

ORIGINAL ARTICLE

Trends in BB/pellet gun injuries in children and teenagers in the United States, 1985–99

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Objective: To characterize national trends in non-fatal BB/pellet gun related injury rates for persons aged 19 years or younger in relation to trends in non-fatal and fatal firearm related injury rates and discuss these trends in light of injury prevention and violence prevention efforts.

Setting: The National Electronic Injury Surveillance System (NEISS) includes approximately 100 hospitals with at least six beds that provide emergency services. These hospitals comprise a stratified probability sample of all US hospitals with emergency departments. The National Vital Statistics System (NVSS) is a complete census of all death certificates filed by states and is compiled annually.

Methods: National data on BB/pellet gun related injuries and injury rates were examined along with fatal and non-fatal firearm related injuries and injury rates. Non-fatal injury data for all BB/pellet gun related injury cases from 1985 through 1999, and firearm related injury cases from 1993 through 1999 were obtained from hospital emergency department records using the NEISS. Firearm related deaths from 1985 through 1999 were obtained from the NVSS.

Results: BB/pellet gun related injury rates increased from age 3 years to a peak at age 13 years and declined thereafter. In contrast, firearm related injury and death rates increased gradually until age 13 and then increased sharply until age 18 years. For persons aged 19 years and younger, BB/pellet gun related injury rates increased from the late 1980s until the early 1990s and then declined until 1999; these injury rates per 100 000 population were 24.0 in 1988, 32.8 in 1992, and 18.3 in 1999. This trend was similar to those for fatal and non-fatal firearm related injury rates per 100 000 which were 4.5 in 1985, 7.8 in 1993, and 4.3 in 1999 (fatal) and 38.6 in 1993 and 16.3 in 1999 (non-fatal). In 1999, an estimated 14 313 (95% confidence interval (CI) 12 025 to 16 601) cases with non-fatal BB/pellet gun injuries and an estimated 12 748 (95% CI 7881–17 615) cases with non-fatal firearm related injuries among persons aged 19 years and younger were treated in US hospital emergency departments.

Conclusions: BB/pellet gun related and firearm related injury rates show similar declines since the early 1990s. These declines coincide with a growing number of prevention efforts aimed at reducing injuries to children from unsupervised access to guns and from youth violence. Evaluations at the state and local level are needed to determine true associations.

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BB and pellet gun related injuries represent an important public health concern in the US, especially for children and teenagers. A previous study reported that children and teenagers account for about 80% of all non-fatal BB/pellet gun related injuries.¹ In the early 1990s, an estimated 23 500 persons aged 19 years or younger were treated annually for non-fatal BB/pellet gun related injuries in US hospital emergency departments.² Although a majority of these injuries in children and teenagers resulted from unintentional shootings, at least 10% of them were from interpersonal or self directed violence.² This is in contrast to fatal and non-fatal firearm related injuries which are predominantly violence related.^{3–4}

An estimated 3.2 million BB/pellet guns are sold in the US each year. Eighty per cent of these guns have muzzle velocities greater than 350 feet per second (fps) and 50% have velocities between 500 fps and 930 fps.^{2–5} At close range, BBs and pellets fired from these air powered guns, especially those with velocities >350 fps, can cause tissue damage similar to that inflicted by powder charged bullets fired from small caliber handguns.⁶ Numerous studies have documented the potentially severe or lethal nature of penetrating injuries from BB/pellet gunshots, especially those to the abdomen, chest, eye, and head of children. These studies indicate that unsupervised access to these guns by children is a major risk factor for injury.^{5–7–10} To reduce the risk of disability and death of patients inflicted with such wounds, some hospitals and doctors have modified their trauma care protocols to account

for potentially severe, penetrating injuries from these compressed air powered guns.^{10–12}

This study presents nationally representative data on trends in non-fatal BB/pellet gun related injury rates for persons aged 19 years and younger and compares these trends with national trends in fatal and non-fatal firearm related injury rates. National data are used to examine trends in gun related injury and death rates from 1985 through 1999, and to characterize these injuries by age, sex, race/ethnicity, intent of injury, and disposition at emergency department discharge. National data on BB/pellet gun related deaths were not included in our analysis because these deaths are coded in "other specified" categories and, therefore, cannot be uniquely identified using the *International Classification of Diseases*, 9th revision (ICD-9), external cause of injury coding system.¹³

METHODS

Data on non-fatal BB/pellet gun related injuries and non-fatal firearm related injuries were obtained using National Electronic Injury Surveillance System (NEISS) operated by the US

Abbreviations: CI, confidence interval; CPSC, Consumer Product Safety Commission; fps, feet per second; ICD-9, *International Classification of Diseases*, 9th revision; NEISS, National Electronic Injury Surveillance System; NVSS, National Vital Statistics System

Table 1 Number of BB/pellet gun related injuries and firearm related injuries and deaths, and rates per 100000 population for persons aged 19 years and younger, by selected characteristics of the injured person, United States, 1993–99

Characteristics	Non-fatal BB/pellet gun related injuries*			Non-fatal firearm related injuries*			Firearm related deaths		
	No	Mean annual No	Rate (95% CI)	No	Mean annual No	Rate (95% CI)	No	Mean annual No	Rate (95% CI)
Age (in years)									
0–9	26351	3764	9.7 (7.9 to 11.6)	4529	647	1.7 (1.1 to 2.2)	1387	198	0.5 (0.49 to 0.54)
10–14	64364	9195	48.4 (41.6 to 55.3)	16690	2384	12.6 (8.9 to 16.2)	3719	531	2.8 (2.71 to 2.89)
15–19	31353	4479	24.0 (20.6 to 27.5)	121980	17426	93.5 (57.3 to 129.7)	27806	3972	21.3 (21.07 to 21.57)
Sex†									
Males	105825	15118	38.7 (33.2 to 44.1)	126367	18052	46.2 (29.3 to 63.1)	28392	4056	10.4 (10.26 to 10.50)
Females	16243	2320	6.2 (5.2 to 7.3)	16832	2405	6.5 (4.1 to 8.8)	4520	646	1.7 (1.69 to 1.79)
Race/ethnicity									
White, non-Hispanic‡	70474	10068	24.1 (19.8 to 28.4)	27228	3890	8.3 (6.2 to 10.5)	11920	1703	3.4 (3.34 to 3.47)
Black	19614	2802	28.4 (20.7 to 36.1)	73348	10478	94.8 (43.7 to 146.0)	13787	1970	16.7 (16.39 to 16.94)
Hispanic§	5450	779	9.0 (4.2 to 13.8)	27548**	3935**	40.5** (11.4 to 69.7)**	5770	824	7.9 (7.73 to 8.14)
All other races/unknown¶	26530	3790	–	15076	2154	–	1435	205	–
Total	122068	17438	22.9 (19.7 to 26.0)	143199	20457	26.8 (17.1 to 36.6)	32912	4702	6.2 (6.10 to 6.23)

*National estimates of non-fatal gunshot injuries treated in hospital emergency departments.

†There were six cases of unknown sex for BB/pellet gun related injuries.

‡Excludes those who were of Hispanic origin.

§Excludes black Hispanic.

¶Includes non-Hispanic Asian/Pacific Islander, non-Hispanic American Indian/Alaska Native, and unknown race.

**Estimate may be unstable because the coefficient of variation was >30%.

Data sources: National Vital Statistics System, National Center for Health Statistics for deaths; Centers for Disease Control and Prevention's Firearm Injury Surveillance Study for non-fatal injuries; US Census Bureau for population estimates.

Consumer Product Safety Commission (CPSC). Data from 1985 through 1992 on BB/pellet gun injuries were collected as part of CPSC's routine surveillance of consumer product related injuries using NEISS. Data from 1993 through 1999 on non-fatal BB/pellet gun related injuries and non-fatal firearm related injuries were collected through a "special study" using NEISS.¹⁴ This special study was implemented through an interagency agreement between the Centers for Disease Control and Prevention and CPSC to collect more detailed information about the circumstances of all gun related injury incidents.¹⁴

A BB/pellet gun related injury was defined as a gunshot wound from a pistol or rifle that uses compressed air to fire a metal BB or pellet. These guns can operate through a spring or pump action mechanism or a carbon dioxide cartridge.¹⁵ A firearm related injury was defined as a gunshot wound from a pistol, revolver, or rifle that uses a powder charge to fire a projectile.

The NEISS is comprised of approximately 100 hospitals selected as a stratified probability sample of the approximately 5000 hospitals with emergency departments located throughout the US.^{16,17} The system includes very large inner city hospitals with trauma centers, as well as urban, suburban, rural, and children's hospitals. Data obtained from these NEISS hospitals were weighted by the inverse of the probability of selection to provide national estimates of injuries treated in hospital emergency departments in the US and its territories.¹⁷ NEISS on-site personnel at each hospital were trained to identify all gun related cases treated in the emergency department by reviewing emergency department logs, trauma registries (when available), and emergency department charts. Based on information written in the medical record, on-site personnel classified gun related injuries by type of weapon (BB/pellet gun or firearm). For each BB/pellet gun related case from 1985 through 1992, coders abstracted information from the medical record on age and sex of the patient, nature of the injury, primary body part injured, disposition at discharge from the emergency department. For each special study gun related case treated from 1993 through 1999, coders abstracted those routine NEISS variables plus race/ethnicity of the patient, method of transport to the emergency department, type of firearm used, victim-offender relationship, intent of injury (for example, unintentional, suspected and confirmed assault, suspected and confirmed suicide attempt, law enforcement related), and other selected factors. A narrative taken verbatim from the medical record was

also captured to provide more details about the injury circumstances. Further details of the system, abstraction methods, and evaluations of case ascertainment and completeness and accuracy of coding are provided elsewhere.^{18–20}

In 1997, the sampling frame of NEISS was updated and a stratum was added for children's hospitals increasing the number of NEISS hospitals from 91 to 101.¹⁷ During an eight month overlap in 1997, gunshot cases were collected from both the old and new NEISS samples. Analysis of the weighted data indicated that differences in national estimates of non-fatal firearm related injuries based on these two samples were minimal (that is, ≤1%). However, differences in national estimates of non-fatal BB/pellet gun related injuries were relatively high (that is, ≤15%) and depended on age. To account for this, a SAS program developed by CPSC was used to calculate ratios for adjusting both firearm related and BB/pellet gun related injuries. These ratios were then applied to sample weights for NEISS cases before 1997 to ensure comparability of national estimates over time.

In cases before 1993, there was no way of distinguishing non-fatal BB/pellet gun related injuries associated with gunshot wounds from those induced by other causes (for example, lacerating or pinching finger on trigger after a fall). In the special study cases treated from 1993 through 1999, 4% were determined to be non-gunshot wounds. Accordingly, rates calculated for the earlier years were adjusted downward by 4% to account for non-gunshot wound cases.

Race and ethnicity data for persons treated for non-fatal gun related injuries were obtained from NEISS hospital emergency department records. The majority of cases were reported as either white, black, Hispanic, Asian, or American Indian*. Those reported as black Hispanic were classified as black, and those reported as any other race and Hispanic were classified as Hispanic.³ Because of the small numbers of cases,

*Frequently, only one entry on the emergency department record is available for either race or identity, not for both. The classification scheme used in this study assumed that most white Hispanics, Asian/Pacific Islander Hispanics, or American Indian/Alaskan Native Hispanics, were likely to be recorded on the emergency department record as Hispanic and most black Hispanics were likely to be recorded as black.

Table 2 Number and percentage* of BB/pellet gun related injuries and firearm related injuries and deaths for persons aged 19 years and younger, by selected characteristics of the injury incident, United States, 1993–99

Characteristics	Non-fatal BB/pellet gun related injuries†		Non-fatal firearm related injuries†		Firearm related deaths	
	No	Mean (%) annual No	No	Mean (%) annual No	No	Mean (%) annual No
Intent						
Unintentional	80345	11478 (65.8)	26633	3805 (18.6)	2636	377 (8.0)
Assault‡	11145	1592 (9.1)	92131	13162 (64.3)	20231	2890 (61.5)
Self inflicted	201**	29** (0.2)**	4089	584 (2.9)	9365	1338 (28.5)
Undetermined	30377	4340 (24.9)	20346	2907 (14.2)	680	97 (2.1)
Disposition						
Treated and released	113917	16274 (93.3)	70014	10002 (48.9)	–	–
Treated and transferred	3271	467 (2.7)	6707	958 (4.7)	–	–
Hospitalized	4690	670 (3.8)	66170	9453 (46.2)	–	–
Observation/unknown	190**	27** (0.2)**	308**	44** (0.2)**	–	–
Primary body part affected						
Extremity	65073	9296 (53.3)	76225	10889 (53.2)	–	–
Trunk	14757	2108 (12.1)	36901	5272 (25.8)	–	–
Face	18784	2683 (15.4)	7504	1072 (5.2)	–	–
Head/neck	14296	2042 (11.7)	13166	1881 (9.2)	–	–
Eye	7258	1037 (5.9)	664	95 (0.5)	–	–
Other	1901	272 (1.6)	8739	1248 (6.1)	–	–
Total	122068	17438 (100.0)	143199	20457 (100.0)	32912	4702 (100.0)

*Column percentages may not sum up to 100.0 due to rounding error.
 †National estimates of non-fatal gunshot injuries treated in hospital emergency departments.
 ‡Includes injuries from legal intervention.
 **Estimate may be unstable because sample size was <20 or the coefficient of variation was >30%.
 Data sources: National Vital Statistics System, National Center for Health Statistics for deaths; Centers for Disease Control and Prevention’s Firearm Injury Surveillance Study for non-fatal injuries; US Census Bureau for population estimates.

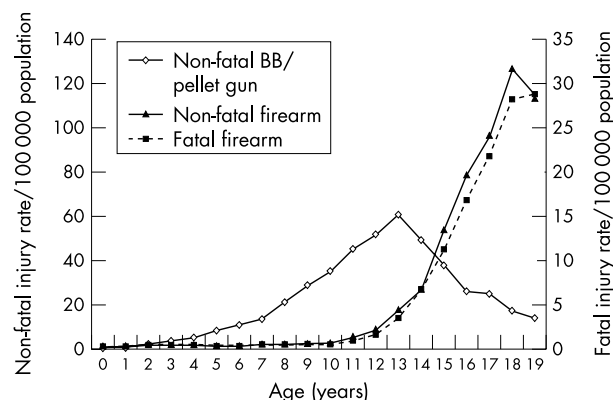


Figure 1 Non-fatal and fatal gun related injury rates per 100 000 for persons aged 19 years or younger, by single year of age and weapon type, US, 1993–99.

non-Hispanic Asians/Pacific Islanders and non-Hispanic American Indians/Alaskan Natives were combined with other/unknown races.

Information about fatal firearm related injuries from 1985 through 1999 was obtained from the National Vital Statistics System (NVSS) of Center for Disease Control and Prevention’s National Center for Health Statistics. The NVSS provides a complete enumeration of all deaths in the US.²¹ For this study, all firearm related deaths of residents of the US with an ICD-9 underlying cause of death code of E922.0–E922.9, E955.0–E955.4, E965.0–E965.4, E985.0–E985.4, or E970 were included.¹³ Annual population estimates of the resident population, used to calculate injury and death rates per 100 000 population, are from the US Census Bureau.

The 95% confidence intervals (CI) around national estimates of numbers and rates were calculated using a direct variance estimation procedure that accounts for sample weights and the stratified sample design.¹⁶ Linear regression

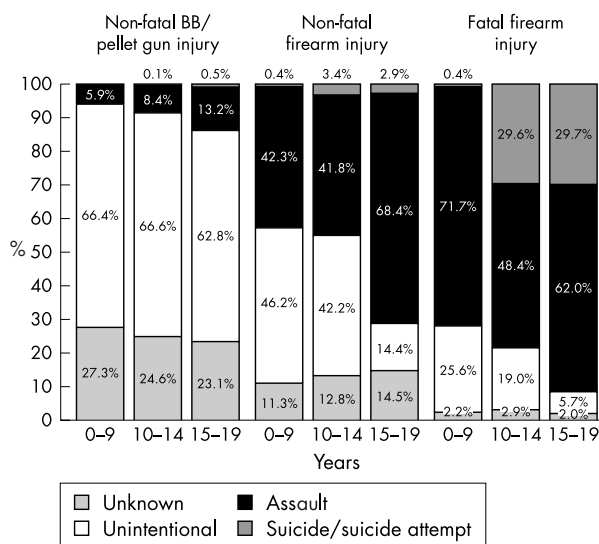


Figure 2 Non-fatal and fatal gun related injuries for persons aged 19 years or younger, by type of gun, age, and intent of injury, US, 1993–99.

was used to calculate the percentage decline in fatal and non-fatal gun related rates from the early 1990s through 1999. The 95% CI calculated for these percentage declines also accounted for the sample weights and stratified sample design.

RESULTS

From 1993 through 1999, an estimated 122 068 persons (95% CI 105 275 to 138 861) aged 19 years or younger with non-fatal BB/pellet gun related injuries were treated in US hospital emergency departments. This represents an annual average of 17 438 persons ranging from 22 598 in 1993 to 14 313 in 1999. These estimates were based on data obtained

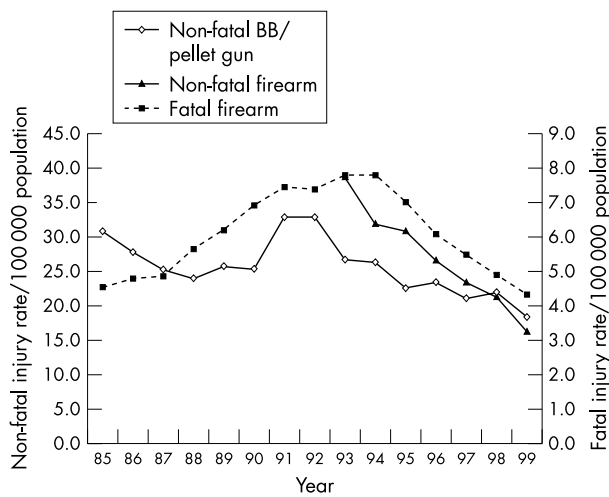


Figure 3 Non-fatal and fatal gun related injury rates per 100 000 for persons aged 19 years or younger, by year and weapon type, US, 1985–99.

from 3076 sample persons using NEISS. The non-fatal BB/pellet gun related injury rate was highest for persons 10–14 years of age (table 1). Among this age group, the non-fatal BB/pellet gun related injury rate was 3.8 times the non-fatal firearm related injury rate and 17.3 times the fatal firearm related injury rate (48.4 v 12.6 and 2.8 per 100 000). Similar to firearm related injuries and deaths, non-fatal BB/pellet gun related injuries predominantly occurred among males (86.7%; 95% CI 74.5% to 98.9%). The non-fatal BB/pellet gun related injury rate was similar for non-Hispanic whites and blacks, 24.1 and 28.4 per 100 000, in contrast to firearm related injury and death rates which were much higher among black than white persons, 94.8 and 8.3 per 100 000 for injuries and 16.7 and 3.4 per 100 000 for deaths. The BB/pellet gun related injury rate for Hispanics (9.0 per 100 000) was about one third of the rate for non-Hispanic whites and blacks.

The age distributions differed for BB/pellet gun related injury rates and firearm related injury and death rates (fig 1). BB/pellet gun related injury rates increased sharply after age 7 years, peaked at age 13 years, and then declined thereafter. Firearm related injury and death rates increased gradually until age 13 years and then increased sharply until age 18 years.

Comparisons of non-fatal BB/pellet gun related injuries with firearm related injuries and deaths for selected characteristics also showed notable differences (table 2). While a

majority of non-fatal BB/pellet gun related injuries were unintentional (65.8%; 95% CI 56.0% to 75.7%), firearm related injuries and deaths were mostly assaults (64.3%; 95% CI 35.5% to 93.1% for injuries and 61.5%; 95% CI 61.0% to 62.0% for deaths). Although the number of violence related injuries associated with BB/pellet guns, including assaults and suicide attempts, was relatively small, the percentage of violence related injuries increased with age (fig 2). This finding was consistent with an increase in the percentage of violence related firearm related injuries and deaths by age (fig 2).

When compared with non-fatal firearm related injuries (table 2), non-fatal BB/pellet gun related injuries were 12 times less likely to result in hospitalization (3.8%; 95% CI 2.7% to 5.0% compared with 46.2%; 95% CI 23.1% to 69.3%). Compared with those who survived a firearm injury to the facial area and were treated in a hospital emergency department, non-fatal BB/pellet gun related injuries occurred three times more often to the face (15.4%; 95% CI 12.6% to 18.1% compared with 5.2%; 95% CI 3.5% to 7.0%) and almost 12 times more likely to involve an eye (5.9%; 95% CI 4.6% to 7.3% compared with 0.5%; 95% CI 0.2% to 0.7%).

Comparison of trends in BB/pellet gun related injury rates with firearm related injury and death rates showed similar patterns over the 12 year period from 1988 through 1999 (fig 3). BB/pellet gun injury rates increased from 1988 through 1992 and then declined thereafter; the predicted per cent change from 1992 through 1999 was –38.8% (95% CI –48.0% to –29.5%). Non-fatal firearm related injury rates declined steadily from 1993 through 1999; the predicted per cent change from 1993 through 1999 was –55.0% (95% CI –60.1% to –49.8%). Firearm related death rates increased from 1985 through 1993 and then declined steadily after 1994; the predicted per cent change from 1994 through 1999 was –45.2% (95% CI –48.2% to –42.1%).

DISCUSSION

BB/pellet gun related injuries and their potentially harmful and lethal effects have been well documented in the medical literature since the early 1980s.^{6 12 14–23} BB/pellet gunshot wounds, particularly those inflicted at close range, can penetrate the abdomen, chest, head, and eye, and cause permanent damage and death.^{10 24–26} Most of these injuries occurred in children and teenagers aged 19 years or younger. Based on NEISS data for the most current year available, 1999, almost 76% of 18 911 all persons with BB/pellet gun related injuries treated in US hospital emergency departments were 19 years of age or younger.

Trend analyses indicated that BB/pellet gun related injury rates for persons aged 19 years or younger declined

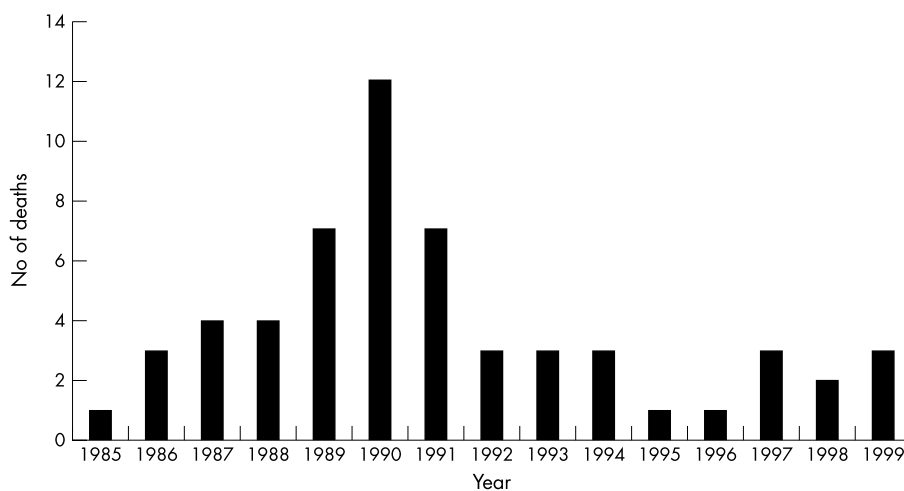


Figure 4 Number of BB/pellet gun related deaths for persons aged 17 years or younger, reported annually to CPCS, 1985–99.

Table 3 State gun laws (2000) pertaining to possession/use and sales of BB/pellet guns

State of residence	BB/pellet gun defined as firearm or dangerous weapon	General possession/use of BB/pellet gun by minors	Selling of BB/pellet guns to minors	Possession/use of BB/pellet guns in and around schools	Parent/guardian responsible for knowing illegal possession of firearm by minor	Parent/guardian responsible for proper storage of firearm
AL				X*		
AK				X*		
AZ				X*	X	
AR				X†		
CA		X (<18 years)	X (<18 years)	X*	X‡	
CO				X*		
CT				X*	X	X
DE		X (<16 years)	X (<16 years)	X§		
DC					X	
FL		X (<16 years)			X	
GA				X*	X	
HI						X
ID		X* (<12 years)	X* (<18 years)	X*		
IL	X¶			X**		X
IN				X**		
IA				X*		X
KS				X*		
KY					X	
LA				X*		
ME	X	X (<16 years)	X (<16 years)		X	
MD				X*		
MA		X (<18 years)‡	X (<18 years)	X*		X
MI	X	X (<18 years)	X (<18 years)	X§	X	
MN		X (<14 years)	X (<18 years)	X§		
MS				X§	X	
MO				X*		
MT				X*	X	
NE				X**		
NV	X			X§		
NH		X (<18 years)	X (<18 years)	X§		
NJ	X	X (<18 years)	X (<18 years)	X§	X	X
NM				X*		
NY		X (<16 years)	X (<16 years)	X§		
NC	X††	X (<12 years)	X (<12 years)	X§	X	X
ND	X††					
OH		X (<18 years)‡	X (<18 years)‡	X*	X‡	X‡
OK	X††	X (<18 years)	X (<18 years)	X*	X	
OR				X*		
PA		X (<18 years)	X (<18 years)			
RI	X	X (<18 years)	X (<18 years)	X§	X	X
SC				X*		
SD				X§		
TN				X*	X	
TX				X*	X	
UT	X††	X (<14 years)		X*	X	X
VT			X (<16 years)	X*		
VA				X*		
WA				X§		
WV				X**		
WI	X††	X (<18 years)		X§		
WY						
Total No of states	11	18	16	43	19	10

*Law refers to the illegal possession/use of weapons on educational premises; BB/pellet guns not specifically mentioned, but implied.

†Law refers to the illegal possession/use of a handgun only on educational premises.

‡For California, law only applies in Oakland; for Massachusetts, law refers to possession in a motor vehicle; for Ohio, these laws only apply in Cincinnati.

§Law refers to the illegal possession/use of weapons on educational premises; BB/pellet guns specifically mentioned.

¶BB/pellet guns are considered firearms if they exceed a muzzle velocity of 700 fps.

**Law only refers to the illegal possession/use of a firearm and/or deadly weapon on educational premises.

††BB/pellet guns are deemed dangerous weapons; in North Carolina, they are deemed dangerous firearms in some counties.

Data source: State laws and published ordinances (2000)—firearms, 22nd edition, Department of the Treasury, Bureau of Alcohol, Tobacco and Firearms (<http://www.atf.treas.gov/firearms/statelaws/22edition.htm>).

39% from 1992 through 1999. In 1999, an estimated 14 313 (95% CI 12 025 to 16 601) children and teenagers with BB/pellet gun related injuries compared with an estimated 12 748 (95% CI 7881 to 17 615) cases with non-fatal firearm related injuries were treated in US hospital emergency departments. NVSS data for 1999 indicated that 3385 persons 19 years of age or younger died from firearm related injuries, second only to motor vehicle traffic related injuries (7476 persons) as the leading cause of death in this age range in the US.

The ICD, the classification system used by the NVSS to code deaths, does not have external cause of injury codes to specifically identify BB/pellet gun related deaths.¹³ However, CPSC has an extensive consumer product related injury tracking system for use in identifying BB/pellet gun related deaths that occur each year. CPSC's system documented 57 deaths of persons aged 17 years or younger (or 3.8 deaths per year) from 1985 through 1999 (unpublished data from CPSC's In-Depth Investigation, Injury or Potential Injury Incident, and NEISS files). The highest number of deaths

occurred in 1989, 1990, and 1991 (seven, 12, and seven deaths); the number of deaths ranged from one to four in other years (fig 4).

The decline in BB/pellet gun related injury rates was similar to the declines in firearm related injury rates and death rates among children and teenagers. This similarity is intriguing and could be potentially the result of legislative and educational efforts to prevent unsupervised access to guns by children. More research is needed to investigate the potential role of these efforts in explaining the decline in BB/pellet gun related injury rates. Most BB/pellet gun related injuries occurred among younger males, were unintentional shootings, and were either self inflicted or inflicted by a relative or friend.² Public awareness and concern about this issue has increased since the early 1990s, as evidenced by increased legislation. In 1981, a survey by CPSC found that 12 states had laws that restricted possession or use of BB/pellet guns by minors and furnishing or selling these guns to children.²⁷ According to a search using LexisNexis (Reed Elsevier, Inc, Dayton, Ohio), a database that provides full text access to state laws pertaining to firearms, that number increased to 14 states by 1994 and 28 states by 1996.¹⁵ Our research for the year 2000 found that 43 states currently have laws (table 3).²⁸ Eleven states now have laws that define BB/pellet guns as either firearms or dangerous weapons.²⁸ Nineteen states have enacted laws that hold parents or guardians legally responsible for injuries or deaths resulting from minors using their firearms and 10 states have laws requiring parents or guardians to protect minors by properly storing their firearms.²⁸ Safe storage laws intended to make firearms less accessible to children have been linked to a 23% reduction in unintentional shooting deaths of children aged 15 years or younger.²⁹ Also, the number of unintentional firearm related injury deaths for children aged 19 years and younger in the US was relatively constant from 1985 through 1993 and then declined from 526 deaths in 1993 to 214 deaths in 1999.³⁰

Another factor that might have contributed to the recent decline in BB/pellet gun related injury rates is the increase in prevention programs aimed at reducing gun violence among children and youth. Although BB/pellet gun related injuries were mostly unintentional, about 13% of BB/pellet gun related injuries among persons aged 15–19 years were assaults. Fatal and non-fatal firearm related injuries are predominantly violence related. Since the early 1990s firearm related injury and death rates have declined substantially in the US.³ Efforts supported by public health, criminal justice, and educational agencies and organizations may have contributed to the decline in BB/pellet gun related injuries, especially those associated with interpersonal violence. These efforts promote the adoption of youth violence prevention programs shown to be effective in reducing violent behavior and associated injuries and target parents, children, and teenagers.^{31, 32} In the year 2000, 63% of all elementary and middle/junior high schools participated in programs to prevent bullying and 46.4% of all schools participated in a program in which family or community members serve as role models or mentor students, such as the Big Brothers/Big Sisters program. Most schools (96.1%) also have a policy that prohibits student weapon possession or use.³³ Prevention messages aimed specifically at reducing firearm related injuries among children have focused on increasing parent/guardian awareness of the increased risk of injury associated with unsupervised access to firearms, promoting safe gun storage and practices for gun owners and users, and educating policy makers about those at risk of injury.

Limitations of our data exist because our national estimates of non-fatal BB/pellet gun related injuries include only those that were treated in hospital emergency departments. BB/pellet gun related injuries that were not medically treated or were treated in outpatient clinics or doctors' offices were not included. We could not examine trends in BB/pellet gun related injuries treated in these outpatient settings because no

Key points

- Tracking BB/pellet gun and firearm related injury rates simultaneously can be an informative injury surveillance tool.
- For persons aged 19 years and younger, non-fatal BB/pellet gun related injuries have been declining along with fatal and non-fatal firearm related injuries from the early 1990s through 1999.
- Prevention efforts aimed at reducing unsupervised access to guns by children and reducing youth violence coincide with declines in BB/pellet gun related injury rates and firearm related injury and death rates for persons aged 19 years and younger in the US.
- A carefully designed evaluation of the effectiveness of prevention efforts in reducing both BB/pellet gun and firearm related injuries at the state and local levels is warranted.
- Prevention messages should continue to remind parents and guardians that BB/pellet guns are not harmless toys. Not only can their children hurt themselves seriously from improper use of these guns, but they may also inflict injuries on others.
- Prevention efforts, including legislation and law enforcement, education, programs, and improved gun safety design, working collectively could potentially help to reduce the risk of gun related injuries and improve the safety of our children.

national data exist. NEISS provides nationally representative estimates, but does not accommodate state or local estimates. Additionally, NEISS is a probability sample of US hospitals and estimates are subject to sampling error. Nevertheless, the coefficients of variation for national estimates of BB/pellet gun related injuries have remained relatively small, approximately 7% overall for persons aged 19 years and younger, and have been stable over time. Also, adjustments were made for a NEISS sampling frame change that occurred in 1997 so that our trend analyses would be statistically valid.¹⁷ Trend analysis with or without these statistical adjustments lead to similar conclusions for this study.

IMPLICATIONS FOR PREVENTION

Prevention efforts have focused on informing gun owners that BB/pellet guns can be dangerous, even lethal, and need to be properly stored, locked and unloaded, so that children will not be tempted to play with them or use them without adult supervision.³⁴ These prevention messages remind parents or guardians about their role in ensuring the safety of their children around guns. Parents or guardians should also be informed that injuries can occur to their children at a friend's home where a loaded, BB/pellet gun may be readily available.⁸ Parents need to take steps to ensure that their children, especially boys, are not exposed to BB/pellet guns in various places that they go and play. Boys have been found to choose handling a gun, if they find one, regardless of their parents' beliefs about their children's perceived interest in guns.³⁵

Our study suggests that growing prevention efforts aimed at reducing unsupervised access to guns by children and reducing youth violence coincide with the decline in national BB/pellet gun related injury rates and firearm related injury and death rates in the US. A carefully designed evaluation at the state and local levels of prevention efforts aimed at reducing both BB/pellet gun related and firearm related injuries is warranted. These prevention efforts should be combined with other efforts, such as improving the design and safety features of guns; increasing the number of states with laws that restrict unsupervised access to powder and non-powder guns by minors; using stricter sentencing guidelines for crimes committed with guns³⁶; and improving law enforcement practices.³⁶ Together, these efforts could potentially help to reduce the risk of gun related injuries and improve the safety of our children.

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