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## Characteristic Features of Pediatric Firearm Fatalities—Comparisons Between Australia and the United States

**ABSTRACT:** Gunshot deaths in children less than 17 years of age from Adelaide, SA, Australia (1969–2005) and from San Diego County, CA, United States (1988–2005) were compared. Forty-two pediatric gunshot fatalities occurred in South Australia (1.1 cases/year; M:F = 30:12). There were 6 accidents (14%), 14 suicides (33%), and 22 homicides (52%). In San Diego there were 185 cases (*c.* 10 cases/year; M:F = 148:37). There were 6 accidents (3%), 42 suicides (23%), 130 homicides (70%), and 7 undetermined cases (4%). The incidence of homicide was significantly higher in San Diego County compared to Adelaide ( $p < 0.001$ ), with a higher proportion of murder–suicides occurring in Adelaide. There were markedly more accidents and suicides involving males in Adelaide and a far higher number of male homicide victims in San Diego County compared to females. Rifles of 0.22-caliber were preferred weapons in South Australia, compared to handguns in San Diego County.

**KEYWORDS:** forensic science, firearm, gunshot fatalities, pediatric, childhood, homicide, suicide

While causes of death in countries with similar socioeconomic and cultural profiles often follow similar patterns for specified age groups, variations in death rates sometimes occur. Given the differences that exist in firearm availability between the United States and Australia, and recent highly publicized incidents of school shootings in North America, we decided to undertake a retrospective review of firearm fatalities in two pediatric populations, one in Australia and the other in the United States, to determine whether there were any significant differences in the numbers and characteristics of these deaths in children living in the two areas.

### Materials and Methods

The files of Forensic Science SA, Adelaide, South Australia, Australia, and the Medical Examiners Office, San Diego County, California, United States were searched for all cases where death was attributed to a firearm in children aged less than 17 years.

Forensic Science SA (FSSA) provides an autopsy service to the coroner of South Australia and serves a mixed urban and rural population of *c.* 1.5 million people. The Medical Examiner Office provides a similar service for San Diego County with an urban and rural population of approximately 3 million people. Initially, cases were reviewed over an 18-year period from 1988 to 2005. Due to the small number of pediatric deaths from gunshot wounds in South Australia, however, accessioning from FSSA was extended to a 37-year period, from 1969 to 2005. All cases had full police-coronial/medical examiner investigation and forensic autopsies.

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Data concerning the age and gender of the victims, the site of lethal injury (head—including upper torso and neck; torso—including chest, back, and abdomen; and lower extremity including legs and pelvis), the type of firearm, and the manner of death were collated where available.

### Statistical Methods

Categorical variables were analyzed using the chi-square test or Fisher's exact test. Continuous data were analyzed with two-sample *t*-tests and are summarized using mean  $\pm$  standard deviations. Calculations were performed with SPSS Version 12.0 (SPSS, Inc., Chicago, IL). A *p*-value less than 0.05 was considered significant.

### Results

#### South Australia

A total of 42 pediatric gunshot fatalities occurred over the 37 years of the study (1969–2005) (1.1 cases per year) involving 30 males (71.4%) and 12 females (28.6%) (M:F = 2.5:1). The age range was 5 months to 16 years (mean  $11.9 \pm 4.7$  years). The manner of death was accidental in 6 cases (14.3%), suicidal in 14 cases (33.3%), and homicidal in 22 cases (52.4%). The victims in all of the suicides and in all but one of the accidental deaths were male. The age range of the accident victims was 11–16 years (mean 14 years) and of the suicide victims was 12–16 years (mean 15 years). There were equal numbers of male and female homicide victims ( $n = 11$ ). The population of South Australia was *c.* 1,158,000 in 1970 increasing to 1,542,000 in 2005 (1,2).

The weapons involved in the six accidental deaths were 0.22 caliber rifles ( $n = 4$ , 67%) and one 0.32 caliber target pistol (17%). In one case the type of weapon was not specified. All victims were shot in the head/neck region.

The weapons involved in the 14 suicides were 0.22 caliber rifles ( $n = 9$ , 64%), shotguns ( $n = 2$ , 14%), and a 0.303 rifle ( $n = 1$ ,

7%). In two cases the type of weapon was not specified. All of the victims were shot in the head.

The weapons involved in the 22 homicides were 0.22 caliber rifles ( $n = 15$ , 68%) and a 0.45 handgun, a 0.303 caliber rifle, and a shotgun ( $n = 1$  each, 5%). There were four cases where the type of weapon was not specified. Victims were shot in the head in 16 cases (73%), the chest in 2 (9%), the abdomen in 2 (9%), and at multiple sites in 2 cases (9%). Ten of the homicide deaths (46%) were associated with the subsequent suicide of the perpetrator who was the mother in three cases and the father in five. (Details of murder-suicide cases occurring between 1969 and 1998 have been the subject of a separate study [3].)

#### San Diego County

A total of 185 pediatric gunshot fatalities occurred over the 18 years of the study (1988–2005) (c. 10 cases per year) involving 148 males (80%) and 37 females (20%) (M:F = 4:1). The age range was 4 months to 16 years (mean  $14.0 \pm 3.3$  years). The manner of death was accident in 6 cases (3.2%), suicide in 42 cases (22.7%), and homicide in 130 cases (70.3%). The manner of death was undetermined in 7 cases (3.8%). There was a male predominance in all categories, with four out of six accident victims (67%), 31 out of 42 suicide victims (74%), and 107 out of 130 homicide victims (82%) being male. The population of San Diego County in 1985 was 2,080,300 increasing to 3,066,820 in 2006 (4.5).

The most common site of injury in the six accidental deaths was the head ( $n = 4$ , 67%), followed by chest and torso wounds ( $n = 1$  each, 17%). Information regarding the caliber/type of weapons used in this group was not available.

The weapons used in the 42 suicides were 0.38 revolvers ( $n = 13$ , 31%), 0.357 revolvers and 0.22 revolvers ( $n = 7$  each, 17%), 0.22 rifles ( $n = 4$ , 10%), 0.25 and 9 mm automatic pistols ( $n = 3$  each, 7%), 0.45 automatic pistols ( $n = 2$ , 5%) and a 0.22 automatic pistol, a 0.380 automatic pistol and a 0.44 revolver ( $n = 1$  each, 2%).

The weapons used in the 130 homicides were 0.38 caliber handguns ( $n = 8$ , 6%), 0.357 caliber handguns ( $n = 7$ , 5%), 9 mm and 0.22 caliber handguns ( $n = 3$  each, 2%), 0.3 and 0.45 caliber handguns ( $n = 2$  each, 1.5%) and one case each of 0.6, 0.25, and 0.375 caliber weapons and a 12 gauge shotgun ( $n = 1$  each, 0.8%). There were 82 cases in which the weapon was not identified (63%). The weapon was merely identified as large caliber ( $\geq 0.44$ ) in six cases, medium caliber (0.32–0.38) in seven, and small (0.22) in six. The most common site of injury was the head ( $n = 63$ , 49%) followed by the chest ( $n = 51$ , 39%) and lower extremities ( $n = 1$ , 0.8%). Multiple injury sites were seen in nine cases (7%). For the remaining cases no specific site of injury was recorded. Sixteen of the homicide deaths (12%) were associated with suicide of the perpetrator who was most often male (68%).

The distribution of manner of death was significantly different between Australia and San Diego cases ( $p = 0.005$ ). San Diego County had a larger percentage of homicide cases, whereas Adelaide had a higher proportion of suicides and accidents. The proportion of homicides that were followed by suicide of the perpetrator also reached statistical significance ( $p = 0.005$ ). Regarding distribution of cases by gender, there were significantly more accidents and suicides involving males in Adelaide ( $p = 0.004$ ) but in San Diego County no significant differences by gender were observed. The distribution of homicide victims by gender by location was significant at  $p = 0.001$ . Consistent information on medical intervention and survival times was not available. The results are summarized in Table 1.

TABLE 1—Characteristics of childhood gunshot fatalities in South Australia and San Diego.

	South Australia (1969–2005)	San Diego (1988–2005)
Male:Female (M:F)	30:12 ( $N = 42$ )	148:37 ( $N = 185$ )
Age range (mean/range)	5 months–16 years ( $11.9 \pm 4.7$ years)	4 months–16 years ( $14.0 \pm 3.3$ years)
Homicide	22 (52%) M:F = 11:11	130 (70%) M:F = 107:23
Suicide	14 (33%) M:F = 14:0	42 (23%) M:F = 31:11
Accident	6 (14%) M:F = 5:1	6 (3%) M:F = 6:1
Undetermined	0	7 (4%) M:F = 6:1

#### Discussion

The classification of causes of death in different jurisdictions may be influenced by a variety of factors including the extent to which cases are investigated, the diagnostic preferences of individual pathologists, and available resources. Cultural and environmental differences between communities may also have a major effect on the numbers and types of deaths that occur. An example of this occurs with pedestrian deaths in children in developing countries that are much higher than in the West, because of greater exposure to traffic and less safe thoroughfares (6).

Numbers of lethal episodes with firearms have shown great variability between communities with, for example, death rates due to gunshots being five to six times higher in the United States than in other countries of a similar socioeconomic level (7). The rate of firearm deaths overall in the United States of 14.24 per 100,000 reported in 1998 compares to 0.12 per 100,000 in Australia in 2005 (1.7). Specifically, in Australia in 2005 there were only 26 homicides due to firearms nationwide out of a population of 20,328,600, with a decline in the use of firearms from 16% of all murders in 2001 to 10% in 2005 (1). The data from the current study indicate that the differences in causes and manner of death between these two populations extend to the pediatric age range, with an average of 10 deaths under the age of 17 years in San Diego County every year, the majority of which were homicides involving males, compared to an average of only 1.1 per year in South Australia; a difference that is not explained by the population difference of only 2:1. Decreasing numbers of firearm suicides have also been noted in the elderly and in females in the same South Australian population (8,9), a trend that has been related in other Australian states to the effects of a national firearm amnesty and gun buy-back scheme (10).

Firearm-related trauma has become one of the leading causes of pediatric injuries and death in the United States with significant increases noted in cases presenting to emergency departments (11). The increases in pediatric firearm injuries have been reported particularly among lower socioeconomic black and Hispanic youths, and have been associated with more cases with violent circumstances such as assaults, crossfire, and drive-by shootings (12–14). A study from North Carolina has shown that the majority of pediatric firearm deaths in that community are homicides involving handguns legally purchased within 3 years of the shooting (15). Such deaths tend to occur more often in adolescence than in early childhood.

In both Adelaide and San Diego, there was a predominance of males in both the accident and suicide categories. This would be in keeping with the known tendency for higher risk-taking behavior in young males and also with the tendency of males to choose more

violent means of suicide such as firearms (16,17). Availability of methods of suicide has also been found to be a factor in determining the popularity of particular techniques, with firearms more likely to be found in the homes of adolescent suicide victims (18). The higher incidence of suicide in San Diego County children compared to South Australia has been previously demonstrated in a study from 1985 to 1997, again with a high proportion of firearm deaths (16). Other studies of adolescent suicide in North America have also shown firearms to be a favored method of self extinction (19–21).

While there was no gender difference in homicide victims in Adelaide, there were markedly more male homicide victims than female in San Diego County. The increased proportion of homicides among young males in San Diego County may be a reflection of gang activity or other different socioeconomic or cultural factors.

The favored weapon in South Australia in all categories was the 0.22 rifle. Unfortunately the type and caliber of weapon was not available in the majority of North American cases often due to perforating gunshot wounds. When this information was available, however, the most common weapon was a handgun. This is in keeping with other studies where 58% of fatal pediatric gunshot injuries were inflicted by handguns, many of which were unsecured and loaded in the home environment (22,23) (an estimated 37–50% of American homes contain firearms [24]). Part of the reason for the incompleteness of the San Diego County data may be the higher number of homicides utilizing medium and large caliber weapons with projectiles not being found, and offending weapons not recovered. The percentage of cases of murder–suicide in South Australia was significantly higher than in San Diego County, ( $10/22 = 46\%$  vs.  $16/130 = 12\%$ ) reflecting the observation that murder–suicide rates are higher in areas with low homicide rates (3).

The reasons for the alarming numbers of gunshot fatalities in the United States compared to countries such as the United Kingdom and Australia have been extensively discussed, without consensus being achieved. However, availability and access to firearms must be considered a potential contributor to higher rates of firearm deaths (25). For example, it has been shown that a “disproportionately” high rate of firearm deaths in children aged from 5 to 14 has occurred in areas and states where guns are more prevalent (26), and an Austrian study looking at firearm suicides at all ages showed that an increase in gun licenses was paralleled by an increase in firearm suicides (27). The finding that a child is 100 times more likely to die of a firearm injury in Missouri (US) compared to Ontario (Canada) has been related to greater availability of guns in Missouri, with firearm injuries accounting for 19% of trauma deaths in Missouri, compared to only 0.5% in Ontario (28). Another factor that may have contributed significantly to the higher number of male homicide victims in San Diego County is the prevalence of gang- or drug-related activities (29). Support for this was found in Harlem (US) when reduced drug selling in schools and playgrounds was matched by a decline in childhood gunshot injuries (30). The levels of organization and violence of youth gangs at the level seen in modern North American urban communities are not found in South Australia.

This study has shown a much lower number of firearm deaths in children resident in South Australia compared to San Diego County. The rarity of gunshot deaths in this cohort of Australian children most likely relates to differences in cultural and legislative practices with reduced weapon availability. Further studies into predisposing and precipitating factors for pediatric firearm deaths in areas with low death rates may assist in the formulation of strategies that may be implemented to reduce the death toll from this

preventable form of childhood trauma in areas with higher death rates.

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