

Firearm-Related Death and Injury among Children and Adolescents

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SUMMARY

As the articles in this journal issue show, gun violence affects children and youth in many ways: psychologically, emotionally, financially, and legally. But first and foremost, gun violence affects children's physical safety. Therefore, this issue opens with an overview of the physical toll that firearms exact upon children and youth, reviewing the incidence of firearm-related injury and death among Americans under age 20.

This article analyzes trends and current status in firearm death and injury, based on nationwide data collected by the federal government. Several key findings emerge from the data:

- ▶ Firearm death rates among children and youth in the United States have declined dramatically since 1993, but remain high compared with historical rates in this country and rates in other developed nations. A majority of these deaths are homicides.
- ▶ Certain groups of children and youth, especially adolescents, boys, minority youth, and those residing outside the Northeast, are particularly at risk for firearm death. The problem is most acute among black teenage males.

- ▶ Firearm injuries are much more likely to result in death than are other injuries for which children and youth visit emergency departments—a reflection of the extreme lethality of firearms.

Given these findings, the authors call for a concerted effort to reduce youth firearm deaths to levels comparable to those of other industrialized nations, using a wide variety of approaches that span the public health, criminal justice, and educational spheres. They also recommend improved data systems to track firearm injury and death, so that researchers can better analyze these incidents and evaluate intervention strategies.

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From the mid-1980s through the early 1990s, the number and rate of young Americans dying from firearm injuries rose to unprecedented levels—led by handgun homicides in urban centers, which primarily affected male minority teens and young adults. Teen firearm suicides also rose, particularly for rural white male teenagers and young adults.¹ This information helped to guide prevention and policy efforts around the country, as discussed in the articles by Wintemute, by Hardy, and by Fagan in this journal issue.²

The trend reversed itself fairly quickly. Since the early 1990s, for reasons that are still being debated, firearm death rates have fallen for all population groups, including youth. However, the problem remains significant. In 1998, the firearm death rate for youth was still 34% higher than it was in 1968; nearly 3,800 children and youth died from firearm injuries in homicides, suicides, or unintentional shootings. Twelve percent of all firearm deaths in the United States occurred among children and youth under age 20.³

This article summarizes patterns of firearm death and nonfatal injury among children and youth under age 20 in the United States. The article begins with an overview of the magnitude of the problem, including a discussion of trends over time in youth deaths due to firearm homicide, suicide, and unintentional shootings; possible explanations for the recent patterns in youth firearm deaths; and comparisons between youth firearm death rates in the United States and in other industrialized nations. The data make it clear that despite recent substantial declines in firearm injuries, firearm violence exacts a huge toll on America's youth. More than 20,000 children and teenagers under age 20 were killed or injured by a firearm in 1998. There are also an uncountable number of young persons whose lives are touched by firearm injury and violence each year, through the economic and social impact on families and friends of victims. (See the articles by Cook and Ludwig and by Garbarino, Bradshaw, and Vorrasi in this journal issue.)

The data also show that certain children and youth—boys, older teenagers, minority youth, and those residing outside the Northeast—are particularly at risk for firearm death. The second section of the article reviews key risk factors for youth firearm death, including age, gender, race, urbanization, and geographic location. This article

briefly presents data on youth firearm-related injury and concludes with a discussion of the need for further research to clarify prevention strategies and options for the future.

The article relies on a number of data sources. The two most heavily used sources are the National Vital Statistics System, from which statistics on firearm deaths in the United States are derived, and the Firearm Injury Surveillance System (FISS), from which estimates of nonfatal firearm injuries are derived.⁴⁻⁸ The Appendix provides an overview of the major data sources used in this article. Detailed discussion of data sources and methodology also may be found in the endnotes.

Youth Firearm Deaths: An Overview

In 1998, there were 3,792 young persons under age 20 who died as a result of a firearm-related injury in the United States, accounting for 7% of all deaths in this age range.³ This number represents a substantial decline from the early 1990s. In 1994, the number of firearm-related deaths for those under age 20 peaked at 5,833, and accounted for 9% of all deaths in that age range.

Despite this decline, for youth ages 10 to 19, only motor vehicles were responsible for more deaths than firearms in 1998. Firearms were the fifth leading cause of injury death for children ages one to nine in 1998, following motor vehicle traffic-related deaths, suffocation, drowning, and fire- and burn-related deaths.

The majority of firearm deaths among children and youth are homicides—particularly among children under age 12 and older teens ages 17 to 19. For both these age groups, homicides accounted for 60% to 70% of all firearm deaths in 1997–1998. For teenagers ages 12 to 16, homicide accounted for a lower proportion of firearm deaths (about 40% to 50%), whereas suicide accounted for close to 40% of firearm deaths. Unintentional injury remains a significant cause of firearm death for children under age 12, accounting for 27% of all firearm deaths in that age group.

Trends over Time

One way to examine trends in youth firearm violence is to look at death rates. Figure 1 shows firearm death rates by age from 1968 through 1998, calculated as

the number of deaths per 100,000 children in a given age group.⁹

These data show that death rates for young people ages 10 to 19 rose gradually throughout the 1970s and 1980s, then increased substantially in the late 1980s and continued to rise through the early 1990s. Most of this increase was due to a sudden rise in youth firearm homicides among older teenagers ages 15 to 19. To a much lesser extent, an increase in teen firearm suicide also resulted in higher death rates. Since 1979, firearms have been used in the majority of homicides and suicides among youth ages 10 to 19.¹⁰ Specifically, for youth ages 10 to 14, firearms have accounted for 50% to 60% of suicides and 50% to 80% of homicides; for youth ages 15 to 19, firearms have accounted for 60% to 70% of suicides and 70% to 90% of homicides.

From 1993 to 1998, the death rate from firearms declined by nearly 50%. By 1998, the firearm death rate for children

and teenagers under age 20 was the same as it was in 1978. This death rate is more than one-third lower than in the early 1990s, but it is still about one-third higher than in 1968.

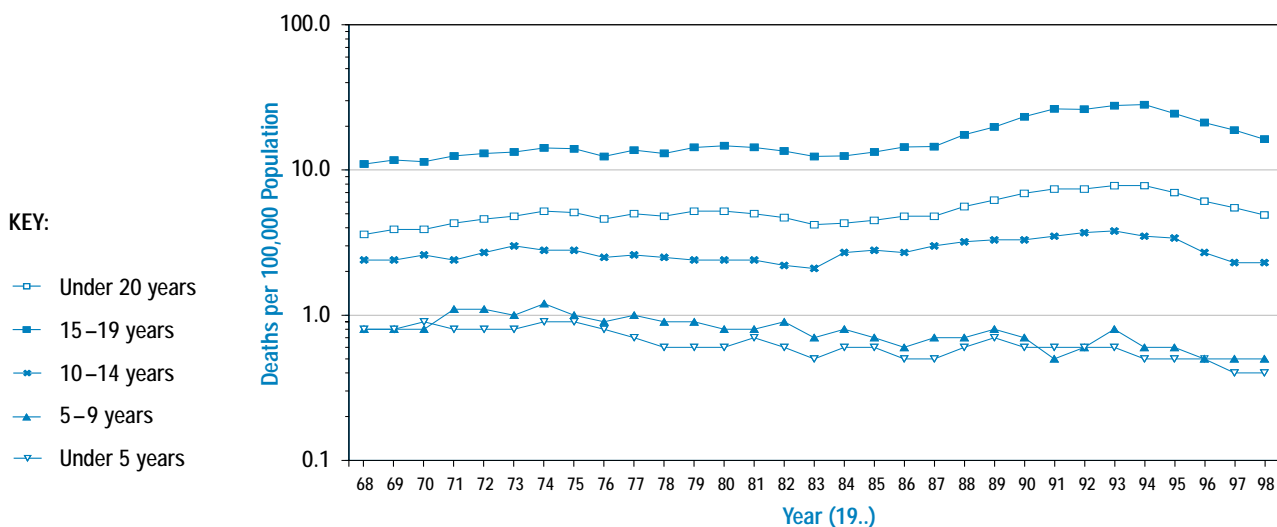
The decline in the firearm death rate among young people in the 1990s is due in large part to a decline in the youth firearm homicide rate, and to a lesser extent to declines in rates of firearm suicide and unintentional firearm death. From 1993 to 1998, firearm homicide rates for youth ages 10 to 14 and 15 to 19 fell nearly 50%. Firearm suicide rates for these age groups also fell in the 1990s, but less dramatically, declining 20% to 25%. The death rate for unintentional firearm injuries also has declined significantly since 1979—by 60% to 70%, depending on the age group.

Why the Decline in Youth Firearm Deaths?

Researchers are still debating the causes of the recent declines in firearm deaths among children and youth. The explanations put forward are inevitably speculative, but they include:^{11,12}

Figure 1

Firearm Death Rates by Age, 1968–1998



Source: National Center for Health Statistics, National Vital Statistics System.

Note: These rates are displayed in log format, so the rates shown in the top section of the figure are 10 times those in the middle section, and the middle section rates are 10 times those in the bottom section.

- ▶ *Prevention efforts.* The unprecedented increase in youth firearm homicide rates (and in firearm homicide across all age groups) in the early 1990s resulted in increased attention to homicide prevention. This may well have led to a variety of changes that resulted in lower firearm homicide rates. These may include, but probably are not limited to, increased police enforcement of firearm laws, public education efforts, led by pediatricians, violence prevention advocates, and others, about the dangers of firearms in the home, and falling handgun sales in recent years.¹³
- ▶ *Changes in factors that affect the frequency of violence.* Another possibility is that a strong economy, a declining crack cocaine market, and community-based violence prevention efforts contributed to the broad fall in firearm homicides.¹⁴ (See the article by Blumstein in this journal issue.)
- ▶ *Changes in factors that affect whether guns are present when violence occurs.* Police approaches to prosecuting gun offenders, resulting in less carrying of guns in violent situations, decreased handgun manufacture and possession, and increased use of safer gun storage measures all may have played a role in the decline in firearm homicides.¹⁴ (See the articles by Fagan and by Wintemute.)

▶ *Specific attention to young children.* The marked decrease in firearm deaths among children ages one to nine could reflect specific attention to reducing firearm risks in this age range, stemming from the increasingly broad consensus that such deaths are preventable and unacceptable. Interventions include clinical counseling by pediatricians, the use of locked storage for firearms and ammunition in the home, and discussion among parents about firearm storage when children visit one another.^{2,15} (See the article by Hardy.)

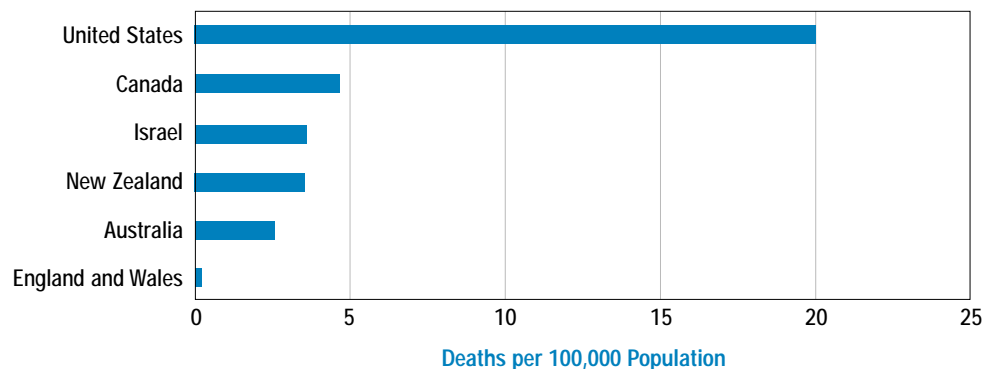
U.S. Youth Firearm Death Rates in an International Context

Even with the decline in the 1990s, youth firearm death rates in the United States are still far higher than those in other industrialized nations. A recent report¹⁶ examined international patterns of firearm death rates among children and youth under age 15. The report found that the firearm homicide rate in the United States was 16 times that of the average for other industrialized countries, the firearm suicide rate was 11 times higher, and the unintentional firearm death rate was 9 times higher.

As Figure 2 shows, youth death rates for teens ages 15 to 19 in the United States also are high when compared

Figure 2

Firearm Death Rates for Teenagers Ages 15 to 19, Selected Countries



Source: Data provided by each country's vital statistics office. Because of inconsistencies in data collection, data shown here reflect different time periods for each country. Note: The United States data are from 1996–1997; Canada data are from 1993–1997; Israel data are from 1995–1997; New Zealand data are from 1988–1997; Australia data are from 1994–1998; and England and Wales data are from 1993–1998.

with those of other nations. The firearm death rate for teenagers ages 15 to 17 in the United States is roughly 11 times the rate in Israel, and the rate for American teens ages 18 to 19 is 3 times the rate for Israeli teens of the same age. The United States firearm death rates for ages 15 to 17 and ages 18 to 19 are 4 to 8 times the respective rates in New Zealand, Canada, and Australia.¹⁷

In most of these other countries, the vast majority of firearm deaths among teenagers are suicides. Thus, these countries show very different patterns of risk than in the United States, where a majority of youth firearm deaths are homicides.¹⁷

Risk Factors for Death by Firearms

The general trends discussed above hold true for both males and females, and all racial and ethnic groups. Some youth are at greater risk for firearm death than others, however. This section reviews these risk factors in more detail, and estimates the risk that children born in 1998 will die from a firearm injury before they reach age 20. The section concludes with a brief discussion of the risk children face from school shootings.

Statistical analysis techniques that take into account demographic and geographic variables¹⁸ reveal that, after adjusting for all other variables:

- ▶ *Older teens, ages 17 to 19*, are more likely than younger children to die from firearm-related injury, with firearm homicide accounting for substantially more deaths than suicide and unintentional death;
- ▶ *Males* are more likely than females to die from firearm homicide and suicide, and most markedly from unintentional firearm injuries;
- ▶ *Black and Hispanic youth* are much more likely than non-Hispanic white youth to die in firearm homicides; non-Hispanic white youth are more likely than Hispanic and black youth to die in suicides; and Hispanic and black youth are more likely than non-Hispanic white youth to die from unintentional firearm injuries;
- ▶ *Residing in a core metropolitan county* raises the risk for firearm homicide, but lowers the risk for firearm suicide. When compared with nonmetropolitan areas with city populations of less than 10,000, all other areas have

a greater risk of firearm homicide, but a lower risk of suicides and unintentional firearm deaths.^{19,20}

- ▶ *Residing in the Northeast region* of the country markedly lowers the risk for youth firearm homicide, suicide, and unintentional firearm deaths.

Age

The older children are, the more likely they are to risk death by firearm. Among infants, firearms were responsible for 5 deaths in 1998, and, as Figure 3 illustrates, fewer than 1 in 100,000 children under age 12 died from firearm wounds in 1997–1998.

But beginning around age 11, the death rate from firearms begins to rise. Among children ages 11 to 13, the firearm death rate doubled. By age 19, approximately 25 out of every 100,000 youths died of firearm injury. Twenty percent of all deaths to American teenagers ages 15 to 17, and 26% of deaths to those ages 18 to 19, resulted from firearm injury.

This pattern holds true for both homicide and suicide. The firearm homicide rate at age 18 (16 per 100,000) was 21 times the rate at age 12 (0.8 per 100,000) in 1998. Firearm suicide rates also increased sharply between the ages of 12 and 18, rising 18-fold to about 8 per 100,000 at ages 18 to 19.

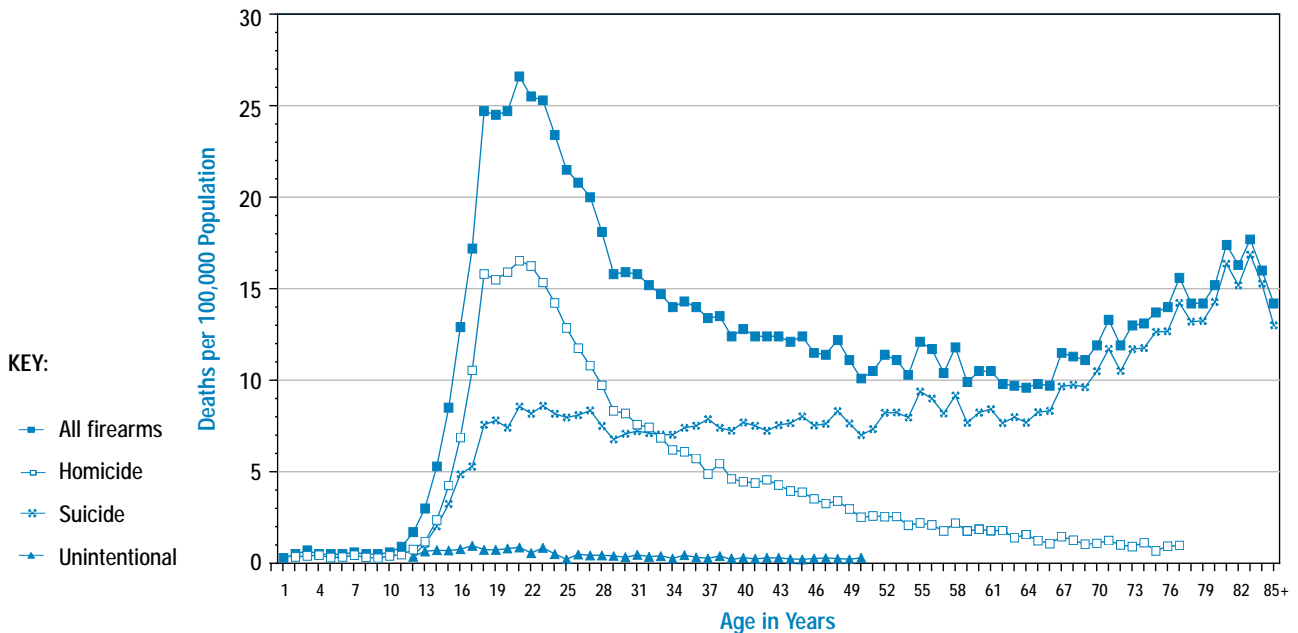
Gender

As Figure 4 shows, firearm death rates for males exceeded those for females in 1997–1998, and the differences grew with increasing age. This general trend holds true for both homicides and suicides. For children under age 11, firearm death rates for males were 1.4 times those for females; by age 15, the sex ratio was 5:1, and at age 19, it was 10:1.

Race

Minority youth are at significantly greater risk for firearm death than are non-Hispanic white youth. This is particularly true for black males. Black males ages 15 to 19 are much more likely to die from firearm wounds than are any other group of youth. The firearm death rate for these black males in 1998 was five times the rates for non-Hispanic white and Asian/Pacific Islander males, and twice the rates for Hispanic and American Indian males.

Figure 3
Firearm Death Rates by Age and Intent, 1997–1998



Source: National Center for Health Statistics, National Vital Statistics System.

Trends in death rates for black teenage males have mirrored the trends among all teenagers. In the early 1980s, for example, the firearm homicide rate for black male teenagers was about 30 per 100,000. By 1993, this rate had climbed to 130 per 100,000, an increase of more than 300%. The rate has fallen dramatically since then, to 63 per 100,000 in 1998, but this rate is still extremely high compared to the firearm homicide rate for non-Hispanic white male teenagers, which was just 3 per 100,000 in 1998. It is also high compared to the firearm homicide rate for Hispanic male teenagers, which was 29 per 100,000 in 1998.

Urbanization

Researchers who look at the risk of firearm death based on county of residence tend to classify counties by level of urbanicity.^{19,20} “Core metropolitan counties” have more than one million residents and contain a large cen-

tral city. “Fringe metropolitan counties” also have more than one million residents, but do not include a major city. “Small metropolitan counties” have fewer than one million residents. “Nonmetropolitan counties”—generally rural areas—have populations under one million and are divided into two categories: those with a city of 10,000 or more, and those without a city of 10,000.

Children under age 13 who live in nonmetropolitan areas are more likely to die from a firearm wound than are children in core or other metropolitan counties. However, firearm death rates in core metropolitan counties rise rapidly with increasing age. In 1996–1998, core county firearm death rates for ages 15 to 19 were more than twice the rates of those in the other metropolitan and nonmetropolitan counties.

Most urban teen deaths are homicides. Teens living in the most densely populated metropolitan counties are more

likely to die from a firearm homicide than are children in other metropolitan or nonmetropolitan counties, whereas those in more rural counties have higher firearm suicide rates. These trends have held true for at least the past two decades.²¹

Geography

Figure 5 shows firearm death rates nationwide in 1996–1998 for the highest-risk age group, ages 15 to 19.²² As the map makes clear, teens living in the West and South are more likely to die from a firearm wound than are teens in the Northeast and Upper Midwest. Louisiana had by far the highest teen firearm death rate—nearly 20% higher than any other state.

States show different patterns for homicide and suicide. In general, states in the South and West had higher teen firearm homicide rates compared with the rest of the nation, whereas the Upper Midwest and

Great Plains/Rocky Mountain states had the lowest rates. Louisiana, Maryland, and Illinois had the highest firearm homicide rates.

On the other hand, the highest teen firearm suicide rates were in the Great Plains/Rocky Mountain states and Alaska, which had the highest rate in the country. New England and the Mid-Atlantic states had among the lowest firearm suicide rates.

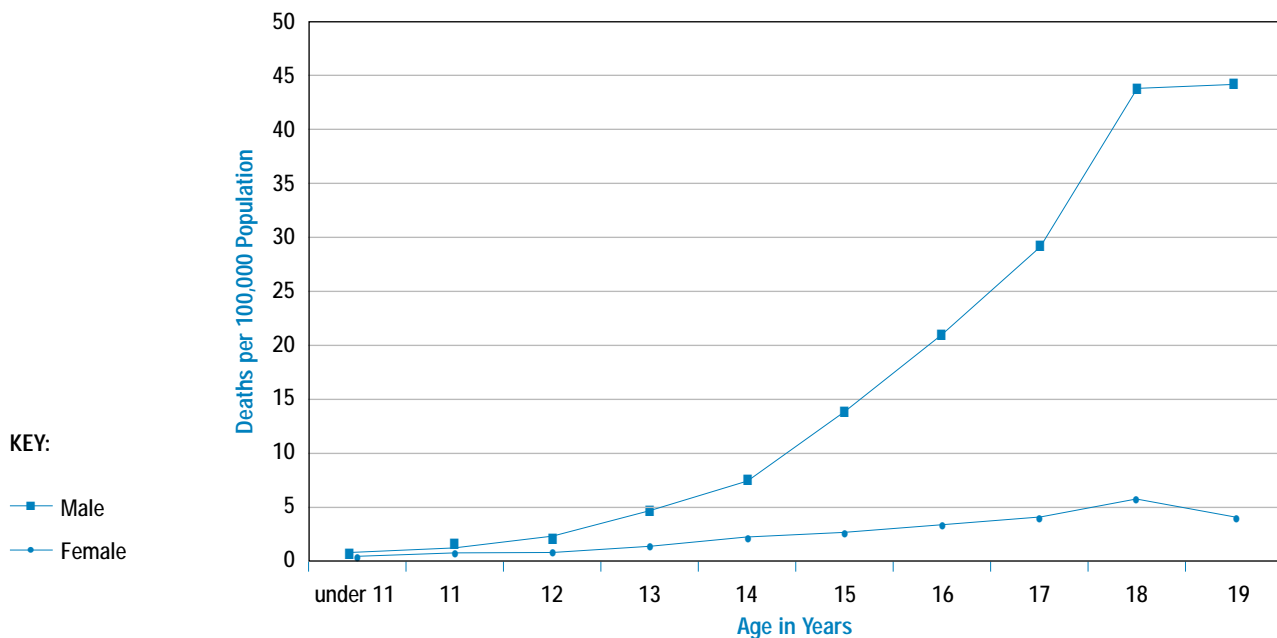
Developing a Cumulative Risk of Death

Table 1 shows the cumulative risk or probability of firearm death before age 20, by sex, for all youth, as well as for black and white males and females.²³

For 100,000 children born in 1998, the chance of dying before age 20 as the result of a firearm-related injury would be 1 in 1,040; among black males, the risk would be 1 in 248.²⁴ For white males, the risk of firearm suicide

Figure 4

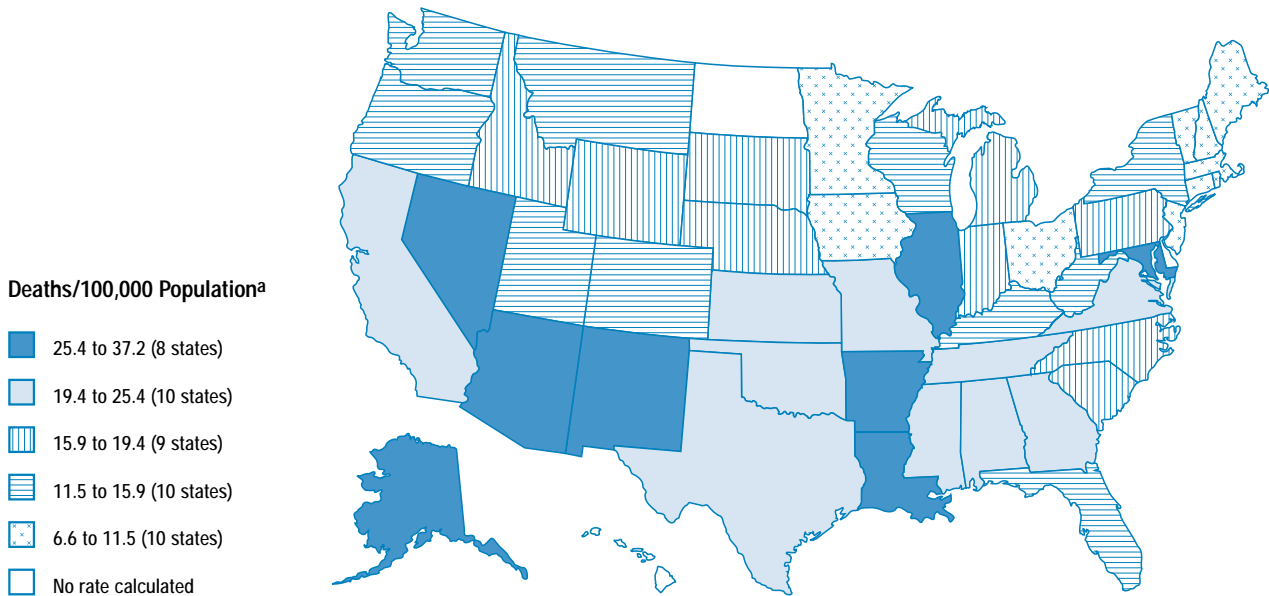
Firearm Death Rates by Age and Sex, 1997–1998



Source: National Center for Health Statistics, National Vital Statistics System.

Figure 5

Firearm Death Rates for Ages 15 to 19, 1996–1998



Source: National Center for Health Statistics, National Vital Statistics System.

^a Maine, New Hampshire, Rhode Island, and Vermont each had fewer than 20 firearm deaths per year for the three years between 1996 and 1998 for teenagers ages 15 to 19, so a rate was estimated by pooling the data for the four states, thereby assuming similar risk. Three states—North Dakota, Hawaii, and Delaware—had fewer than 20 firearm deaths over the three years, so no rate was calculated because it would be unstable.

is higher than the risk of firearm homicide; for black males and for white and black females, firearm homicide risk exceeds suicide risk.

School Shootings

Despite the high-profile shootings at schools like Columbine High School in Littleton, Colorado, school shootings account for a very small percentage of all youth firearm deaths. In each year from 1993 to 1998, fewer than 1% of all firearm deaths among young people ages 5 to 19 occurred in schools. As Figure 6 shows, the annual number of school-related firearm deaths among young persons has fluctuated, at times due to multiple shootings in a single incident.²⁵ The number of deaths was higher in 1992–1993 than during any later academic year.

Nonfatal Firearm Injuries

For every child or teenager who died from a firearm-related injury in 1996–1998, more than four others sought care in an emergency department for a firearm injury. This section reviews the incidence of firearm injuries among children and youth under age 20, including trends and risk factors. While the data for firearm injuries are more limited than the data for firearm deaths,²⁶ generally the patterns are similar.

For the three-year period 1996–1998, the annual number of visits to the emergency department for firearm injuries among young people under age 20 averaged about 18,400, a rate of about 24 per 100,000. These annual estimates include about 8,900 visits that resulted in hospitalization, and another 9,500 that resulted in treatment and then release from emergency departments.⁷

Nonfatal firearm injuries were not among the leading causes of hospital or emergency department utilization among young people under age 20.²⁷ In addition, emergency department and hospital utilization rates for children and youth under age 20 with firearm injuries decreased nearly 50% from 1993 to 1998.

For the period 1995–1998, about 60% of the firearm-related emergency department visits among children and youth under age 20 were for injuries resulting from assaults, with an additional 20% from unintentional firearm injuries; for about 15% of these visits, intent was not stated. Fewer than 3% of the visits were related to intentional self-harm; this is because suicide attempts with firearms are completed more often than are attempts by other means.²⁸

As with firearm death, age, gender, and race are major risk factors for firearm injury. From 1995–1998, about 85% of all firearm injuries treated in emergency departments or requiring hospitalization were among teenagers ages 15 to 19. Visit rates for males were 7 times those for females, and the average annual firearm

injury rate for black youth was about 10 times that for non-Hispanic white youth. Hispanic youth were twice as likely as white youth to be injured.

For young persons under age 20, for every 4.4 visits to an emergency department during 1996–1998 because of a firearm injury, there was one firearm-related death. This ratio stands in sharp contrast to emergency department visits and deaths for nonfirearm injuries. In general, for young persons under age 20, the ratio of nonfirearm injury-related emergency department visits to deaths was 760:1. The very high proportion of deaths resulting from firearm injuries—when compared with all other injuries—reflects the extreme lethality of firearms.

Conclusion

The rate of firearm deaths affecting children and adolescents in the United States is too high, compared both with rates in other developed countries and with historical rates in this country. It is reasonable to aim to reduce the risk of firearm death among American youth to levels closer to those of their peers in other nations.

Table 1

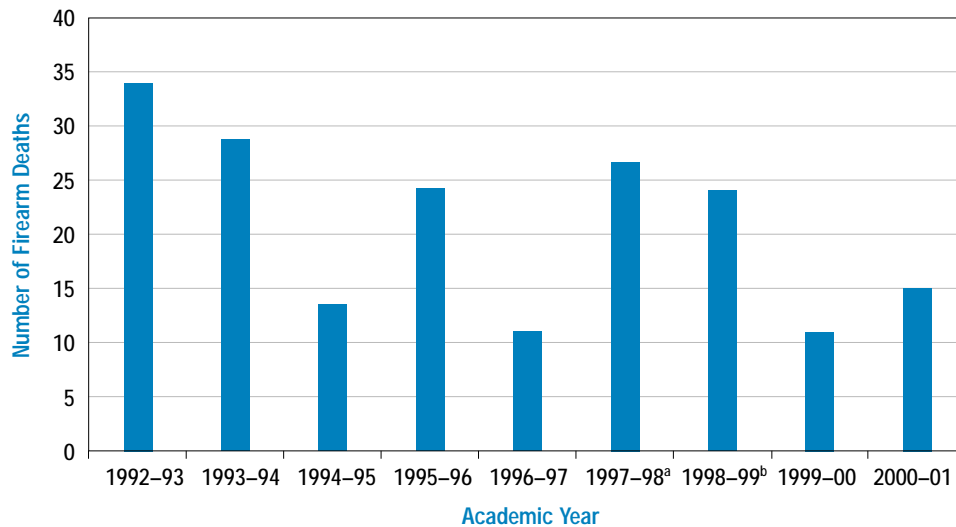
Cumulative Risk of Firearm Death before Age 20 by Race, Sex, and Type of Gun Death: 1998

| Race/sex group | Risk of death due to: | | | |
|-----------------|-------------------------|------------------------------|-----------------------------|-----------------------------------|
| | Any Firearm 1 out of | Firearm Homicide 1 out of | Firearm Suicide 1 out of | Firearm Unintentional 1 out of |
| Both sexes, all | 1,040 | 1,806 | 3,180 | 15,015 |
| Males | | | | |
| White | 869 | 2,172 | 1,807 | 9,756 |
| Black | 248 | 301 | 2,471 | 5,394 |
| Females | | | | |
| White | 4,228 | 8,251 | 10,267 | 68,493 |
| Black | 1,772 | 2,196 | 15,873 | 30,675 |

Sources: Based on data in Murphy, S.L. Deaths: Final data for 1998. *National vital statistics reports*. Vol. 48, no. 11. Hyattsville, MD: National Center for Health Statistics, 2000; and Anderson, R.N. United States life tables, 1998. *National vital statistics reports*. Vol. 48, no. 18. Hyattsville, MD: National Center for Health Statistics, 2001.

Figure 6

Firearm Fatalities in School-Related Settings among Children and Teenagers Ages 5 to 19, 1992–1993 through 2000–2001



Source: National School Safety Center, School-Associated Violent Deaths Report. Available online at <http://www.nssc1.org>.

^aAt least two incidents in which more than two students were shot

^bOne incident with 14 victims

The rise and fall of youth firearm homicides in recent decades reflects a still poorly understood interplay of factors, but suggests that modifiable factors affect firearm death rates. These may include changes in firearm ownership, storage, or carrying rates and practices, as well as police enforcement measures. (See the article by Fagan.) This should encourage ongoing—indeed, intensified—prevention efforts in the years to come, using sound and comprehensive data on youth death and injury rates, and including rigorous evaluations.

To reduce firearm deaths and injuries among children, it will be necessary to develop a broad repertoire of approaches—in the public health, criminal justice, and educational spheres. Clear demographic and geographic factors are associated with risk of firearm injury and death for children and youth in the United States. Researchers should use this knowledge to focus prevention efforts on higher-risk groups and areas, and to

focus their research on understanding what factors protect lower-risk groups and areas.

Finally, the available data on firearm injuries are not yet adequate to the tasks of monitoring injury prevalence, analyzing details of injury and fatality incidents, and evaluating intervention strategies. Continued progress toward reducing the burden of firearm injuries affecting children and youth will require better data systems that integrate data from a variety of existing sources, such as vital statistics, health care systems, and the criminal justice system.²⁹

Every year, more than 20,000 children and youth in the United States are killed or injured by firearms, and countless more are touched by firearm violence. These deaths and injuries are preventable and unnecessary. By building on the decline in firearm deaths in recent years, researchers and policymakers can help ensure that more American children will live to see adulthood.

ENDNOTES

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- For data from 1968 through 1978, this article uses the following International Classifications of Disease (ICD) codes: E922 for unintentional injuries; E955 for suicide; E965 for homicide; E970 for legal intervention; and E985 for undetermined intent. See National Center for Health Statistics. *International Classification of Diseases, adapted for use in the United States*. 8th rev. Vol. 1. Washington, DC: U.S. Government Printing Office, 1967. For data from 1979 through 1998, this article uses the following ICD codes: E922 for unintentional injuries; E955 (.0–.4) for suicide; E965 (.0–.4) for homicide; E970 for legal intervention; and E985(.0–.4) for undetermined intent. See World Health Organization. *Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death: Based on the recommendation of the Ninth Revision Conference, 1975, and adopted by the Twenty-ninth World Health Assembly*. Geneva: WHO, 1977. In ICD-8, codes for firearm suicide, homicide, and undetermined intent included explosives. However, based on analysis of deaths using ICD-9 codes, death rates from explosives for persons under age 20 were less than 0.1 per 100,000.
- For clarity, mortality and morbidity rates in the text are rounded to the nearest whole number (unless the rate is less than 1), but relative changes in rates were calculated based on unrounded rates.
- Homicides for this age group that do not involve firearms are most commonly committed with knives or other instruments for stabbing or cutting, and, to a lesser extent, suffocation. In suicides, the two other primary mechanisms are suffocation (hanging) and, for those ages 15 to 19, poisoning. See note no. 3, National Center for Health Statistics.
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- Unpublished data from participants in the International Collaborative Effort on Injury Statistics.
- To estimate the independent effects of demographic and geographic variables on firearm mortality, multivariate logistic regression models were fit using the SAS procedure, GENMOD, to generate adjusted mortality odds ratios for the risk of firearm homicide, suicide, and unintentional death.
- To describe death patterns by level of urbanization, the decedent’s county of residence was used. Counties were assigned to one of five urbanization levels based on their classification in the Urban Influence code system (December 1996 revision) devel-

- oped by the Economic Research Service, U.S. Department of Agriculture. County-level codes were then linked to the Vital Statistics files. For Vital Statistics files, see Ghelfi, L.M., and Parker, T.S. A county-level measure of urban influence. *Rural Development Perspectives* (February 1997) 12(2):32–41; and National Center for Health Statistics. *Health, United States, 2001 chartbook*. Hyattsville, MD: NCHS, 2001.
20. The metropolitan county categories are those used by the National Center for Health Statistics: a) core counties, those large central counties with one million or more population that contain the largest central city of the Metropolitan Statistical Area/Primary Metropolitan Statistical area; b) fringe counties also with one million or more population but that do not contain any part of the largest central city; and c) small counties with less than one million population. Nonmetropolitan counties were divided into two categories: a) those with a city of 10,000 or more population, and b) those without a city of 10,000 or more population. See note no. 3, National Center for Health Statistics, National Vital Statistics System, and note no. 19, National Center for Health Statistics.
 21. Fingerhut, L.A., Ingram, D.D., and Feldman, J.J. Homicide rates among U.S. teenagers and young adults—differences by mechanism, level of urbanization, race and sex, 1987–1995. *Journal of the American Medical Association* (1998) 280(5):423–27; MacKay, A.P., Fingerhut, L.A., and Duran, C.R. *Adolescent health chartbook*. *Health, United States, 2000*. Hyattsville, MD: National Center for Health Statistics, 2000; and Cubbin, C., Pickle, L.W., and Fingerhut, L.A. Social context and the geographic patterns of homicide in black and white males in the United States. *American Journal of Public Health* (2000) 90:579–87.
 22. Maine, New Hampshire, Rhode Island, and Vermont each had fewer than 20 firearm deaths per year for the three years between 1996 and 1998 for teenagers ages 15 to 19, so a rate was estimated by pooling the data for the four states, thereby assuming similar risk. Three states—North Dakota, Hawaii, and Delaware—had fewer than 20 firearm deaths over the three years, so no rate was calculated because it would be unstable.
 23. This is not to be confused with another often-calculated measure—the probability of *eventually* dying from a firearm death.
 24. To calculate the cumulative risk of firearm death, age-specific life table deaths due to firearm injuries were calculated for 1998 using abridged National Center for Health Statistics life tables and data on race-, sex-, and age-specific firearm deaths. See note no. 4, Murphy; and Anderson, R.N. United States life tables, 1998. *National vital statistics reports*. Vol. 48, no. 18. Hyattsville, MD: National Center for Health Statistics, 2001. A life table death shows, for each 5-year age interval in the abridged life table, the number dying out of the hypothetical cohort of 100,000 born alive at the beginning of the time period (1998 in this case). These deaths are then multiplied by the percentage of all deaths due to firearms to derive the number of life table firearm deaths. Next, the firearm-specific life table deaths from birth up to age 20 are summed and divided by 100,000 (the number of persons born alive). The reciprocal of the life table death rate can be interpreted as the odds of firearm death before age 20.
 25. These data are based solely on newspaper accounts, and as a result may not be complete. A complete listing of school-associated violent deaths may be found online at <http://www.nssc1.org>.
 26. The National Hospital Discharge Survey (NHDS) could not be used to directly estimate the number of hospitalizations resulting from firearm injuries because not all states routinely collect external cause of injury codes (E-codes) in their hospital discharge data systems. As of 1998, only 26 states mandated and another 5 to 6 states routinely collected E-codes in their hospital discharge data. See Dennison C., and Pokras, R. Design and operation of the National Hospital Discharge Survey: 1988 redesign. *Vital Health Statistics* (2000) 1(39):1–42. As a result, the NHDS does not have E-codes for about 30% of all records with a principal diagnosis of injury. However, indirect estimates of persons hospitalized for nonfatal firearm injuries were based on the 70% of records that had E-codes, and the Centers for Disease Control and Prevention Firearm Injury Surveillance Study (FISS) corroborated those estimates. Among the variables collected in the FISS is “disposition of visit.” FISS data are obtained from the National Electronic Injury Surveillance System (NEISS), managed by the Consumer Product Safety Commission. NEISS collects nationally representative data for persons treated in emergency departments. The annual numbers of cases “hospitalized,” “transferred/released,” or “transferred/hospital” were summed to estimate the total number of hospitalized firearm injury cases. The estimated number of hospitalized cases from the FISS was statistically similar to the number derived from the NHDS.
 27. As estimated by L.A. Fingerhut based on data from Hank Weiss, University of Pittsburgh; Ted Miller and Bruce Lawrence, Children’s Safety Network; and Robert Pokras, chief of the Hospital Care Statistics Branch at the National Center for Health Statistics. See also McCaig, L.F. *National Hospital Ambulatory Medical Care Survey: 1998 emergency department summary*. Advance data from vital and health statistics; no. 313. Hyattsville, MD: NCHS, 2000.
 28. Beaman, V., Annest, J.L., and Mercy, J.A. Lethality of firearm-related injuries in the United States population. *Annals of Emergency Medicine* (2000) 35:258–66.
 29. Barber C., Hemenway, D., Hargarten, S., et al. A “call to arms” for a national surveillance system on firearm injuries. (Editorial) *American Journal of Public Health* (2000) 90(8):1191–93.

APPENDIX

Sources of National Firearm Mortality and Morbidity Data

| | Ownership | Coverage | Geographic Detail | Data Years | Limitations |
|---|---|--|-----------------------------------|------------|--|
| Firearm Death: | | | | | |
| National Vital Statistics System ^{a,b} http://www.cdc.gov/nchs/about/major/dvs/mortdata.htm | Centers for Disease Control and Prevention, National Center for Health Statistics | Census of all deaths in the United States | National, state, county, and city | 1968–1998 | Death certificates have limited information on the circumstances of injury deaths; often no detail is given on the type of firearm and no information on perpetrators. |
| Firearm Injury: | | | | | |
| Firearm Injury Surveillance Study ^{c,d} http://www.icpsr.umich.edu:8080/ABSTRACTS/03018.xml?format=ICPSR | Consumer Product Safety Commission, National Electronic Injury Surveillance System; Centers for Disease Control and Prevention, National Center for Injury Prevention and Control | Ongoing surveillance system based on a national sample of persons visiting emergency departments | National estimates only | 1993–1998 | Only national estimates; about 50% of cases are missing information on perpetrators. |
| National Hospital Ambulatory Medical Care Survey (Emergency Department) ^e http://www.cdc.gov/nchs/about/major/ahcd/ahcd1.htm | Centers for Disease Control and Prevention, National Center for Health Statistics | National sample survey of visits to emergency departments | National and regional | 1993–1999 | Sample size is too small to make reliable annual estimates of visits for firearm injuries; includes repeat visits by same person, thus counts visits rather than people. |
| National Hospital Discharge Survey ^f http://www.cdc.gov/nchs/about/major/hdasd/nhds.htm | Centers for Disease Control and Prevention, National Center for Health Statistics | National sample survey of inpatient hospital discharges | National and regional | 1996–1999 | Incomplete documentation in record of external causes of injury; includes repeat hospitalizations by same person, thus counts discharges rather than people. |

^a Murphy, S.L. Deaths: Final data for 1998. *National vital statistics reports*. Vol. 48, no. 11. Hyattsville, MD: National Center for Health Statistics, 2000.

^b *Vital Statistics of United States 1995: Mortality*. Technical appendix. Hyattsville, MD: National Center for Health Statistics, April 1992. Available online at <http://www.cdc.gov/nchs/data/techap95.pdf>.

^c Gotch, K.E., Annett, J.L., Mercy, J.A., and Ryan, G.W. Surveillance for fatal and nonfatal firearm-related injuries—United States, 1993–1998. In CDC Surveillance Summaries, April 13, 2001. *Morbidity and Mortality Weekly Report* (2001) 50(No. SS-2):1–44.

^d Centers for Disease Control and Prevention, National Center for Injury Prevention and Control. *Firearm Injury Surveillance Study, 1993–1998: Computer file*. 2nd ICPSR version. Atlanta, GA: NCIPC, 2000; Ann Arbor, MI: Inter-university Consortium for Political and Social Research, 2001.

^e McCaig, L.F. *National Hospital Ambulatory Medical Care Survey: 1998 emergency department summary*. Advance data from vital and health statistics; no. 313. Hyattsville, MD: National Center for Health Statistics, 2000.

^f Dennison, C., and Pokras, R. Design and operation of the National Hospital Discharge Survey: 1988 redesign. *Vital Health Statistics* (2000) 1(39):1–42.