Characteristics and outcomes of self-inflicted pediatric injuries: the role of method of suicide attempt

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Abstract

Objective—To examine the epidemiologic characteristics and clinical outcomes of self-inflicted pediatric injuries in relation to the method of suicide attempt.

Methods—Using data from the National Pediatric Trauma Registry Phase II, a comparative analysis was conducted for children under 15 years of age who were admitted from 1 October 1988 through 30 April 1996 because of self-inflicted injury by firearm (n=28), hanging (n=38), or jumping from heights (n=21).

Results—Of the 87 cases under study, 90% occurred at home, and 86% occurred between noon and midnight, with a peak in early evening (between 6 pm and 7 pm). More than one quarter (29%) had pre-existing mental disorders, such as disturbance of conduct and depression. Toxicological tests were conducted on admission on 40 (46%) of the patients; 20% tested positive for alcohol or other illicit drugs. The method of suicide attempt was associated with gender and age of the patients: 75% of the firearm cases and 82% of the hanging cases were boys compared with 29% of the jumping cases (p<0.01); 79% of the hanging cases were aged 13 years or younger compared with 39% of the firearm cases and 48% of the jumping cases (p<0.01). The mean injury severity score was 18.6 for the firearm cases and 16.3 for the hanging cases, significantly greater than 8.5 for the jumping cases (p<0.02). Reflecting the differences in injury severity, firearm cases and hanging cases were more likely than jumping cases to be sent to intensive care units or operating rooms from emergency departments, and to develop complications during hospitalization. The case fatality rate was 50% for the firearm cases, 32% for the hanging cases, and 5% for the jumping cases (p<0.01). On average, these patients stayed in hospitals for 11 days and 52% of those who were alive at discharge had at least one impairment in communication, cognition, or self care functions.

Conclusion—Boys and older children tend to use more lethal methods in suicide attempts. Even in this age group, suicide attempts often involve psychiatric disorders and acute abuse of alcohol or other illicit drugs. Firearms are associated with significantly increased risk of inhospital fatality. The clinical outcomes of self-inflicted injuries appear to be worse than other injuries treated in the same trauma centers.

Keywords: mental disorder; suicide; suicide attempt.

Suicide is the eighth leading cause of death in the United States, claiming about 31 000 lives each year. In 1992, suicide was listed as the underlying cause of death for 304 children aged 10 to 14 years. Although childhood suicides account for only 1% of all suicides, and the death rate from suicide in the pediatric population is much lower than in any other age groups, suicide in children is of special concern and increasing importance. For children aged 10 to 14 years, suicide is the fourth leading cause of death, outranked only by unintentional injury, cancer, and homicide. Moreover, the death rate from suicide in this age group has doubled from 0.8 per 100 000 population in 1980 to 1.7 in 1992, while the rate for all ages combined remained fairly stable. The increase in suicide mortality among children appears to be real, because the coding system for suicide has not changed in the past two decades.

Previous research on suicide has focused primarily on adolescents and young adults because of the extremely high suicide rate for ages 15 to 24, in particular by means of firearms. Documentation of the epidemic of suicide is largely based on mortality data. To develop effective strategies for reducing the ever rising death rate from suicide in children, data on the epidemiologic characteristics of self-inflicted injuries for the pediatric population are essential but rarely available. Using data from the National Pediatric Trauma Registry (NPTR), this study examines the demographic, circumstantial factors, and clinical outcomes of self-inflicted injuries in children under 15 years of age. Of special interest are variables associated with the method of suicide attempt and the effects of the method on the outcome of the attempt.

Methods

The NPTR is a database developed for investigating the effects of acute care management on functional outcomes of pediatric trauma patients. As of April 1996, there were 76 hospitals (74 in the continental United States, one in Puerto Rico, and one in Canada) voluntarily participating in the NPTR. First started in 1985, the NPTR has evolved into an important data source for epidemiological and
clinical research on pediatric trauma. The methods of data collection and quality assurance used in the registry are described in detail elsewhere by Tepas and colleagues. Briefly, each participating trauma center is required to submit data on children and adolescents under 20 years of age who were admitted with injury as the primary diagnosis to the registry center (based in New England Medical Center, Boston, MA). Excluded are children with the primary diagnosis being poisoning, burns, or near drowning. A standard data form includes demographic information, circumstances of the injury, prehospital treatment, assessment of injury severity on admission, trauma management and treatment during hospitalization, and assessment of functional status at discharge. Before entering into the database, each record is reviewed by a full time staff member for completeness. Automatic cross checking is conducted by specially designed computer programs. For records with illogical or missing data, the participating trauma center is requested to provide supplemental information for correction or clarification. About 8000 records are added to the database each year.

Data on all patients aged 14 years or younger who were recorded in the NPTR (Phase II) because of self inflicted injuries from 1 October 1988 through 30 April 1996 were obtained by screening the database. The NPTR contains a data item indicating the intent of injury, categorized by the trauma coder as ‘accident’, ‘assault’, ‘self destruction’, ‘child abuse’, or ‘other’ based on information provided by the patient, family members, or police officers. ‘Self destruction’ comprises suicide and attempted suicide. During the study period, there were 99 patients aged 14 years or younger who were admitted due to injuries resulting from ‘self destruction’. The suicide intent was further confirmed by examining the E codes; all 99 patients have an E code between E950 and E959. Based on the method of suicide attempt indicated by the E code, patients were categorized into three groups: injury by firearms (E955.0 to E955.9), injury by hanging (E953.0), or injury by jumping from heights (E957.0 to E957.9). Six patients whose injury was sustained by cutting or piercing instruments were excluded because of the small sample size. Also excluded were six patients with unspecified method of suicide attempt. Therefore, there were 87 patients available for data analysis.

Comparisons were made among the three groups of patients divided according to the method of suicide attempt. Pre-existing medical conditions, including mental disorders, were those that existed before the injury and were recorded by clinicians on admission based on reports of the patients or their relatives. Using standardized protocol and criteria, functional status at discharge was assessed by clinicians for nine functions—that is, vision, hearing, speech, self feeding, bathing, dressing, walking, cognition, and behavior. Each of these functions was rated as either ‘age appropriate’, ‘impaired’, or ‘unable’. The rate of impairment of a specific function was calculated by dividing the number of patients with ‘impaired’ or ‘unable’ on this function by the total number of patients who were evaluated. The statistical significance of the differences among the three groups of patients was assessed using $\chi^2$ tests for categorical variables and $F$ tests (based on one way analysis of variance) for continuous variables. Data analyses were performed with an IBM mainframe system using the Statistical Analysis System (SAS) software.

**Results**

**CHARACTERISTICS**

During October 1988 and April 1996, the NPTR recorded 87 pediatric patients who were hospitalized due to self inflicted injuries (exclusive of the six cases of cutting and six cases of unknown method of suicide attempt). Of the 87 cases, 28 (32%) attempted suicide by shooting themselves, 38 (44%) by hanging, and 21 (24%) by jumping from heights. There were twice as many boys as girls in the study sample (table 1). The method of suicide attempt was associated with gender: hanging and shooting accounted for 53% and 36% of the male cases, respectively, while jumping was the method in 52% of the female cases ($<0.01$). Older children appeared to be more likely to use firearms whereas younger children were more likely to choose hanging (table 1). Of the 28 firearm cases, 17 (61%) were aged 14. Of the 38 hanging cases, 79% were children aged 13 years or younger. Seven patients were under 10 years of age and none of these used a firearm in their suicide attempts. Of the 87 cases, 25 (29%) were reported to have pre-existing mental disorders, primarily disturbance of conduct, depressive disorder, or drug abuse. Pre-existing mental disorder was not related to the method of suicide attempt (table 1). Neither gender nor age was significantly associated with the prevalence of pre-existing mental disorders. Of the 40 patients for whom toxicological testing results were available, eight (20%) were positive for alcohol or other illicit drugs.

Self inflicted pediatric injuries occurred
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predominantly from noon to 9 pm with a peak in early evening (between 6 pm and 7 pm) (fig 1). The time distributions of self inflicted injuries were not significantly different among the three groups of patients (table 1).

Of all cases, 30% occurred on weekends and 90% at home. Compared with injuries by firearms and by hanging, injuries by jumping from heights appeared to be more likely to occur in non-home settings, such as bridges and water towers (table 1). The tool used for hanging was known for 19 cases, with belts being used in 10 cases, cords in four, bathrobes in two, ropes in two, and a necktie in one.

OUTCOMES
Of the 28 firearm cases, 16 (57%) sustained head injury, predominantly skull fracture and intracranial hemorrhage. Brain injury was recorded in 58% of the hanging cases, with concussion being the leading diagnosis. The most common diagnosis for the jumping cases was ankle fracture (48%), followed by head injury (19%) and fracture of humerus/radius/ulna (19%).

Injuries sustained by the firearm cases and hanging cases were rated as being more severe than those sustained by the jumping cases in both injury severity score (ISS) and pediatric trauma score (table 2). On average, the firearm cases had an ISS of 18.6, similar to 16.3 for the hanging cases, but significantly greater than 8.5 for the jumping cases (p < 0.02). Reflecting the more serious injuries, the hanging cases and firearm cases were more likely than the jumping cases to be obtunded or comatose on admission, and to be sent to intensive care units (ICUs) or operating rooms from emergency departments (table 2). Overall, patients who received intensive care stayed in ICUs for an average of 3.7 days. The difference in length of stay in ICUs for those who received intensive care was not statistically significant among the three groups of patients, nor was the difference in length of stay in hospitals. Patients stayed in hospitals for an average of 10.6 days.

During hospitalization, 53% of the hanging cases developed complications, compared with 43% of the firearm cases, and 5% of the jumping cases (p < 0.01) (table 2). Most of the injuries and complications were neurologic or pulmonary. About one third (31%) of the patients were dead at discharge (table 2). The case fatality rate for the firearm cases was 50%, which was significantly higher than that for the hanging cases (32%) and for the jumping cases (5%). Head injury contributed to 25 (93%) of the 27 deaths.

Of the patients who were alive at discharge, 52% had at least one impairment in communication, cognition, or self care functions. About two thirds (65%) of the surviving jumping cases had functional impairment at discharge, compared with 46% of the firearm cases and 36% of the hanging cases (p = 0.21). The prevalence rates of cognition impairment were similar among the three groups, but the surviving hanging cases appeared to be more likely than the other two groups to have behavior impairment (p < 0.05) (fig 2). Due to the high rates of limb fractures, jumping cases were more likely than firearm cases and hanging cases to have self care function impairments at discharge (fig 2).

Table 2 Outcome of self inflicted trauma patients by method of suicide attempt, ages 5–14, NPTR, October 1988 to April 1996; values are number (%)*

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Method of suicide attempt</th>
<th>1–19</th>
<th>20–75</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISS</td>
<td>Firearm</td>
<td>17</td>
<td>20</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Pediratic trauma score</td>
<td>Hanging</td>
<td>1</td>
<td>1</td>
<td>&gt;0.01</td>
</tr>
<tr>
<td>Level of consciousness at admission</td>
<td>Jumping</td>
<td>1</td>
<td>1</td>
<td>&gt;0.01</td>
</tr>
</tbody>
</table>

*Totals may vary within groups due to missing values.

†Excluding eight patients who died at emergency departments.

Discussion
Suicide attempts emerge in children ages 5 to 14 years due in part to their rapidly increasing cognitive capacities, in particular the conceptualization of death.16 Shadowed by the high mortality rates in adolescents and young adults, suicide in the pediatric population has been studied mainly from a psychiatric perspective and has received scant attention from public health researchers. This study reveals that firearms, hanging, and jumping are three important components of self inflicted pediatric injuries treated in trauma centers. The results show that boys and older children are more likely to use firearms in committing suicide, whereas girls are more likely to choose jumping from heights. Hanging is the most common means for boys and younger children. These age and gender specific patterns may
explain, to a certain extent, the excess suicide mortality in males and in older children.

Although mental disorder has long been recognized as an important risk factor for adolescent and adult suicides, it is disturbing to note that more than one quarter of this pediatric study sample were reported as having pre-existing mental disorders and 20% of those for whom toxicological testing results were available were positive for alcohol or other illicit drugs. In a case-control study, Brent et al reported that depression, conduct disorder, and substance abuse are associated, respectively, with a 37-fold, sixfold, and threefold increase of suicide risk in adolescents.17 Yet, it is unclear whether admitting children with mental disorders to psychiatric hospitals is effective in preventing suicide. In fact, no research with a rigorous study design has evaluated the effects of psychiatric treatment on the risk of suicide.18 The public health implication of the finding with mental disorders is twofold. On the one hand, mental disorders as easily identifiable markers can be used to detect children at high risk for suicide. On the other hand, to modify this risk factor by providing psychiatric therapies is often difficult because many of these children are from disrupted families of low socioeconomic status.18

The detailed clinical data collected in the NPTR made it possible to document the outcomes of the study population using a variety of measurements. Although self inflicted injury constitutes less than 1% of all childhood injuries, its outcomes appear to be far worse than other injuries. The results of this study indicate that self inflicted injuries are more severe, as measured by different injury severity scales, deplete more medical resources per admission, and have much higher hospital case fatality rates than injuries resulting from unintentional events or assaults.11-14 The average length of stay for this study population was 11 days, about twice as long as was reported for other injuries treated in the same trauma centers.12,13 Almost one third of the patients in this study were dead at discharge and 52% of those who survived had at least one functional impairment. The case fatality rate of self inflicted injuries is eight times that for traffic related injuries and about three times that for unintentional and assaultive firearm related injuries treated in the same trauma centers.11,14

The high lethality of firearms is well documented.19,20 This study provides more evidence as to the excess fatality of firearms in childhood suicide attempts and suggests the potential benefit of reducing the accessibility of firearms to children. The results reveal that use of firearms is associated with significantly higher mortality than hanging or jumping from heights, given a self inflicted injury resulting in admission to a trauma center. However, the lethality of firearms is likely to be underestimated in this study because deaths from firearm related suicide are more likely to occur at the scene than suicides by other means. For instance, of the 256 deaths from suicide among children aged 10 to 14 years in the United States in 1990, 55% died from firearm related injuries, 36% by hanging, and fewer than 1% by jumping from heights.2 In contrast, fewer than one third of the self inflicted injuries treated in trauma centers were firearm related, and nearly one quarter resulted from jumping from heights. In addition to the excess lethality of firearms given a suicide attempt, several case-control studies have demonstrated consistently that the availability of guns in the home increases the risk of suicide by about 300%.17,21-22

This study was limited to children admitted to trauma centers because of self inflicted injuries. Most of these injuries were very serious, with an ISS of 20 or greater. The patients under study, however, represent only a small fraction of injuries resulting from suicide attempts. The majority of suicide attempts cause either minor injuries requiring emergency department visits only, or deaths at the scene. Neither are captured by the NPTR and they are likely to be different from the study population in many aspects, including the methods of attempts. Furthermore, the NPTR does not include cases of poisoning. Poisoning accounts for about 75% of suicide attempts and is the method used in about 4% of suicide deaths in children.23-24

As the NPTR was designed for evaluating clinical outcomes of pediatric trauma, information on some variables important to epidemiologic studies, such as race, area of residence, and socioeconomic status, is not available. This study was further limited by the fact that the NPTR is a database based on voluntary participation, rather than a population based surveillance system. Thus, risk factors for childhood suicide could not be assessed by this study.

Although a variety of suicide prevention programs has been developed and implemented, ranging from general suicide education to screening, and to crisis hotline, little is known whether or not these programs are effective in reducing suicide rates.7 Future research needs to examine the full spectrum of self inflicted
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injury in children based on population based data, including etiologic factors and long term outcomes. Of special importance are studies that evaluate the cost effectiveness of different suicide prevention programs, such as mental health promotion by improving the social adjustment of high risk children, and restriction of access of children to firearms through education and legislation.

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Editorial Board Member: brief biography

IAN ROBERTS

Ian Roberts is Director of the Child Health Monitoring Unit at the Institute of Child Health. He became interested in child injury prevention after becoming a parent, and as a result of his experiences while working as a paediatrician in an intensive care unit. From 1991 to 1994 he worked as a research fellow in the Injury Prevention Research Centre at the University of Auckland. He was co-principal investigator with Dr Robyn Norton on the Auckland Child Pedestrian Injury Study, a case-control study of risk factors for child pedestrian injury. In 1995 he spent a postdoctoral year at McGill University working with Professor Barry Pless at the Department of Community Paediatric Research. He is currently Co-ordinating Editor of the Cochrane Brain and Spinal Cord Injury Group. This Collaborative Review Group has been established in order to produce systematic, periodically updated reviews of the evidence for the effectiveness of interventions in the prevention, treatment, and rehabilitation of brain and spinal cord injury.