

Unintentional injuries in infants in Singapore

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ABSTRACT

Introduction: To describe the risk factors, causes and outcome of infant injuries so as to guide the formulation of injury prevention strategies specific for Singapore babies less than one year old.

Methods: Demographical, socio-economic data, and data on the circumstances of injury, nature, severity of injury and clinical outcome of all infants less than one year old and who sought medical attention for or died from unintentional childhood injuries or poisoning, at the Emergency Departments of three SingHealth hospitals, two SingHealth primary care polyclinics and the Forensic Medicine Department, Health Sciences Authority during a six-month period, were extracted from a larger Childhood Injuries Surveillance database and analysed.

Results: 405 cases of accidental injury and poisoning in infants aged less than one year were seen from February to July 2002. 40.5 percent of injuries occurred when infants were left alone. Most infants were aged between nine months to one year (37 percent), male (57.3 percent), first-born (57.3 percent) and Chinese (69 percent), with no past medical history (96.1 percent). 91 percent of the injuries occurred at home, of which 60.5 percent occurred in the bedroom. Falls were the major mechanism of injury (77 percent). A total of 431 injuries were sustained. 63 percent were head injuries - mainly stable head injuries, which made up 93.1 percent of all the head injuries. 67.5 percent of the cases were discharged without follow-up, while 17.9 percent required hospital admission, mostly to the general ward (98.6 percent of total admissions), and to the neurosurgery department (84.9 percent of total admissions). There were two fatalities in this study population. The mechanisms and patterns of

injury changed with increasing motor ability of the infants.

Conclusion: Parents and caregivers of infants should be taught and reminded about the age specific measures in injury prevention as their wards go through the various developmental stages in the first year of life. Emphasis should be placed on close caregiver supervision, identifying potential injury hazards in the home, fall prevention, adopting safe infant care practices and the safe use of infant care products.

Keywords: accidental falls, accident prevention, head injuries, home accidents, infant.

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INTRODUCTION

Unintentional childhood injuries are currently the third to fourth leading cause of death in children aged 0-14 years in Singapore, and an appreciable cause of morbidity. In the 1990s, accidental injuries accounted for 10%-17% of all yearly deaths in Singapore children aged 1-14 years⁽¹⁾. This is comparable to the statistics in other countries⁽²⁻²¹⁾. Parental knowledge, attitudes and practices with regard to child safety practices are important in the prevention of childhood injury^(22,23). This is especially pertinent in infants under the age of one year, who are pre-mobile and hence entirely caregiver-dependent. However, relatively few studies have looked exclusively at the causes and prevention of unintentional injuries in infants under the age of one year⁽²⁴⁾. The objective of this study was thus to describe the risk factors, causes and clinical outcome of infant injuries in order to plan specific injury control strategies in local infants.

METHODS

Information on injuries in infants aged one year or younger was extracted from the database of the Childhood Injury/Poisoning Reporting and

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Prevention Programme. This is a two-year long surveillance study involving all children (0-16 years old), who sought medical attention for, or die from, unintentional childhood injuries or poisoning, at the Emergency Departments of a children's hospital, two general hospitals and two primary care polyclinics in the Singapore Health Services (SingHealth) cluster, and the Forensic Medicine Department, Health Sciences Authority. The entire project was supported by a grant from the National Medical Research Council. Approval for the study was obtained from the KK Women's and Children's Hospital Research Ethics Committee.

The data collection form for the programme consisted of two sections. The first section, filled out by the caregivers, documents patient demographical and socio-economic data, as well as details of the circumstances of the injury. The second section, completed by the attending physician, includes details of the patient's past medical history, clinical diagnosis and management. Data was also collected from the review of the in-patient records and coroner's reports.

Data was entered into a custom-designed computer database. International Classification of Diseases version 9 (ICD-9) codes and External Cause of Injury (E- codes) were used for all injuries sustained. The International Classification of External Cause of Injury (ICECI) version 1⁽²⁵⁾ was used to code for the details regarding the circumstances of injury. Injury severity measures used include the Paediatric Trauma Score, Abbreviated Injury Score and Injury Severity Score. For the purpose of this descriptive analysis of unintentional infant injuries, the patients aged one year old or younger, with unintentional injury episodes occurring during the six-month period spanning February to July 2002, were identified.

RESULTS

Infant injuries comprised 7.7% of total attendances at participating institutions during the study period (405/5,233 cases). 405 cases of unintentional injury and poisoning in infants aged zero to one year were seen in the participating institutions from February to July 2002. The majority of infants were aged between nine months and one year (Fig. 1). 57.3% of cases were first-born children. The male to female ratio was 1:34. The racial distribution of the study cohort was similar to that of the general population, with Chinese infants making up 69%, Malays 16%, Indians 9% and other races 5% of the cohort (missing data 1%).

Most patients were previously well with no past medical history (96.1%). 28 infants (6.9%) had sought medical attention for a previous unintentional injury

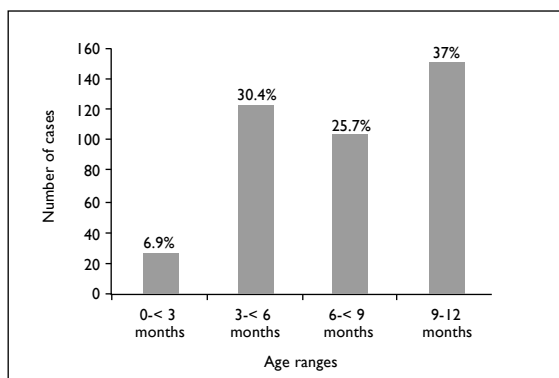


Fig. 1 Age ranges of the study population.

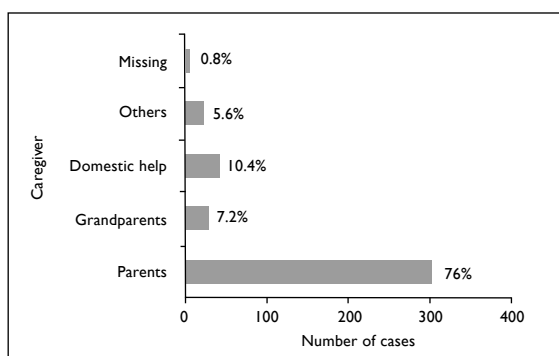


Fig. 2 Caregiver at the time of injury.

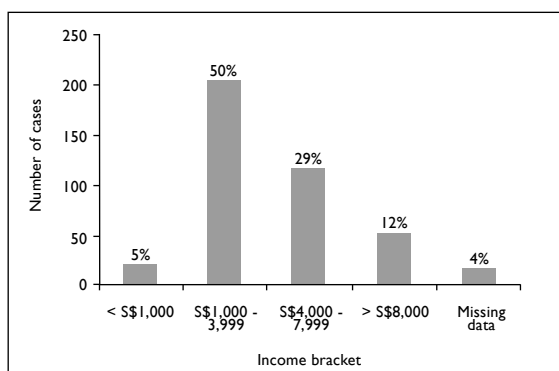


Fig. 3 Income bracket.

or poisoning within the past year. Mothers were the main caregivers in 47.9% of the cases. Mothers were also the caregivers responsible for the infants during at the time of injury in 56% of the cases (Fig. 2). 40.5% of injuries occurred when infants were left alone. 54.8% of the injuries were not witnessed by the caregivers.

The majority of parents in the study cohort were married (97.5%). Only 2.5% of the patients had single parents. Most parents had completed tertiary education (47.2% of fathers and 45.9% of mothers), and the majority (55%) had an approximate total monthly household income of S\$1,000 - 3,999 (Fig. 3).

Table I. Location in home where injury occurred.

Room	Frequency	Percentage
Bedroom	245	60.49%
Living room	75	18.52%
Kitchen	18	4.44%
Bathroom	7	1.73%
Stairs	7	1.73%
Others, specified	4	0.99%
Void deck/corridor	3	0.74%
Garage/driveway	2	0.49%
Balcony	1	0.25%
Missing	7	1.73%
Total	369	91.11%

Table II. Objects involved in injury.

Object involved in injury	Number of cases
Furnishing (bed/chair)	202 (49.9%)
Infant/child products	79 (19.5%)
Person/plant/animal	50 (12.3%)
Building component/fitting	23 (5.7%)
Food/drink	12 (3.0%)
Personal use item	8 (2.0%)
Tools/machines	5 (1.2%)
Ground surface/conformation	4 (1.0%)
Household appliances	2 (0.5%)
Land vehicle/transport	2 (0.5%)
Drugs	2 (0.5%)
Chemical substances	2 (0.5%)
Utensil/container	1 (0.2%)
Missing	13 (3.2%)
Total	405 (100%)

91% of the injuries occurred in the home. 60.5% of these occurred in the bedroom. Other danger spots within the home were the living room, kitchen and bathroom (Table I). Injuries also occurred in public areas (5.9%), on roads (2%), in playgrounds (0.5%)

Table III. Mechanism of injury by age group.

Age range	Falls	Poisoning	Burns	FBs*	RTAs**	Others	Unknown
0-<3 months	21	1	0	0	1	3	2
3-<6 months	99	0	3	1	0	17	3
6-<9 months	84	1	5	4	0	7	2
9 months-1 year	107	2	7	4	2	23	5

* FBs: foreign bodies

** RTAs: road traffic accidents

and schools (0.25%) (missing data 0.25%). With increasing age, injuries were found to occur more frequently in public areas and within the home itself, in the living room, kitchen and on stairs.

The majority of injuries were related to furnishing, with 40% of cases involving beds or bedding. Most of these injuries involved falls from furniture. Infant and child products, such as cots, sarong cradles, infant walkers, highchairs, baby prams and playpens, accounted for 19.5% of cases (Table II). Notably, with increasing age, infant and child products were more frequently cited as causes of injury, the three most common items being cots, sarong cradles and infant walkers. Unintentional self-inflicted injuries also increased with age.

Falls accounted for 77% (312 cases) of injuries in this study population (Table III), with 6.4% involving falls on level ground and 70.6% involving falls from a height (Table IV). Most cases involved falls from a height of less than two metres (98.8%), but there was one case involving a 12-storey fall from a block of flats. Only 12 cases cited the presence of safety features, such as non-slip mats, safety barriers, cot rails and seat belts (3.9%). There were three cases involving road traffic accidents in this study, all involving vehicle collisions. One infant was seated in a rear-facing infant capsule in a private car, while a second infant was seated on an adult's lap in a taxi and was flung forward hitting the backrest of the driver's seat during the collision. The third infant was seated in a pram and fell out when a reversing car accidentally hit the pram.

Four cases in our study population involved poisoning by ingestion of medicinal or non-medicinal substances. Substances ingested included paracetamol, lactulose, wintergreen oil and eucalyptus oil. Three required admission to hospital, while one infant was discharged from the emergency department. There were nine cases involving foreign bodies in this study population. Mechanisms of injury included ingestion, choking and nasal obstruction. Items ingested included metal pieces and screws, coins, hair clips and cigarettes. Objects causing choking following ingestion included a piece of

Table IV. Falls and objects involved in falls.

Age range	Falls from height							Falls on level ground
	Bed/cot	Sarong cradle	Walker	Stroller	Sofa	Highchair	Others	
0-<3 months	4	5	1	2	2	0	5	2
3-<6 months	76	3	1	6	4	1	7	1
6-<9 months	50	4	3	2	0	8	11	6
9 months-1 year	46	6	6	6	2	4	20	17

Table V. Body part involved in injury.

Type of injury	Number of cases
Head	274 (63.6%)
Face/neck	94 (21.8%)
Upper limb	34 (7.4%)
Lower limb	6 (1.5%)
Thorax	2 (0.5%)
Abdomen	1 (0.2%)

biscuit and a coin, while a cotton bud was the source of nasal blockage in one case.

There were 15 cases of burns in this study population, with seven first-degree burns, five second-degree burns, and three involving the face, hands or genitalia. Ten cases involved scalds by hot liquids such as bathwater, soup, milk or porridge, two burns by hot oil, and two dry burns from a rice cooker and joss stick, respectively.

The predominant mechanism of injury in our study population also varied according to age (Table III). While falls from a height remained the primary cause of injury for all age groups, an increase in the number of falls on level ground, walker-related injuries and injuries caused by burns and foreign bodies, was seen with increasing age during the first year of life. Falls from beds/cots were the most common. An increasing number of falls from infant walkers was noted with increasing age (Table IV).

Among the non-fatal cases, the total number of injuries sustained was 431. Injuries to the head and face were the most common, with 274 cases of head injury (63.6%) and 94 cases of facial injury (21.8%) (Table V). Of the 274 cases of head injury, there were 255 stable head injuries with no loss of consciousness (93.1% of all head injuries) and 19 cases of serious head injury, including 15 closed skull fractures, two small extradural haematomas, one small subdural haematoma, and one case who suffered fatal mass destruction of the skull and brain due to a 12-storey fall. Most injuries were minor, with 346 cases (85.4%) receiving an ISS score of one.

The majority (67.5%) was discharged without follow-up, while 10.6% were discharged with follow-up clinic appointments and 2.5% against medical advice. 17.9% required hospital admission, and of those admitted to the general ward (98.6% of all admissions), the majority (62 cases, or 84.9%) were admitted to neurosurgery. There were two deaths in this study population. The first child, aged one year old, was found dead at the foot of a block of flats after a purported 12-storey fall. She sustained multiple severe injuries, including massive destruction of skull and brain, lacerations of the vena cava, lung, liver, kidney and upper limb musculature, and open fractures of both radius and ulna. The second child, an eight-month-old, aspirated a metal screw while playing with his brother. At post-mortem, a 2.5 X 0.2 cm metal screw, with a base 0.7 cm in diameter, was found impacted in the right lower lobe bronchus.

DISCUSSION

This short descriptive survey illustrates that unintentional injuries in infants can cause significant morbidity and mortality. Several studies have attempted to define other predisposing factors for childhood injury, and the influence of single-parent families or step-families⁽²⁶⁾, maternal age, education and parity⁽²⁷⁾, low socio-economic status^(28,29), male gender⁽³⁰⁾, very low birth weight⁽³¹⁾ and the presence of an older sibling or higher birth order⁽³²⁾ on childhood injuries have been well described in the literature. Various studies have also investigated the causal relationships between injury and child and infant product, such as infant walkers⁽³³⁻³⁷⁾, strollers⁽³⁸⁾, high-chairs^(39,40), sarong cradles⁽⁴¹⁾, and the improper use of car seats and baby carriers^(42,43). Most infants in our study were first-borns, and parental inexperience may contribute to the accidents. Predominance of males (57.3%) and lower-income families (49.9%) was in keeping with current literature^(20,28,29). In the local context, the injury prevention message should therefore be targeted at first-time pregnant mothers either as part of their antenatal visits in primary healthcare or the hospital, or in the antenatal or postnatal wards.

The bedroom (60.5%) at home (91.1%) was found to be the most common place of injury, as with other studies^(1,19). This is not unexpected, given the youth of our cohort, which would mean that they spend more time at home and asleep. Nursing infants in adult beds rather than in baby cots is common in Singapore⁽¹⁹⁾, resulting in a significant percentage of bed-related injuries (40%), typically roll-over falls. Sarong cradles (4.4%) - devices unique to Southeast Asia - and infant walkers (4.2%) continue to be widely used in the local population despite definite association with injury^(33,35,41), and legislation on the sale of such devices, in addition to public education, may be necessary to ensure infant safety⁽⁴⁴⁾. Infant walker-related injuries are not limited to trauma; other mechanisms include accidental poisonings, as the added height of an infant walker places potential poisons within reach of this vulnerable population⁽³⁶⁾. 11 cases (2.7%) involved infant highchairs and five (1.2%) involved baby prams, with injuries typically resulting from falls from the chair or pram. Again, this has been documented in other studies, and restraint use may prevent most of these injuries^(38,39,40). Caregivers should be counselled on the potential injury hazards in the home, and the safe practices in the use of baby care products and equipment.

Head injuries accounted for the majority of cases (63.2%) in our study population, followed by facial/neck injuries (19.8%). This is not unexpected, given that the head and face comprise a large part of the body surface area in infants. In a paper published in 2003 utilising data from the ALSPAC study, Warrington and Wright noted that the majority (97%) of injuries sustained in pre-mobile infants involved the head, mostly secondary to falls⁽²⁴⁾. Most head injuries in this study were relatively minor and did not result in loss of consciousness, but the occurrence of severe injuries, such as subdural/extradural haematomas, is worrying due to possible adverse effects on future development. The potential seriousness of head injuries in infants should therefore be communicated to the caregivers during injury prevention counselling.

Falls were the most common mechanism of injury in our study population (77%), which is pertinent since infants are much more likely to die from a fall than older children⁽⁴⁾. The majority (257 cases, or 63.5%) fell from a height of 0.5 metres. The height of a free fall necessary to cause injury to infants is controversial. Williams, in a study evaluating the circumstances surrounding falls in 106 cases seen at the Children's Hospital in Oakland, California, concluded that falls of less than ten feet (approximately three metres) are unlikely to produce life-threatening injury⁽⁵⁾. Wang et

al stated that children suffering from low-level falls (less than 15 feet) were at similar risk for intracranial and abdominal injuries compared with those who fell from greater heights⁽⁹⁾. Since falls constitute a significant proportion of injuries to infants and even low-level falls may cause serious injury, fall prevention should therefore be an injury prevention counselling priority in caregivers of infants.

The majority of cases involving falls cited a lack of safety features (300 out of 312, or 96.1% of all falls), including the case involving a fatal 12-storey fall - an eminently preventable tragedy. Child restraints were in use in only one of the cases involving road traffic accidents; this low rate of restraint use is consistent with other studies^(19,22). A review by Dowswell et al that was published in 1996 delivered a comprehensive report on the world literature to provide information about the most effective forms of health promotion interventions to reduce unintentional childhood injuries. He noted that provision of child restraint loan schemes and smoke detectors were among the interventions effective in reducing injury⁽⁴⁶⁾. Provision of home safety devices, such as window grilles or non-slip bathroom mats, to low-income families, or increased publicity regarding their use, may help to reduce injury⁽⁴⁶⁾. Current local legislation regarding the compulsory use of appropriate car seats for infants and children up to the age of eight years could also be more widely publicised.

The variation in mechanism of injury with increasing age is not surprising. Infants attain greater mobility with age, and the process of learning to walk is likely to result in more frequent falls on level ground as well as from aids such as walkers. Toddlers also gain the ability to grasp objects previously out of reach, and the tendency to mouth objects, which becomes apparent from the age of three to five months, would also result in more injuries involving swallowed foreign bodies and burns sustained when infants pull hot objects onto themselves. Similar findings have been well-documented in a previous study by Agran et al, which analysed injury rates for children younger than four years of age by quarter-year intervals to determine more specifically the age period of highest risk for injury and for specific causes⁽⁴⁷⁾. Infants go through various motor developmental stages very rapidly during the first year of life, from being relatively immobile during the neonatal period to being able to walk at the age of 10-12 months. Caregivers must be taught awareness of the potential injury hazards in the infant's environment as he goes through the various stages of motor development. This may be communicated through age-appropriate

safety checklists to be incorporated in the child's health booklet during the routine primary healthcare encounters for immunisations and developmental assessments⁽⁴⁸⁾.

As paediatric cases of unintentional injury presenting to healthcare facilities in the western half of Singapore were not included, the study findings may only be representative of the population in the eastern half of the country, and as such may be limited by possible differences in physical environment and socio-economic status between the two areas. Further studies should include participating institutions throughout Singapore. Those who seek care from general practitioners for injuries sustained, as well as those who may not seek medical attention due to financial or cultural reasons, may differ from our study population who presented mainly to tertiary hospitals, and a population-based door-to-door nationwide survey may better delineate this subgroup.

In conclusion, injuries in infants aged less than one year constitute a significant proportion of trauma-related morbidity and mortality in the paediatric age group. Many of these accidents happen in the home and in the presence of a caregiver, although the actual event resulting in injury is often unwitnessed. Falls from beds resulting in head injuries are the commonest presentation. Although most infants do not require hospital admission, the proportion of serious injuries and even death sustained was not insignificant. Educational campaigns on child safety issues should be aimed at primary caregivers, on whom infants are completely dependent, and should emphasise the rapid motor development achieved in the first year of life with need for close supervision by caregivers, fall prevention, the hazards inherent in use of various infant care products and the need for proper use of child safety equipment such as infant car seats. Legislation disallowing the use of infant care products notable for causing infant injury, such as sarong cradles and infant walkers, may also aid in preventing such injuries.

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