential Injuries in US Children and Adolescents, 1985–1997

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ABSTRACT. *Objective.* The majority of deaths from unintentional injuries in children occur in the home environment, but there has not been a comprehensive analysis of residential deaths in the United States since 1985. The objective of this study was to determine the incidence and trends of deaths from injuries that occurred in the residential setting.

Methods. Injury-related death rates of all deaths among US children and adolescents who were younger than 20 years from 1985 to 1997 were calculated using National Vital Statistics System Mortality Data from 1985 to 1997 by age group, gender, region, and race. Poisson regression or negative binomial regression was used to test for trends over time in mortality rates.

Results. From 1985 to 1997, an average of 2822 (55%) of 5103 annual unintentional deaths in US children with a known location of injury took place in the home environment. The annual number and incidence of fatal residential injuries decreased by >22%, from 2973 (4.2 per 100 000) in 1985 to 2310 (3.0 per 100 000) in 1997. The death rate as a result of residential injury was highest in children who were younger than 1 year (12.6 per 100 000) and 1 to 4 years (7.9 per 100 000) compared with older children, boys compared with girls (4.9 vs 2.8 per 100 000), and black children compared with white children (7.0 vs 3.3 per 100 000). The highest death rates were attributable to fires (1.5 per 100 000), submersion or suffocation (1.3 per 100 000), poisoning (0.2 per 100 000), and falls (0.1 per 100 000).

Conclusions. Despite a 22% decline since 1985, residential injuries remain a leading cause of death in US children and adolescents. Black children were 2 times more likely to die from residential injuries than white children. *Pediatrics* 2005;116:454–461; *disparities, environmental health, epidemiology, injury, home safety.*

ABBREVIATIONS. NCHS, National Center for Health Statistics; ICD, *International Classification of Diseases*; E-code, external causes of injury code; ICD-9, *International Classification of Diseases, Ninth Revision.*

Injuries remain the leading cause of death for children in the United States after the first year of life. Deaths from intentional injuries are often more disturbing and receive more attention,[1,2] but unintentional injuries are far more prevalent. In 2001, unintentional injuries accounted for >12 000 injury-related deaths among children and adolescents.[3] Excluding motor vehicle–related deaths, the majority of deaths in US children as a result of unintentional injury occurred in the home environment.[4]

A recently completed study of emergency department visits for US children from 1993 through 1999 found the home environment to be the most common location of injury resulting in an unintentional injury–related visit.[5] From 1978 through 1984, residential injuries accounted for >60% of injury-related deaths among children and adolescents who were younger than 15 years.[6] The mechanisms of death included fire or burns, drowning, suffocation, choking, unintentional firearm injuries, falls, and poisoning. Risk factors for residential deaths included younger age and male gender. Despite the high death rate from injuries that occur in the residential environment, few studies have evaluated the frequency or specific mechanisms of such deaths. Indeed, there has not been a national survey of deaths from residential injuries since 1985.[6]

Although there has been an overall decline in injury-related deaths among children, prevention efforts have largely been mechanism specific, such as the use of smoke detectors in the home to prevent burn injuries.[7] Moreover, there have been no substantive changes in housing codes or laws to protect children from injuries for >50 years. Although housing modifications can be more effective than educational efforts in reducing injury, current efforts to reduce injury-related deaths in the residential environment rely almost entirely on educational interventions.[7,8]

The purpose of this article was to determine the incidence and examine trends in fatal residential injuries from 1985 to 1997. Another aim was to identify associated risk factors for unintentional injury–related deaths in children and adolescents <20 years of age.

METHODS

The 2 primary sources of information used were injury mortality data from the National Vital Statistics System (Multiple Cause of Death for ICD-9 Data) that is publicly available from the National Center for Health Statistics (NCHS) and the population estimates from the US Census Bureau. The NCHS compiles mortality data from information recorded by physicians, medical ex-

aminers, or coroners on the death certificate. This information includes the decedent's age, race, gender, and date of death and the underlying and contributory causes of death. The place of occurrence of injury was also noted on the death certificate and mortality data tapes. Analyses were limited to children and adolescents who were younger than 20 years.

The underlying cause of death and the place of occurrence of fatal injury were abstracted from death certificates by NCHS staff and recorded according to the *International Classification of Diseases* (ICD) codes. External causes of injury codes (E-codes) were used to examine the underlying causes of injury. The NCHS assigns a place-of-occurrence code for fatal, unintentional injuries for ICD codes in the range of 850 to 929 under the *International Classification of Diseases Ninth Revision* (ICD-9), which has been in use since 1979. Place of occurrence was not assigned to intentional injury–related deaths as a result of suicide or homicide or to injuries of undetermined intention.

This report uses data on deaths that resulted from injury for which the NCHS coded the place of occurrence as "home." Unintentional injuries were defined as records with E-codes in the range 800 to 929. Other unintentional injuries (E-codes 829–849 and 870–879) outside the home environment, such as motor vehicle accidents, railway accidents, and surgical or medical problems, were excluded from this analysis. The definition of home as the place of occurrence includes apartment, boarding house, home premises, driveway to home, garage, yard, and swimming pool in private house or garden. Although death certificates are intended to include the place where the injury occurred, the information provided frequently does not allow vital statisticians to assign a specific code.[6] Deaths that are summarized in this article include only those that were attributable to injuries that were assigned a place-of-occurrence code according to ICD-9. The proportion of injury-related deaths with unspecified place-of-occurrence codes, ~30%, did not vary from year to year in the 13 years of this analysis from 1985 to 1997.

Relevant information extracted from the NCHS mortality data tapes included underlying cause of death (ICD-9 code), place of injury, state, county, city, age, month and day of the week, race, and gender. Month and day-of-week information was used to examine differences in mortality between seasons and between days of the week. Age was categorized into 5 age groups: under 1, 1 to 4, 5 to 9, 10 to 14, and 15 to 19 years.[9] In the mortality data, race data were reported in 6 categories, but in this report, race is grouped into 3 categories, white (non-Hispanic), black, and other. We divided weekdays by 5 and weekends by 2 to compare the rates of residential injury–related deaths by weekdays or weekend days. Census data were used to calculate the annual fatality rates by age, gender, race, and region. Population estimates by year were obtained from the US Bureau of Census.[10]

Statistical Analysis

The mortality data were used to calculate deaths among people who were younger than 20 years between 1985 and 1997. Since 1982, all deaths that occur annually in the United States are processed in these data files. Therefore, these data do not constitute a sample but rather a census of all deaths. Our main outcome measure was the fatality rate, defined as the number of deaths divided by the total number of people at risk. Rates were expressed as the number of deaths per 100 000 population. The proportion of unintentional injury–related deaths that occurred at home was calculated as the number of unintentional injury–related deaths that occurred in the home divided by the number of all unintentional injury–related deaths. The average annual number of deaths, death rate, and the proportion of deaths that occurred at home were calculated as an arithmetic average by age, gender, race, region, season, and injury mechanism. Poisson regression (or, in the event of overdispersion, negative binomial regression) was used to analyze the statistical significance of trends over time in death rates from unintentional residential injury.[11] Percentage change was determined for the number of deaths, mortality rates, and the proportion of deaths that occur at home, by taking the difference between the 1985 and 1997 values and dividing that result by the 1985 figure. A significant change in trend was reported as significant only when both Poisson regression and the percentage change were significantly different from baseline. Differences between trends were calculated using a simple comparison of the slope estimates from the Poisson regression.

To examine whether records that were missing place of occurrence may have introduced systematic bias in our results, we examined the characteristics of the records, by state, for unintentional injury–related death data with and without place of occurrence. Approximately 30% of records had "unknown" (or missing) recorded as the location of death for all causes. We compared the distributions for known location of death for states (including Washington, DC) that reported at least 90% "place of occurrence" on death certificates ($n = 22$) with those that reported <90% ($n = 29$). The distributions for location of death were not significantly different between the states with more complete and less complete location of injury information ($P = .30$). Therefore, the numerical estimates reported in these analyses are likely to underestimate deaths from residential injury.

RESULTS

An annual average of 65 871 people who were younger then 20 years died from all causes between 1985 and 1997. Of these, an annual average of 21 052 (32%) people who were younger than 20 years died from injury-related mechanisms. Of the injury-related deaths, an average of 14 501 (69%) people who were younger than 20 years died from unintentional injuries each year. Over the 13-year study period, an annual average of 9499 (65%) people who were younger than 20 years died from injuries outside the home environment caused by motor vehicle injuries, railway accidents, and surgical or medical problems that are not coded for place of occurrence (E-codes 870–879 and 829–849). A mean of 5103 (35%) people who were younger than 20 years died each year from unintentional injuries that were coded for place of occurrence (E-codes 850–849 and 880–929). More than half of these unintentional injury–related deaths with known location of occurrence, an annual average of 2822 (55.31%) deaths, occurred in the residential environment (Table 1).

Younger age was a risk factor for injury-related deaths in the home environment (Table 2). The death rate for children who were younger than 1 year was 12.6 per 100 000 and for children who were 1 to 4 years of age was 7.9 per 100 000 during the period of study. The only injury mechanism that was not higher among younger children was poisonings. The highest death rate from poisonings in all years was in the 15- to 19-year age group (ranging from a low of 0.54 per 100 000 in 1994 to a high of 0.93 per 100 000 in 1997). The proportion of deaths as a result of unintentional injury that occurred in the home environment was also higher in younger children. More

TABLE 1. Place of Occurrence of Deaths Classified as Being of Unintentional Intent in the United States for Children 0 to 19 Years of Age, 1985–1997

Place of Death	Deaths	
	Average No. Each Year	%
Total	5103	100.00
Home	2822	55.31
Recreation and sports	327	6.42
Farm	123	2.42
Public building	101	1.98
Street or highway	84	1.64
Industrial	73	1.42
Residential institution	29	0.57
Mine and quarry	15	0.30
Other specified place	841	16.49
Place not specified	687	13.46

TABLE 2. Annual Average Number of Unintentional Residential Deaths, Proportion of Deaths That Occurred at Home, and Death Rates per 100 000 (Averaged Over the Years From 1985–1997)

Variable	Levels	Mean Deaths	Mean Proportion* Death	Mean Death Rate†
Age	<1	483	93.45	12.58
	1–4	1181	80.83	7.89
	5–9	413	62.41	2.28
	10–14	314	49.76	1.79
	15–19	431	38.09	2.38
Gender	Male	1821	58.38	4.89
	Female	1001	77.78	2.82
Race	White	1947	62.46	3.34
	Black	779	69.98	6.99
	Other	96	54.95	2.91
Region	Northeast	379	66.28	2.78
	Midwest	713	66.86	4.04
	South	1160	63.14	4.58
	West	571	61.17	3.55
Season	January–March	752	78.56	1.04
	April–June	673	55.07	0.92
	July–September	684	52.63	0.94
	October–December	713	76.98	0.98
	Weekday (per day)	373	67.1	0.51
Weekday/weekend	Weekend (per day)	427	61.2	0.58
	Poisoning all	148	70.29	0.20
	Falls	97	42.43	0.13
	Fire or flames	1095	97.79	1.51
Injury mechanism	Natural and environmental	38	39.17	0.05
	Submersion/suffocation	970	49.58	1.33
	Other injuries	474	60.05	0.65

* Proportion of unintentional deaths that occurred at homes for children <20 years of age = (total number of unintentional residential deaths/total unintentional deaths) × 100.
† Unintentional residential deaths per 100 000 population.

than 90% of injury-related deaths occurred in the home for children who were younger than 1 year (Table 2, Fig 1). The proportion of residential injury–related deaths decreased significantly as age increased ($P < .001$).

The incidence of injury-related deaths that occurred in the home varied by gender and race. Boys had higher death rates than girls in all age groups for all unintentional injuries, but girls had a higher proportion of deaths that occurred at home. The death rate for black children was higher than that for white children for all unintentional residential injuries for each year of the study (Fig 2). Black children had a
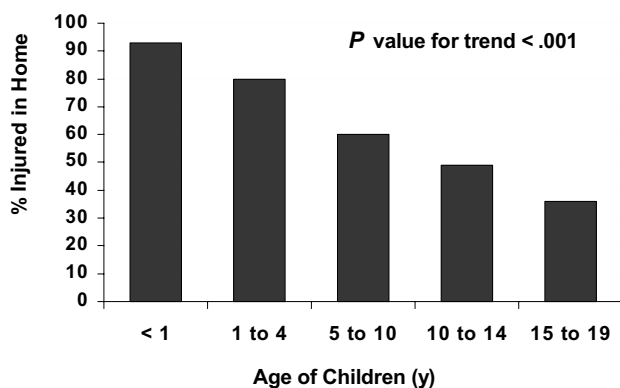

Fig 1. Proportion of fatal unintentional injuries among US children that occurred in the residential environment according to age, 1985–1997.

higher death rate as a result of residential fires compared with whites or other races. The death rate as a result of residential fires for blacks was more than twice the rate for whites or other races in all years. The death rate for blacks as a result of residential fires ranged from a high of 4.89 deaths per 100 000 in 1988 to 2.26 per 100 000 in 1997.

The incidence of injury-related deaths that occurred in the home varied by region, season, day of the week, and injury mechanism (Table 2). The southeastern region had the highest rate for residential injury–related deaths in children, whereas the northeastern region had the lowest rate. The number of residential injury–related deaths peaked in winter. In contrast, the highest rate for all unintentional injury–related deaths in children, regardless of location, peaked in the summer. The proportion of deaths that occurred at home was also highest during the winter, followed by autumn, and was lowest during the summer. Death rates as a result of residential injuries in US children were also slightly higher on average for weekend days than for weekdays. The highest death rates were attributable to fires (1.5 per 100 000), submersion or suffocation (1.3 per 100 000), poisoning (0.2 per 100 000), and falls (0.1 per 100 000).

Trends

The trend in annual number of deaths from unintentional residential injuries showed a 22% decrease ($P < .001$) from 2973 in 1985 to 2310 in 1997 (Table 3). The incidence of death from unintentional residential

Fig 2. Fatality rates among US children as a result of unintentional residential injuries according to race, 1985–1997.
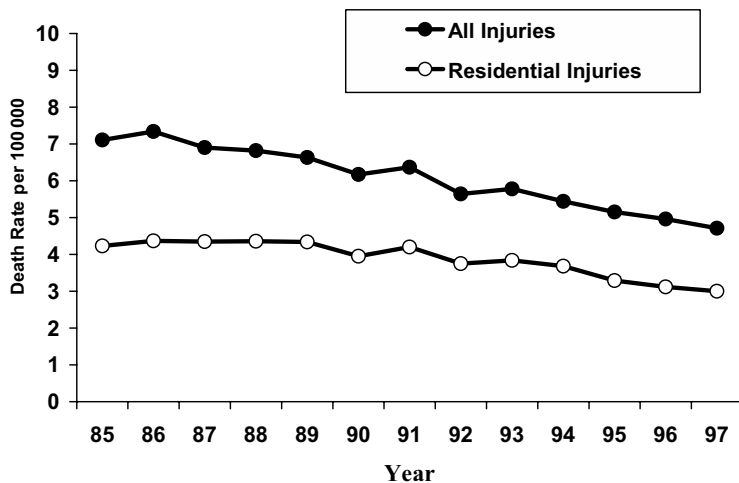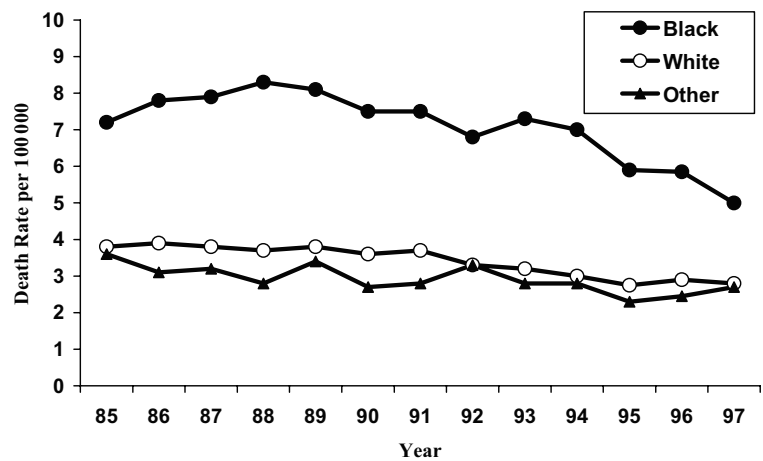

Fig 3. Fatality rates among US children as a result of all injuries and unintentional residential injuries.

injuries to children also showed a significant decline ($P < .001$), decreasing by 29%, from 4.2 per 100 000 in 1985 to 3.0 per 100 000 in 1997 (Fig 3). In contrast, the trend in the proportion of unintentional deaths that occurred at home increased from 59.6% in 1985 to 63.7% in 1997 ($P = .0235$).

Trends in death rates for various types of injuries varied by race and ethnicity. Most notably, the death rate for black children from residential fires decreased more from 1985 to 1997 than the death rate for white children. Specifically, the death rate for black children decreased by 52% from 4.6 (per 100 000) in 1985 to 2.2 (per 100 000) in 1997 compared with the decline of 46% in the rate for white children from 1.3 (per 100 000) to 0.7 (per 100 000). These differences however, were not statistically significant. In contrast, whereas deaths as a result of submersion/suffocation rose from 1.17 (per 100 000) in 1985 to 1.62 (per 100 000) in 1997 among black children, an increase of 38%, the trend for such deaths for white children declined from 1.24 (per 100 000) in 1985 to 1.15 (per 100 000) in 1997, a decrease of 7% ($P = .03$).

Trends varied by mechanism of injury (Table 4). The overall downward trend in unintentional injuries was largely attributable to a decrease in mortality from residential fires, falls, and "other" injuries

(all statistically significant, $P < .001$). In contrast, there was no significant decline in the death rate as a result of unintentional poisonings, with the rate actually increasing among adolescents. The death rate for natural and environmental injuries (eg, earthquakes, tornadoes) also increased, although the average annual rates for these mechanisms were the lowest of the unintentional injury mechanisms.

We found pronounced geographic variations in unintentional injury–related deaths by state (Fig 4). Residential injury–related deaths ranged from 1.7 per 100 000 in states with the lowest rates to 7.2 per 100 000 in those with the highest. Mississippi, Alaska, Arkansas, Louisiana, Georgia, Arizona, Tennessee, and Missouri were the states with the highest childhood residential death rates for unintentional injury, whereas Hawaii, New Hampshire, Connecticut, Massachusetts, and Rhode Island had the lowest rates. In focusing on residential fires, we found that states with higher overall injury-related death rates also had significantly higher fire death rates (correlation coefficient: 0.67; $P < .001$). However, states with higher overall injury-related death rates did not have significantly higher proportion of residential deaths as a result of fire (correlation coefficient: 0.09; $P = .5508$).

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TABLE 3. All Unintentional Residential Deaths, Death Rates* per 100 000 (ICD Codes 850–869 and 880–928), and Proportion† of Deaths That Occurred at Home, for Children 0 to 19 Years of Age, According to Age Group

Year	All Ages <20 y, Deaths			Age <1 y, Deaths			Age 1–4 y, Deaths			Age 5–9 y, Deaths			Age 10–14 y, Deaths			Age 15–19 y, Deaths		
	N	Rate	Proportion, %	N	Rate	Proportion, %	N	Rate	Proportion, %	N	Rate	Proportion, %	N	Rate	Proportion, %	N	Rate	Proportion, %
1985	2973	4.2	60	454	12.3	91	1235	8.7	77	462	2.8	61	366	2.2	48	456	2.4	33
1986	3072	4.4	60	470	12.7	92	1340	9.4	80	467	2.7	61	347	2.1	47	448	2.4	31
1987	3067	4.4	63	492	13.3	94	1362	9.5	81	471	2.7	61	319	2.0	47	423	2.3	35
1988	3095	4.4	64	477	12.7	92	1313	9.1	81	490	2.8	63	357	2.2	53	458	2.5	37
1989	3100	4.3	66	525	13.6	94	1280	8.7	82	486	2.7	63	374	2.2	55	435	2.4	37
1990	2830	4.0	64	523	13.3	95	1161	7.8	80	398	2.2	63	284	1.7	47	464	2.6	39
1991	3038	4.2	66	563	14.0	94	1295	8.5	83	420	2.3	63	319	1.8	50	441	2.6	39
1992	2737	3.8	66	466	11.7	92	1175	7.6	83	373	2.0	62	291	1.6	51	432	2.5	42
1993	2842	3.8	67	515	13.2	94	1225	7.8	82	383	2.1	67	287	1.6	48	432	2.5	41
1994	2758	3.7	68	509	13.2	95	1151	7.3	82	369	2.0	66	309	1.7	53	420	2.4	43
1995	2490	3.3	64	444	11.5	95	1033	6.6	82	358	1.9	62	275	1.5	48	380	2.1	37
1996	2379	3.1	63	414	11.0	93	943	6.1	80	352	1.8	60	265	1.4	48	405	2.2	40
1997	2310	3.0	64	423	11.1	95	846	5.5	79	339	1.7	61	287	1.5	51	415	2.2	42
% Change‡	−22	−29	7	−7	−10	4	−31	−37	3	−27	−39	0	−22	−32	6	−9	−8	27

* Unintentional residential deaths per 100 000 population.
† Proportion of unintentional deaths that occurred at homes for children <20 years of age = (total number of unintentional residential deaths/total unintentional deaths) × 100.
‡ Percent change = (unintentional residential deaths in 1997 − unintentional residential deaths in 1985)/unintentional residential deaths in 1985 × 100.

TABLE 4. All Unintentional Residential Injury Deaths and Death Rates per 1 000 000 Population (ICD-Codes 850–869 and 880–928) for Children 0 to 19 Years of Age, According to Injury Type

Year	Poisoning All		Falls		Fire or Flames		Natural and Environmental		Submersion/Suffocation		Other Injuries	
	No. of Deaths	Death Rate*	No. of Deaths	Death Rate*	No. of Deaths	Death Rate*	No. of Deaths	Death Rate*	No. of Deaths	Death Rate*	No. of Deaths	Death Rate*
1985	147	0.21	135	0.19	1257	1.79	37	0.05	865	1.23	532	0.76
1986	152	0.22	116	0.17	1308	1.86	30	0.04	967	1.38	499	0.71
1987	143	0.20	98	0.14	1289	1.83	28	0.04	1011	1.43	498	0.71
1988	158	0.22	109	0.15	1262	1.78	40	0.06	982	1.38	544	0.77
1989	130	0.18	91	0.13	1266	1.77	33	0.05	1055	1.48	525	0.74
1990	151	0.21	114	0.16	1050	1.46	55	0.08	963	1.34	497	0.69
1991	167	0.23	112	0.16	1171	1.62	39	0.05	1032	1.43	517	0.72
1992	129	0.18	94	0.13	1049	1.44	39	0.05	945	1.29	481	0.66
1993	151	0.20	93	0.13	1071	1.45	43	0.06	981	1.33	503	0.68
1994	129	0.17	77	0.10	1083	1.45	36	0.05	959	1.28	474	0.63
1995	130	0.17	76	0.10	877	1.16	31	0.04	971	1.28	405	0.54
1996	170	0.22	69	0.09	810	1.06	31	0.04	941	1.23	358	0.47
1997	170	0.22	77	0.10	742	0.96	53	0.07	940	1.22	328	0.43
% Change†	16	5	−43	−47	−41	−46	43	40	9	−1	−38	−43

* Unintentional residential injury deaths per 100 000 population.
† Percent change = (unintentional residential injury deaths in 1997 − unintentional residential injury deaths in 1985)/unintentional residential injury deaths in 1985 × 100.
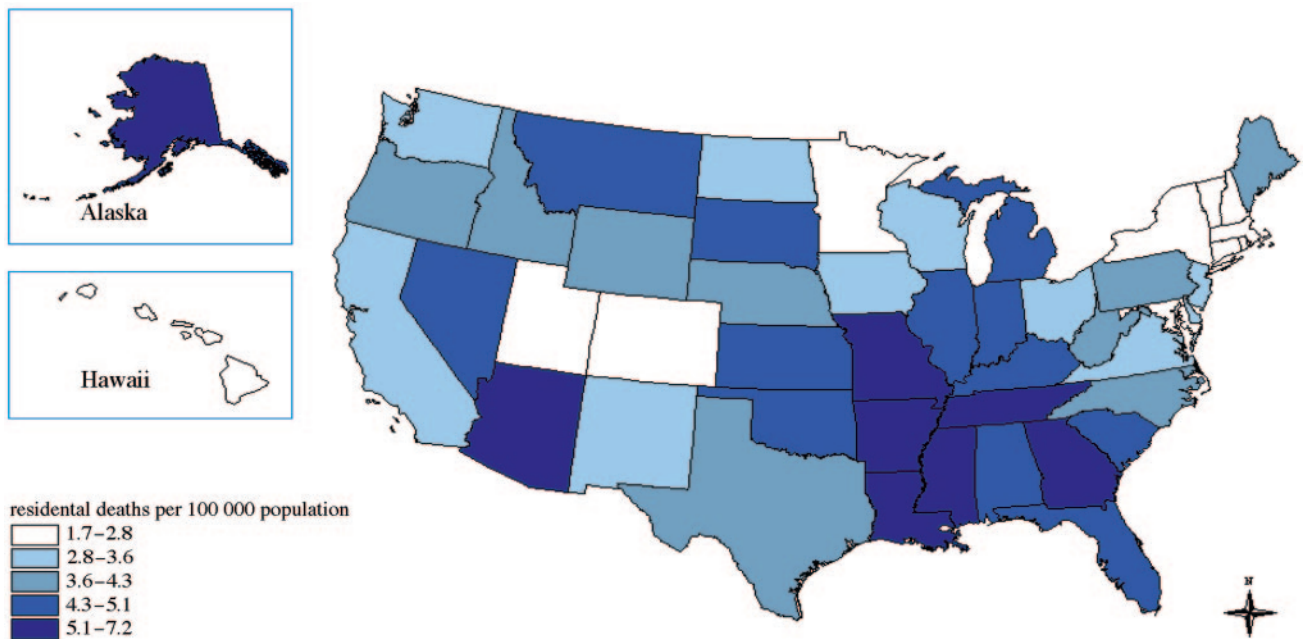
Fig 4. Fatality rates among US children 0–19 years of age as a result of unintentional residential injuries according to state, 1985–1997.

DISCUSSION

Residential unintentional injuries remain a leading cause of death in US children and adolescents. From 1985 to 1997, the mortality rate from residential injuries declined by 29%, but the proportion of deaths that occurred at home increased by 7%. Thus, there has been greater progress in reducing injury-related deaths that occur outside the home (eg, motor vehicle related) compared with those that occur inside the home. More than 2800 children and adolescents die each year from injuries that occur in the home environment. Indeed, the rate of fatal residential injury among children is comparable with the rate for occupational hazards in the United States.[12] In contrast with occupational hazards, there is no agency or infrastructure to protect children from residential hazards.

In this study, deaths from residential injuries varied by age, race, and gender. Younger children and boys of all age groups had the highest death rates. Submersion and suffocation was the leading cause of home injury–related fatalities among infants, whereas poisoning was the leading cause of residential fatalities among children 15 to 19 years of age. Other reports have found similar trends in submersion and suffocation deaths in US children.[3,13] It is likely that a proportion of these adolescent poisonings were, in fact, completed suicide attempts. If this is the case, then additional examination of cause of injury-related deaths for adolescent poisonings and the issues surrounding their correct coding should be undertaken.[14,15]

The risk for fatal, unintentional injuries at home was 2 times greater for black children than for white children. The higher rates of injury-related deaths caused by fires for minority children in this study likely reflect the higher overall rates of home-related injuries associated with poverty or lower levels of education (eg, as a result of type and condition of housing, substandard housing, and lack of building code enforcement).[16,17]

Trends for residential injury vary by the type and the mechanism of injury, and the type and the mechanism of injury vary for different age groups. Although all age groups showed a decline in unintentional residential fatal injuries from 1985 to 1997, children who were younger than 1 year had the lowest decline in unintentional residential deaths from 1985 to 1997. More troubling, there was a 27% increase in the proportion of deaths that occurred in the home environment for children who were 15 to 19 years of age, the only age group that experienced an increase in the proportion of unintentional deaths that occurred in the home. The large proportional increase in teenage residential injury–related deaths was driven, in large part, by the increase in the rate of poisoning-related deaths. Death rates for both male and female children decreased at the same rate; however, the proportion of deaths that occurred at home for boys increased by 11% (from 52.7 in 1985 to 58.7 in 1997). Although the residential death rate declined considerably, younger children remain at risk for unintentional injury–related deaths. The high death rates among very young children are attributable, in part, to their inability to recognize and negotiate residential hazards.[18–20] Residential mortality rates are also a function of the amount of time spent in the home environment (which likely varies by

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climate, season, and age). Clearly, continued emphasis on developing and evaluating prevention strategies for residential injury, especially those targeted at younger children, is warranted.

Death rates for all racial groups declined over the study period. Still, mortality rates for black children continued to be twice that of white children. Although we cannot exclude that access to care may be reduced in some socioeconomic groups, it is unlikely that we will eliminate racial disparity in deaths as a result of residential injuries unless we improve housing conditions among children in lower socioeconomic groups.[21] Of particular note is the lack of progress in reducing unintentional injury–related deaths at home for poisonings, suffocation, and drowning.[22] The persistent racial disparities in death rates are likely correlated with socioeconomic disparities and the quality and the maintenance of housing for lower income groups in the United States.[16,17,23]

A number of factors could explain the state-to-state variations in death rates. The percentage of the population that is rural might affect death rates because the time and the distance from the home to emergency medical care may be a factor in the rate of fatal injuries. For example, the response time for emergency first responders for residential fires, submersions, suffocations, or other unintentional residential injuries may be greater in rural compared with more urban areas. Furthermore, there may be systematic differences in the design and the quality of rural home environments. Poverty, lower levels of education, culturally specific housing design and use, and the quality of the built environment (transient housing, mobile homes, or housing units not meeting safety standards) may also explain some of the differences. Building codes and their enforcement are likely to vary by state and may result in differences in residential death rates. Finally, differences in seasonal weather patterns could be a factor, with warmer climates associated with more outdoor activities and reduced time in proximity to the indoor environment and adult supervision.[24] Seasonal weather patterns will also affect death rates from natural disasters such as floods, tornados, and hurricanes. The higher rates of unintentional residential injury mortality in Alaska and Arizona are particularly perplexing given the diverse climates of these 2 states. However, both states have substantial populations of Native American children, who are known to have significantly higher rates of injury-related death compared with white children. The age-adjusted injury-related death rates (per 100 000) reported by the Indian Health Service for the Navajo and Alaska Areas in 1995 are almost 5 times that of the white population; 30.5 for whites, 134.6 for Navajo, and 127.4 for the Alaska Area Indian Health Service.[25] These higher risk populations of children, together with culture-specific housing, heating, and customs, may have contributed to the higher residential death rates found in Arizona and Alaska.[26]

We also examined state differences in deaths as a result of fire. Although states with higher overall unintentional residential injury mortality rates also had higher fire death rates, the proportion of deaths as a result of fire did not exhibit that same pattern, indicating that the difference between the states was not driven primarily by fire deaths. Clearly, additional research is needed to explore state variation in the reported death rate as a result of unintentional residential injuries.[27]

There are several limitations of these analyses. First, data were missing for place of occurrence in ~30% of records. The University of North Carolina Injury Research Center, in the State of Home Safety in America report,[28] also found 20% to 30% of the data on location of injury missing across all ages and states using the national vital statistics for 1998. Still, in secondary analyses, we found that the proportion of housing-related deaths was similar for states that had >90% complete data on location of death and states that reported <90% complete data. Thus, because we included only deaths with known location of injury, we have underestimated the number and rates of deaths as a result of residential injuries. In addition, underreporting of intentional trauma in infants and young children has been described and may account for some of the deaths in the younger age groups.[21] Also, some of the unintentional poisoning deaths in adolescents may have been misclassified and actually represent completed suicide attempts. Finally, the NCHS mortality data do not include sociodemographic data or details of residential hazards and injuries that would help to clarify the causes of disparities in trends and rates. For example, although the NCHS's data clearly indicate a significant disparity between black children and white children in death rates as a result of fires, the data cannot shed additional light on this disparity by income levels, housing type, or housing condition. Continued surveillance and refinements in causes of death are necessary to guide research and prevention programs that are targeted at reducing injuries at home.

CONCLUSIONS

From 1985 through 1997, unintentional residential injuries resulted in >2800 deaths in children each year in the United States. Although housing injury-related deaths have decreased in the United States, marked regional and racial disparities persist. Strategies to eliminate disparities in the quality of the home environment and subsequent residential injuries are sorely needed to reduce the burden of childhood injury–related deaths in the United States.

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