VIOLENT DEATHS IN SMALL CHILDREN IN NORTHERN SWEDEN

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Received 22 June 2005; Accepted 26 September 2005

ABSTRACT

Objectives. To identify causes and trends of violent deaths among children younger than 4 years in a northern region.

Study design. Retrospective analysis of medico-legal autopsy and police data.

Methods. Data from all 72 deaths from “external causes” 1977-2004, in children < 4 years from the northern half of Sweden were analysed.

Results. The death rate was 7.1 per 100,000 children and year during the first half of the study period, and 5.2 during the second half. Vehicle- and drowning-related deaths were halved. Fifteen were struck by motor vehicles (in 8 cases by heavy vehicles), 14 car occupants were killed in car crashes, 12 were killed by intentional violence inflicted by an adult, and 9 each were killed by (i) carbon monoxide/smoke inhalation, (ii) asphyxiation, or (iii) drowning. The boy:girl ratio was 1:1 in all groups, except in the groups “drowning” and “run over by motor vehicle”, where boys dominated.

Conclusions. Medical professionals have a difficult but important task in identifying and taking action against child abuse and in promoting child safety especially in the traffic and home environments.

(Int J Circumpolar Health 2006; 65(1):28-34.)

Keywords: abuse, accidents, fatal injuries, small children
INTRODUCTION

Injuries are the leading cause of death in children (1, 2). In the European Union (E.U.) 30 per cent (4,500 deaths/year) of all deaths in children of less than 15 years of age are due to injuries (3, 4). Sweden has the lowest rate of death from “external causes” in the E.U.; 5.2 per 100,000 children and per year (5). The annual number of Swedish child fatalities has decreased, from 400 deaths/year in the 1950s, to 65 in the 2000s (6). Many factors have contributed to this low death rate, e.g. use of child safety equipment, regulation, and intensive information campaigns (7). Children of 4 years or younger have been reported to have the highest death rate of all children, 50-100% higher than for other ages (5, 8). The injury panorama shows differences depending on factors such as urban/rural area, social characteristics etc. (9). For example, a Norwegian study indicated a three-fold higher death rate in the north than in southern Norway and Oslo (10). Drowning was a major factor behind this difference. Data on intentional violence to small children is only scarcely reported.

The aim of this study was to identify “external causes” and trends in unintentional and intentional deaths of children younger than 4 years, in order to shed light on areas of injury prevention still in need of improvement.

MATERIAL AND METHODS

A complete 28-year (1977-2004) forensic medicine data set from the northern half of Sweden was analysed. In all, 72 children under the age of 4 years, who died from external causes, were included. The area had an average of 896,500 inhabitants during the study period, with an average of 41,584 under the age of 4 years during the first half of the study period, and of 39,769 during the second half.

The Department of Forensic Medicine in Umeå performs all medico-legal autopsies from the northern half of Sweden. According to Swedish laws and regulations, all unnatural deaths are expected to be autopsied and the number of drop-outs in this category is expected to be negligible (11). Data on all autopsied children below the age of 4 years were re-evaluated and analysed. Those with an “external cause to injuries and poisoning”, equivalent to the E-codes E 800-E989 in the WHO’s ICD 9 classification, were included. Deaths due to “complications to medical treatment” (E 870-897) and foetuses were excluded.

RESULTS

Death rate, gender and age

The number of deaths decreased from 43 to 29 from the first to the second half of the study period (Figure 1), giving an annual death rate decrease from 7.1 to 5.2 per 100,000 children. The boy/girl ratio was 1.1:1 for those younger than one year, and 1.7:1 for the older children. In all groups of injury events (see below), the ratio between boys and girls was about 1:1, except in the “drowning” (8:1) and in “run over/knocked down by motor vehicle” (1.5:1) groups.

Type of injury event

Of the 72 children, 15 (21%) were struck by motor vehicles, and 14 (19%) were passengers in crashing cars. Heavy vehicles were involved.
in 13 of the 29 vehicle-associated incidents (lorries in 9 cases, farming tractors in 3 cases, and a bus in 1 case). Twelve (17%) children were killed by intentionally inflicted violence from adults. A decrease of more than 50% in vehicle-related deaths and drowning was observed from the first to the second half of the study period (Figure 1).

**Struck by motor vehicles**  
(n = 15; 1.3/100 000 children and year)  
Lorries (n = 5) and farming tractors (n = 3) were involved in 8 of these 15 cases, while passenger cars were involved in 7 cases. Five children ran out, and one rode a sledge out, in front of the vehicle. In 3 of these 6 cases, other children distracted the driver’s attention just prior to the incident. Six children were run over by reversing vehicles (3 lorries, 2 cars and 1 tractor). One child fell out of a tractor cabin due to a defective door lock and was crushed under the rear wheel. Another child was killed by a runaway farming tractor, started by two other small children. One child in a pram was crushed when a car skidded up onto the pavement. Fourteen sustained fatal head injuries and one a fatal cervical spine injury.

**Car crashes** (n = 14; 1.2/100 000)  
Ten were killed in multi-vehicle collisions; 5 with other cars, 4 with lorries, and 1 with a bus. Three died in single vehicle rollover crashes and one in a crash into a river. Two non-restrained children were ejected and crushed under the vehicles. In only 2 cases, the police records stated that the child had been sitting in a rear-facing child seat, or a pram. In all other cases, the police data gave no information about the use of any child restraint.  
All children, except one who drowned, died from fatal head injuries, combined with extensive internal injuries of the lungs, liver and spleen. Some of them also had fatal cervical spine injuries.

**Intentionally inflicted deaths**  
(n = 12; 1.0/100 000)  
These are the stories behind the 12 cases:  
- A newborn child was found dead floating in the sea. The child was born alive, but was drowned.  
- An infant died from traumatic bleeding in the skull and chest after having “slept with its mother”.

![Figure 1. Number of deaths from “external causes” in children under the age of 4 years, during the first (n = 43) and the second (n = 29) half of the study period, 1977-2004.](image-url)
- An infant died from suffocation, but also extensive burn injuries on the trunk and lower extremities.
- An infant, who had been repeatedly examined because of poor weight gain and injuries after “being dropped on the floor”, died due to head and neck injuries.
- An infant and a 2-year-old child were both shot in the head by their alcohol-inebriated father, who subsequently set fire to their home and committed suicide.
- A 1-year-old child, examined at several health care centres because of “delayed development and malnutrition”, died of multiple injuries to the head, trunk and extremities.
- A 1-year-old child died of blunt trauma to the head with intracranial haemorrhage. A close relative and her partner (the offender) were temporary baby-sitters. They were previously convicted for physically abusing animals.
- A 2-year-old boy was stabbed with a knife and then hanged by his depressed father, who then committed suicide.
- A 2-year-old boy was battered to death, probably by his mother. She had been under psychiatric care because of alcohol abuse, and relatives had repeatedly expressed their worries about the child’s security to both medical and social authorities. Despite this, no effective preventive actions were taken.
- A 2-year-old child and his father were found in a car, dead from carbon monoxide poisoning. The father left a suicide note.
- A 3-year-old child was suffocated with a cushion by his father, who subsequently committed suicide.

**Carbon monoxide poisoning**

(n = 9; 0.8/100 000)

Nine children died due to CO poisoning, in 7 cases from house fires, and in 2 cases (siblings) from a defect paraffin oil radiator used for the first time in a summer house. No child died of burn injuries.

**Asphyxiation** (n = 9; 0.8/100 000)

One newborn child was suffocated when “sleeping with the mother”. Another newborn child was suffocated when the mother suddenly died and fell so badly that the child’s chest was compressed. One infant, whose body slipped through a 15 cm opening in a 2-storey child bed, was hanged when the head was caught in the opening. One 1-year-old child was strangled by a safety harness in a pram. One 2-year-old child was hanged when a string from its jacket hood was caught in a playground slide. Two 3-year-old children were hanged when their bicycle helmets were caught in climbing frames. One 3-year-old was garrotted when his neck was jammed in a bus door. Another 3-year-old, playing alone, was suffocated by a plastic bag.

**Drowning** (n = 9; 0.8/100 000)

One infant in a parked car drowned when the car suddenly rolled into a lake. One 1-year-old drowned in a small child plastic pool. Two children, 1 and 2 years old, drowned in 20 cm water in a water- and cut oil barrel, respectively. Three 2-year-olds and two 3-year-olds drowned in streams or lakes, after having suddenly disappeared from their home or parents.

**Other incidents** (n = 4; 0.3/100 000)

One 5-month child, lying in a pram, sustained fatal head injuries when an ice spike fell from a roof. One 2-year old child was kicked by a horse and died of cardiac rupture. One 3-year-old sustained fatal head injuries after being
hit by falling timber during log loading and another 3-year-old sustained fatal head injuries when a concrete construction tipped over him.

DISCUSSION

The mortality rate decreased from the first to the second half of the study period to 5.2 deaths per 100 000 children and year. This is at the same level as the average for all children below 15 years of age in the whole of Sweden. Consequently, this study could not confirm an increased incidence in children younger than 4 years, neither could an increased rate be confirmed in the north (10, 12, 13). The death rate in the 0-14 years age group has also decreased in other countries (5, 10, 14-17). However, the Swedish death rate is, in many cases, several times lower (5, 12, 14, 18-20). In the traffic injury “death league”, the United Kingdom, Norway, Australia and Japan, like Sweden, have the lowest death rates (5, 21, 22). During the study period, we noted a halved traffic injury death rate for children under the age of four years.

It is remarkable that every sixth fatality in the present material was caused by intentional violence inflicted by an adult. This is of the same magnitude as reported from the U.S by Trokel et al. (23). Comparable and validated data is sparsely reported. In several cases, signs of suspected child abuse had been known by the health care sector and by the social authorities. However, no effective actions had been taken to reduce the abuse. In other cases, the abuse might have been difficult to foresee, as also reported, for example, by Vock et al. (24). Several authors (24-26) have reported that infants (<1 year) are at particular risk of being battered to death. Medical and social professionals have a heavy responsibility, not only to be aware of typical signs of child abuse (27-29) and of suicidal behaviour among parents, but also to take effective action against the problems, in order to give the children a better chance of survival.

A factor contributing to the reduction of the number of children struck by motor vehicles might be that modern residence areas are off-limits to motor vehicle traffic (30). Reversing vehicles were a risk factor which has also been described by others (31, 32). Warning sound and a monitor allowing a driver to see what is behind the vehicle, are examples of preventive actions introduced in commercial vehicles during the last decade. One-fifth of all victims were car occupants, of which two were ejected, and very few were reported to have used any child restraint at all (cf 33). The 1988 law on the compulsory use of child/infant restraints may have contributed to the decrease of these fatalities, despite increasing traffic. One problem, pointed out in other studies, is that child protection devices are often used incorrectly (34-37). An improved and standardised anchoring construction, or the integration of child seats in new cars, might reduce the risk of incorrect use (37, 38).

Deaths caused by inhalation of carbon monoxide, most often from fires, did not show any decreasing trend. Notably, no child died from burns. Fire-related deaths are reported to be associated with low age, low income areas and, sometimes with fire play (39). However, according to Istre et al. (39), smoke alarms offer no protection against fire play-associated injury, because of the child’s behaviour in these cases.

Asphyxia caused the death of every eighth child. That small children comprise a high risk group is also reported by other authors (40, 41).
Several children were hanged, either by chinstraps of helmets in climbing frames and furniture, or by a jacket strap. To prevent hanging in helmets for small children, the guidelines of the Swedish Department of Consumer Affairs point out the necessity of having a safety buckle, which automatically opens when loaded with 15 kg, or more. Furthermore, the standards for a safe distance between the bars of climbing frames and similar structures may need to be reconsidered, in order to prevent a child’s head, with or without a helmet, to be caught (42). Jacket straps for children may be avoided, as is the case in the UK.

Drowning, often in the vicinity of the home, is a well-known risk in these age groups, and, in the present study, predominately struck boys (16, 43-45). Compared to the high drowning incidence in northern Norway (10,13), with its long coastline, fjords and lakes, our rate is low, despite the largely similar geography. Our halved drowning rate between the first and second half of the study period indicated a positive trend. However, these data must be interpreted cautiously, because of the low number of cases. In a Danish study, one-third of all drowned small children drowned in private pools (16) and, in a report from the U.S., more than half had drowned in swimming pools (46). This risk is low in northern Sweden, where there are very few pools. Whether a lack of supervision (cf 47) played a role in the present drowning cases is not known, but it is probably difficult to always have full control of small and quick children. This emphasises the importance of eliminating, or reducing, physical hazards, such as water barrels and small plastic garden pools, in the vicinity of areas frequented by children.

Conclusions
In the E.U., the fatality rate for children might be halved by practising the accomplishments of the most successful countries in different injury categories (48). In Sweden, intervention against child injuries has decreased the death rate to the lowest in the E.U., and many of the interventions behind this result are, today, unquestionable. However, the injury preventive work needs to continue, especially for the youngest children, with focus on serious incidents and child abuse.

REFERENCES
1. Swedish Official Statistics. Causes of death. The National Board of Health and Welfare, Stockholm 1996.
2. Parkkari J, Kannus P, Niemi S, et al. Childhood deaths and injuries in Finland 1971-1995. Int J Epidemiol 2000;29:516-23.
3. Berfenstam R. Declining injury numbers show that prevention programs pay off. The Journal of the Swedish Medical Association1989;86:240-2.
4. Morrison A, Stone DH. Unintentional childhood injury mortality in Europe 1984-93; a report from the EURORISC Working Group. Inj Prev 1999;3:171-6.
5. United Nations Children’s Fund Innocenti Research Centre Florence Italy, Unicef. A league table of child deaths by injury in rich nations. Innocenti report card Issue No.2 February 2001.
6. The National Board of Health and Welfare, Sweden. www.sos.se/epc/stat/dod.html.
7. Berfenstam R. Prevention of childhood accidents in Sweden: With special attention to the work of the joint committee for prevention of accidents. Acta Paediatr Scand 1979;275:88-95.
8. Ellsäßer G, Berfenstam R. International Comparisons of child injuries and prevention programs: recommendations for an improved prevention program in Germany. Inj Prev 2000;6:41-5.
9. Scholer SJ, Mitchel EF, Ray WA. Predictors of injury mortality in early childhood. Pediatrics 1997;100:342-7.
10. Samuelsen SO, Borge AI, Magnus P, Bakkesteig LS. Temporal and regional trends in fatal childhood injuries in Norway 1971-1989. Scand J Soc Med 1993;21:17-23.
11. Öström M, Ahlm K, Eriksson A. Inadequate management of unnatural deaths. The Journal of the Swedish Medical Association 2001;98:955-9.
12. Hwang HC, Stallones L, Keefe TJ. Childhood injury deaths: rural and urban differences, Colorado 1980-8. Inj Prev 1997;3:35-7.
27. Nimityongskul P, Anderson LD. The likelihood of injury in rural Norway: high rate of mortality and prehospital death. Acta Anaesthesiol Scand 2003;47:153-6.

26. Waller AE, Baker SP. Child hood injury. State-by-state mortality facts. The John Hopkins Injury Prevention Center. Baltimore, MD. 1989.

25. DiGuiseppi C, Roberts I, Li L. Influence of changing travel patterns on child death rates from injury: trend analysis. BMJ 1997;314:710-3.

24. Vock R, Trauth W, Althoff H, et al. Fatal child abuse and neglect, United States, 1979 through 1988. Pediatrics 1993;91:338-42.

23. Trokel M, DiScala C, Terrin NC, Sege RD. Blunt abdominal injury in the young pediatric patient: Child abuse and patient outcomes. Child Maltreat 2004;9:111-7.

22. Scott I, Moller J, Bordeaux S. Injury mortality among children and teenagers in New Zealand compared with the United States of America. Inj Prev 1997;3:195-6.

21. DiGuiseppi C, Roberts I. Injury mortality among children and teenagers in England and Wales, 1992. Inj Prev 1997;3:47-8.

20. Langley JD, Smeijers J. Injury mortality among children and teenagers in New Zealand compared with the United States of America. Inj Prev 1997;3:195-6.

19. National Center for Health Statistics. Vital Statistics of the United States, 1980. US Government Printing Office. Hyattsville, MD, 1984:29.

18. Rodriguez JG. Childhood injuries in the United States. Am J Dis Child 1990;144:625-6.

17. O’Neal Roach J. Injuries kill over 20 000 children a year in developed countries. BMJ 2001;322:317.

16. Steensberg J. Epidemiology of accidental drowning in Denmark 1989-1993. Accid Anal Prev 1998;30:755-62.

15. DiGuiseppi C, Roberts I, Li L. Influence of changing travel patterns on child death rates from injury: trend analysis. BMJ 1997;314:710-3.

14. Baker SP, Waller AE. Childhood injury. State-by-state mortality facts. The John Hopkins Injury Prevention Center. Baltimore, MD. 1989.

13. Wisborg T, Høylo T, Siem G. Death after injury in rural Norway: high rate of mortality and prehospital death. Acta Anaesthesiol Scand 2003;47:153-6.

12. Brenner RA. Prevention of drowning in infants, children and adolescents. Pediatrics 2003;112:437-9.

11. Nimityongskul P, Anderson LD. The likelihood of injuries when children fall out of bed. J Pediatr Orthop 1987;7:184-6.

10. Root I. Head injuries from short distance falls. Am J Forensic Med Pathol 1992;13:85-7.

9. Zimmerman RA, Bilaniuk LT. Pediatric head trauma. Neuroimaging Clin N Am 1994;4:338-43.

8. Winn DG, Agran PF, Castillo DN. Pedestrian injuries to children younger than 5 years of age. Pediatrics 1991;88:776-82.

7. Roberts I, Kolbe A, White J. Non-traffic child pedestrian injuries. J Paediatr Child Health 1993;29:233-4.

6. Brison R, Wicklund K, Mueller BA. Fatal pedestrian injuries to young children: a different pattern of injury. Am J Publ Health 1988;78:793-5.

5. Johnston C, Rivara FP, Soderberg P. Children in car crashes: analysis of data for injury and use of restraint. Pediatrics 1994;93:960-5.

4. Tingvall C. Children in cars. Some aspects of the safety of children as car passengers in road traffic accidents. Acta Paediatric Scand Suppl 339,1987:339-1-35.

3. Weber K. Automobile restraint systems for children. In: Coran AG, Burton HH. Pediatric trauma. Proceedings of the third national conference. Chapter 16. Lippincott Co, Philadelphia, 1990:175-93.

2. Graham J, Kittredge D, Stuemky JH. Injuries associated with child safety seat misuse. Pediatr Emerg Care 1992;8:351-3.

1. Murphy JM. Child passenger safety. J Pediatr Health Care 1998;12:130-8.