

METHOD

Case Identification

Cases were identified and verified by searching electronic data and reports collected and stored by the Coronial Services Centre (CSC) and the Monash University Accident Research Centre (MUARC).

Multiple data sources were utilised to overcome the possibility of missing cases. These case identification methods are outlined below.

- 1) Keyword search conducted on the TOPIC¹ database, which contains electronically stored police report summaries and Coroner's findings.
- 2) Search of the Victorian Coronial Facilitation System (VCFS) provided by MUARC, verified using the publications titled *Unnatural Deaths: Collated from the findings of the State Coroner*.
- 3) Search of the National Coroners Information System (NCIS) for all deaths where the primary mechanism of death was coded as "blunt force" and the secondary mechanism of death was coded as "falling, stumbling, jumping" for deaths of children aged 0-14 years from July 2000 onwards.

These searches involved:

Topic

Electronic versions of police report summaries (known as "Form 83 circumstances text") and Coroner's findings were searched using keywords such as "fall"; "fell"; and "slip". These documents are stored on a database called "TOPIC", which allows for multiple term searching. TOPIC contains data from 1989 onwards. The reports are not available for all cases, particularly deaths that occurred in rural jurisdictions between 1989 and 1999.

Victorian Coronial Facilitation System

The Monash University Accident Research Centre (MUARC) provided the SCO with a copy of the VCFS. The VCFS is a database containing information on all closed cases (cases where the Coroner had made a finding) between July 1989 and June 1995. This database was collated and coded by the Caseflow Analysis Section of the Courts and Tribunals Division of the Department of Justice (Stathakis and Scott, 1999).

This information was also printed as five reports titled *Unnatural Deaths: Collated from the findings of the State Coroner*. These reports contained tables of data listing text descriptions and other codes by manner of death. Each death in the drowning section was reviewed in order to identify relevant cases.

MUARC also conducted a study using the above mentioned data set on child fall injuries (fatal and non-fatal) (see Previous Research, Australian). This study identified 58 fatal child falls classified by cause of death. These cases were identified using the

¹ TOPIC is maintained by the Victorian Institute of Forensic Medicine (VIFM) for use by Coronial Services Centre staff.

"event leading to injury codes" for falls in the VCFS and a text search of death narratives (one line description of incident) for the terms "fall", "fell", "trip", "slip" and "stumble".

For the purposes of the current study a number of these cases were excluded. Twenty-five of the deaths in the MUARC study resulted from drowning. It was felt that there is some uncertainty as to the "intent" of the child when entering water. That is, although it is often recorded that the child wandered and "fell" into the body of water, it could also be argued that these young children entered the water "intentionally", however are too young to understand the concept of water as a danger. Thirteen of the deaths occurred when the child fell from a vehicle (n=7 tractor/trailers, n=6 motor vehicles/cycles) and were subsequently run over. In all 12 cases the cause of death resulted directly from the injuries sustained when the child was run over, not from the fall itself. These cases were therefore excluded. Five other cases were excluded on the basis that: the child was in fact older than 14 years of age at the time of the incident (n=2), the incident occurred in NSW (n=1); the death resulted from homicide (n=1) and the child jumped to their death as opposed to falling (n=1). The remaining 15 cases were included in the study.

National Coroner's Information System

Deaths of children aged 0-14 years resulting from a fall that occurred between July 2000 and December 2003 in Victoria were extracted from the NCIS. The NCIS is a national database that stores all deaths reported to the Coroner in Australia. Victorian cases were identified for the purposes of verification.

Data Collection

In all cases the Coroner had completed the investigation and made a finding. This meant that all the information collected by the police during the death investigation was available in the file. Each file generally contained the following information:

- initial police report of death to the Coroner (Victoria Police Form 83);
- post-mortem examination reports:
 - autopsy report; and
 - toxicology report.
- inquest brief:
 - investigating police officer's summary of events;
 - witness statements; and
 - photographs.
- Coroner's finding.

A list of data items for collection from each case was compiled from previous research, and from a review of the cases. These data items were entered into a Microsoft Excel Spreadsheet and are listed in Table 3.

TABLE 3
List of Data Items

Case Number	Autopsy Conducted
Deceased's name	Body Region of Injury
Case Status (open / closed)	Nature of Injury
Inquest held	Death from Injury Sustained from Fall
Inquest Number	If no, Mechanism of Death
Age	Activity (NCIS Codes)
Age Units	Location (NCIS Codes)
Gender	Pre-Existing Illnesses
Suburb of Incident	Alcohol/ drug remains in blood
Rural / Urban	Distance Fallen
Presence of Carer	Distance Code (short, major)
Presence of other children	Landing Surface
Supervision / Carer Activity	Did Deceased Experience a "Lucid Interval"?
Was fall Witnessed? If yes, by whom?	Time Period of Lucid Interval
Child's Behaviour / Temperament	Object Involved in the Fall (NCIS Object / Substance Codes)
Day	Object Description
Date	Reason for Fall
Time	If Fall from Person, Age of Person
Location of Incident	Summary of Circumstances
If Home, Own Residence	Coroners Recommendations/Comments
Cause of Death	Involvement of consumer product
Injuries	Resuscitation attempts, by whom?

A second review of the cases was undertaken for the purposes of data entry. Some data items could not be completed for all cases, either because the information was not contained in the coronial file or the data item was not relevant to the particular case.

Data Analysis

Each case was allocated to one of four age categories (<1 year, 1-4 years, 5-9 years and 10-14 years) and according to whether the fall resulted in injuries that directly caused the death (coded as "direct") or whether the fall precipitated another event that caused the death (coded as "indirect").

The Auto Filter function on Microsoft Excel™ was utilised to calculate the frequencies and percentages of the following data items:

- number of deaths per year (1989 – 2002);
- age group and gender;
- reason for fall;
- time of day (3 hour blocks);
- day of week;
- time of year (seasonal);
- location (coded according to NCIS Location Codes)²;
- location by age group;
- activity (coded according to NCIS Activity Codes)³;
- activity by age group;

² NCIS Location codes are based on ICD-10-AM Place of Occurrence Codes.

³ NCIS Activity codes adapted from: *AIHW National Injury Surveillance Unit 1998 National Data Standards for Injury Surveillance. Version 2.1.*

- object from which fall occurred (NCIS Object Codes)⁴;
- fall height by age group (direct group only);
- landing surface by age group (direct group only);
- carer supervision.

Themes and patterns were identified by conducting a content analysis on witness statements.

Limitations

Data Source

The data source utilised in the current study consisted of information submitted to the Victorian State Coroner's Office (SCO) for the purposes of death investigation. As the electronic system of data storage and retrieval is based on case management needs, it has limitations for research purposes.

In some cases the height of the fall was not specified in exact measurements. In these cases fall height was approximated. In addition the fall was often not witnessed or witnessed only by the carer, therefore the circumstances leading to fall should be interpreted with this in mind.

In some cases there was conflict between medical evidence, both from the hospital and the forensic pathologist, regarding whether the injuries sustained were unintentional or inflicted by another person. This was particularly an issue in the cases where the deceased was less than one year of age and an objective witness did not observe the fall. Case inclusion was therefore based on the conclusion reached by the Coroner. That is, the case was included if the Coroner determined that the death was unintentional despite contradictory evidence.

Electronic Case Coding and Identification

There are a number of limitations in relation to case identification using the electronic coronial databases. Deaths that occur in rural Victoria are often investigated by local police members and completed by the local Magistrate/s, who act as Coroners. Once the case is completed (the Coroner has made a finding) the documents are sent to Melbourne and stored at the Coronial Services Centre (CSC). The electronic textual information (police summary of circumstances and Coroner's findings) for cases completed in rural Victoria prior to 2000 are not all stored on the SCO LCMS. As a result a keyword search using TOPIC is unable to return potentially relevant cases.

There are also limitations in relation to the accuracy of textual information contained in the Victoria Police Form 83 circumstances text. The Form 83 is required to be submitted to the Coroner within 24 hours of the death occurring in order to inform the forensic procedures and further investigation. Often information is scarce in the first 24 hours of the death and it is not until the investigation is almost complete that the events leading to the death are documented with any accuracy. This process can take days or even months. From a research perspective this information should be interpreted only as a guide.

⁴ NCIS Object or Substance codes are adapted from: *WHO Working Group for Injury Surveillance Methodology Development 1999. International Classification of External Causes of Injuries (June 1999 draft). Amsterdam: Consumer Safety Institute.*

Coding of the deaths on the SCO LCMS is also not designed with research in mind. Each death is classified using one of 45 incident type codes, for example a drowning death would be coded as "DRW". There is no specific code for falls and therefore the death would most likely be given a generic coded such as "reportable" or "REP". "Reportable" is the code applied when the circumstances of the death are unknown or there is no other code applicable. As a result there are a large number of cases with the code REP, for example in 2001 2,120 of the 4,003 deaths reported to the coroner (53%) were coded as reportable. It was not feasible to examine every one of these deaths for the 14-year study period in order to identify the deaths resulting from a fall. Furthermore, the codes are allocated to deaths when they are first reported to the SCO, and are not updated as more details are known about the case.

RESULTS

Between 1989 and 2002 there were 26 deaths of children aged between 0 and 14 years where the Coroner determined that the death resulted from a fall. In 77% (n=20) of these cases, the death occurred as a direct result of the injuries sustained in the fall. In the remaining cases, a fall precipitated the events leading to injury that resulted in death. Where relevant a distinction was made between the deaths resulting directly and indirectly from a fall.

Trend Over Time

During the 14-year study period there were 26 deaths, an average of approximately two deaths per year (See Figure 1).

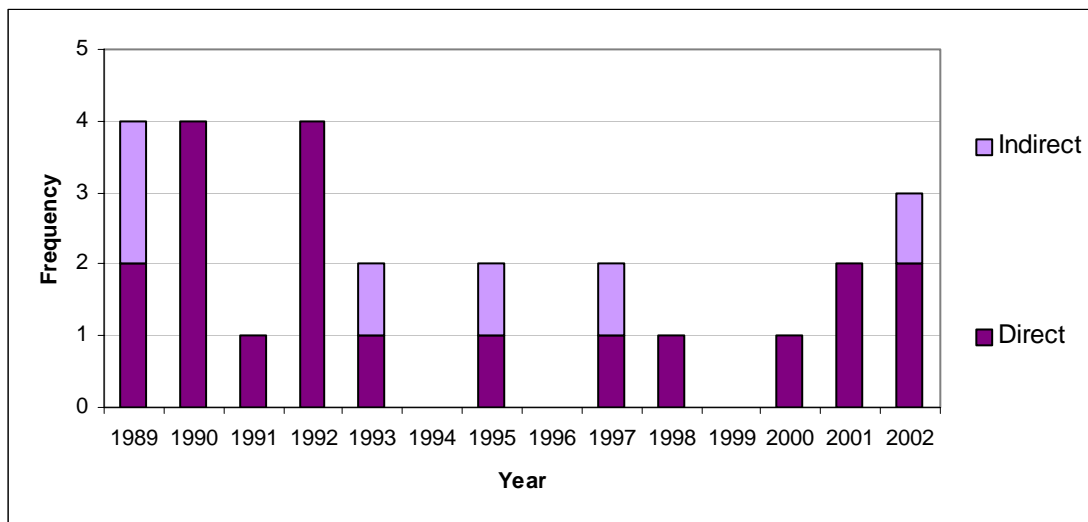


FIGURE 1
Frequency of fall-related deaths per year, Victoria 1989-2002 (n=26)

Age and Gender

Sixteen (62%) deceased were male, ten (38%) were female.

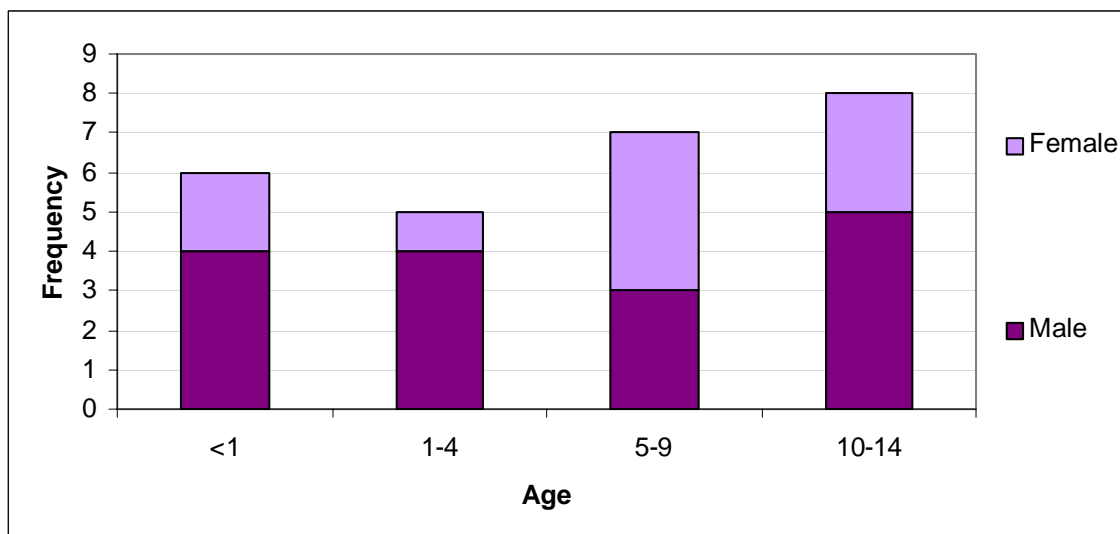


FIGURE 2
Frequency of fall-related deaths by age and gender, Victoria 1989-2002 (n=26)

There were six deaths of children aged less than one year. The height of the fall in this age group ranged from 0.4 metres to 1.6 metres. Most often the child fell from a bed or from their carer whilst they were sleeping or being cared for. All the deaths occurred in the home, three at the child's usual place of residence and three at a residence the deceased was visiting.

There were five deaths of children aged between one and four years. The height of the fall ranged from 0.4 metres to 1.1 metres. The child either fell from their carer or an object around the home such as a bed or toilet. At the time of the incident the child was sleeping, being cared for or playing. All the deaths occurred at the child's usual place of residence.

There were seven deaths of children aged between five and nine years. The height of the fall ranged from 2 to 14.2 metres. The fall most often occurred during "play" or informal recreation involving trees, play equipment and buildings. Five of the seven deaths occurred in the home, mostly outside.

There were eight deaths of children aged ten to 14 years, seven of which occurred on the weekend. The height of the fall ranged from 2.1 to 180 metres. These falls were from cliffs and buildings while engaged in informal recreation or "play". With the exception of one, all the deaths occurred away from the home.

Reason for Fall

Due to small numbers and the variety of circumstances amongst the cases, it was difficult to categorise the reasons why the child fell. The circumstances outlined below describe small groups of incidents and their contributing factors.

- fall from furniture while sleeping;
- unbalanced from a sitting or standing position due to stage of development;
- dropped by carer or was in carer's arms when they fell;
- environmental factor: slipped on rocks, tree branch broke;
- play: climbing / jumping from / on to roofs, climbing down cliffs.

There was only one case where a Coroner formulated a recommendation, which was in relation to increased signage where the fatality occurred.

Time of Day

Eleven (44%) of the incidents occurred between 3:00 pm and 5:59 pm. A further six incidents (24%) occurred between 6:00 pm and 8:59 pm. There were only three incidents (12%) between 6:00 am and 11:59 am (See Figure 3). Note that in one incident the time of day was not specified.

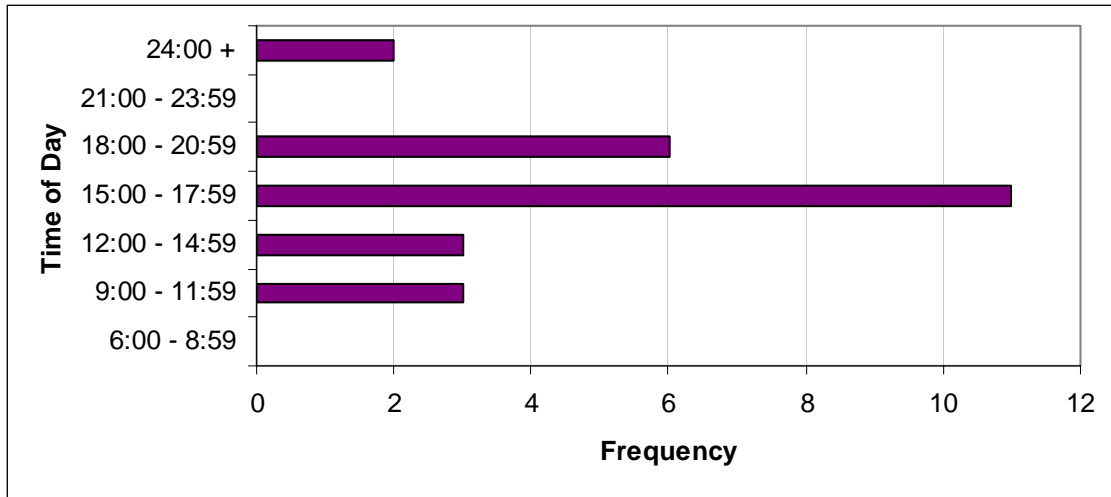


FIGURE 3
 Frequency of fall-related deaths by time of day, Victoria 1989-2002 (n=25)

Day of Week

Fifteen of the 26 incidents (58%) occurred on the weekend.

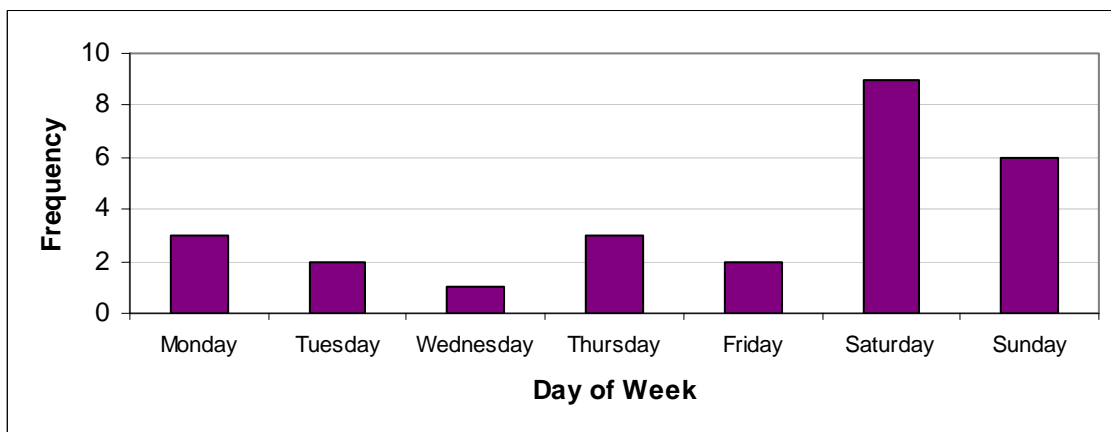


FIGURE 4
 Frequency of fall-related deaths by day of week, Victoria 1989-2002 (n=26)

Season

There was an even distribution of fall-related deaths amongst the seasons of the year.

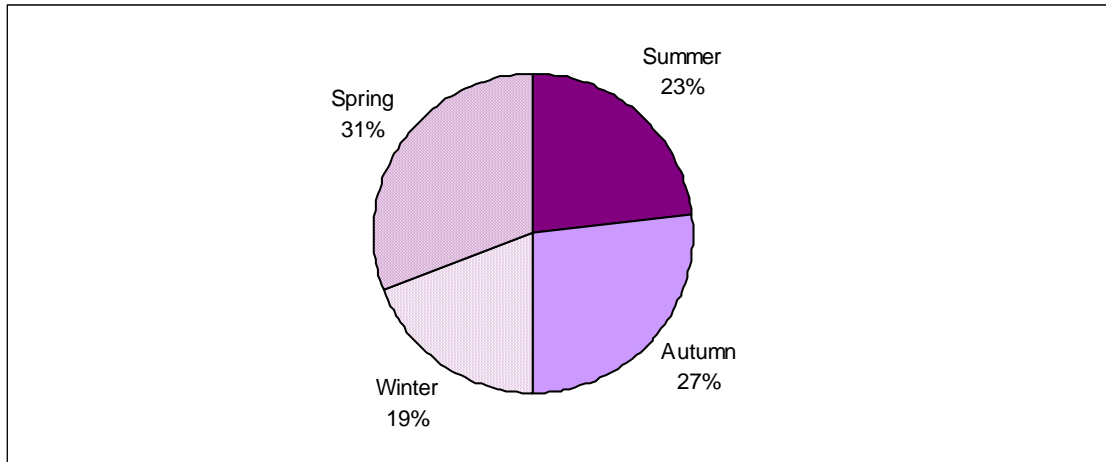


FIGURE 5
Frequency of fall-related deaths by season, Victoria 1989-2002 (n=26)

Location

Seventeen of the 26 incidents (64%) occurred in a private house. In 12 of the 17 deaths, the incident occurred at the child's own home (71%).

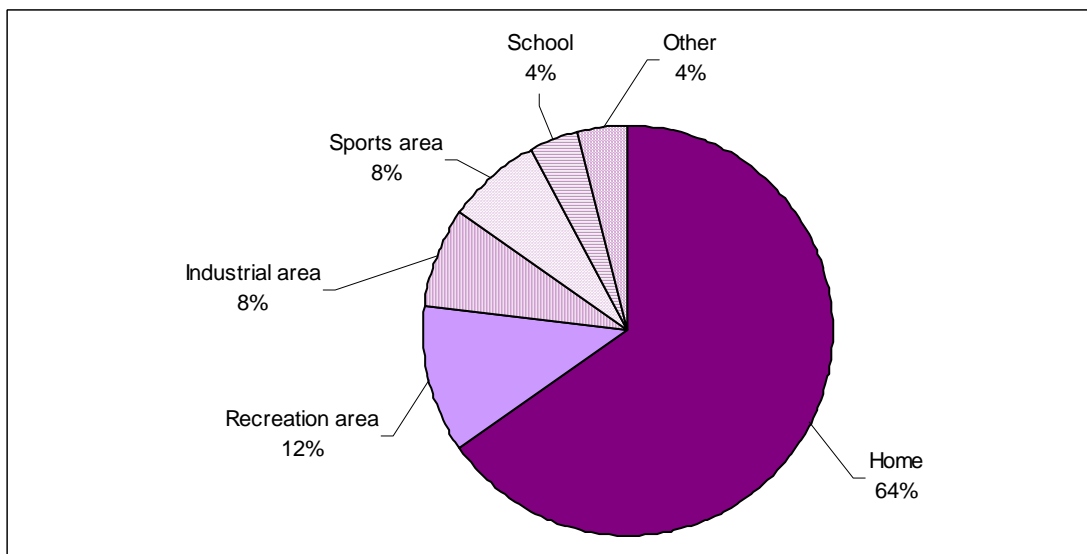


FIGURE 6
Frequency of fall-related deaths by location, Victoria 1989-2002 (n=26)

All of the deaths in the < 1 year and the 1-4 year age group and the majority of the deaths in the 5-9 year age group (71%) occurred in the home. In the 10-14 year age group, with the exception of one, all the deaths occurred in public space, at locations such as national parks and places for informal sport and recreation (See Figure 7).

There was an even distribution between the number of deaths that occurred in rural areas (n=12, 46%) and deaths that occurred in urban areas (n=14, 54%).

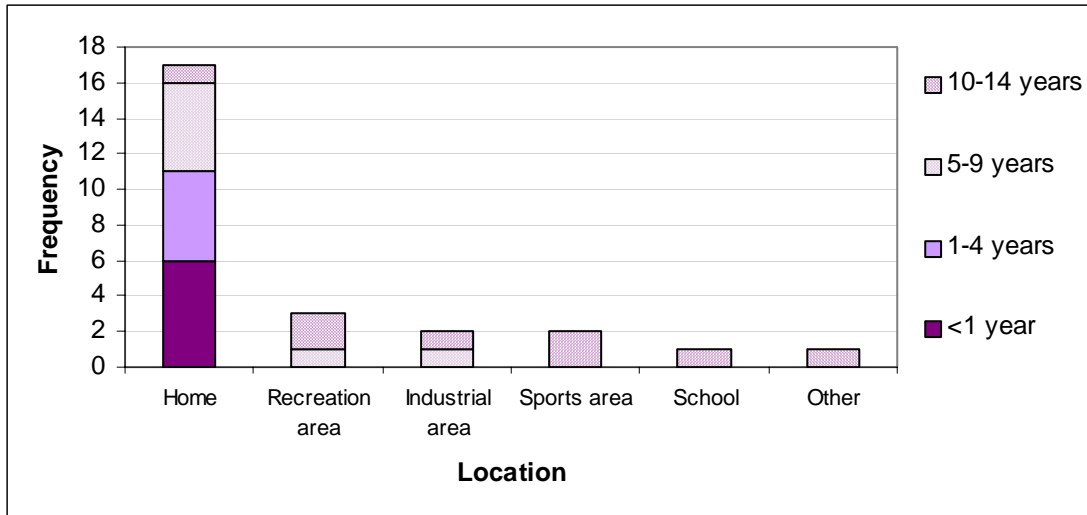


FIGURE 7
Frequency of fall-related deaths by age and location, Victoria 1989-2002 (n=26)

Activity

Twelve of the 26 incidents (46%) occurred while the deceased was engaged in a leisure activity, most often "play". Nine of the incidents (34%) occurred while the deceased was sleeping or being cared for.

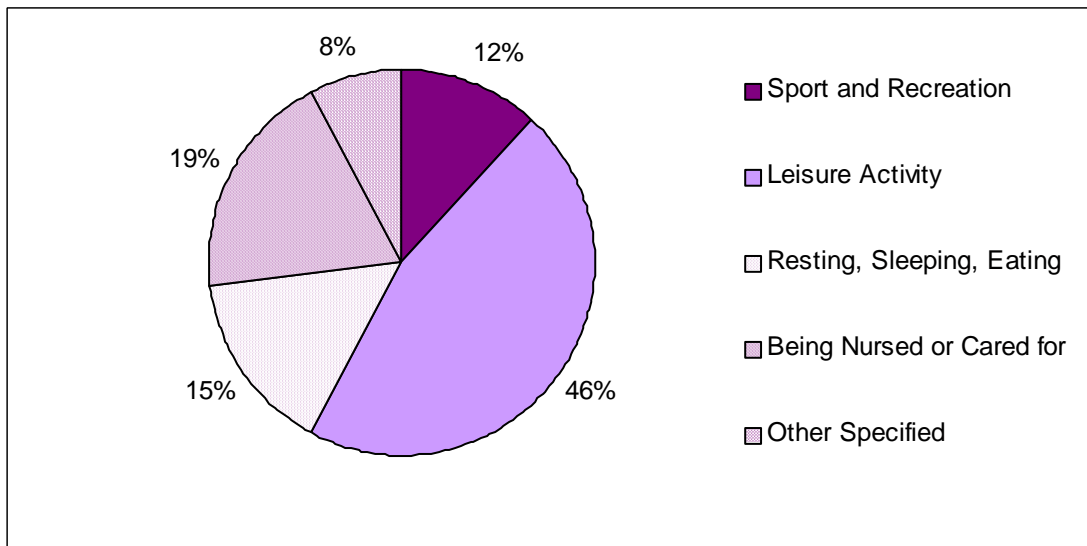


FIGURE 8
Frequency of fall-related deaths by activity, Victoria 1989-2002 (n=26)

Sleeping or being cared for accounted for all deaths in the <1 year age group and the majority of deaths in the 1-4 year age group. The two oldest age groups (5-9 years and 10-14 years) were mostly engaged in leisure activities i.e. general play or informal sport and recreation such as horse riding and visiting national parks.

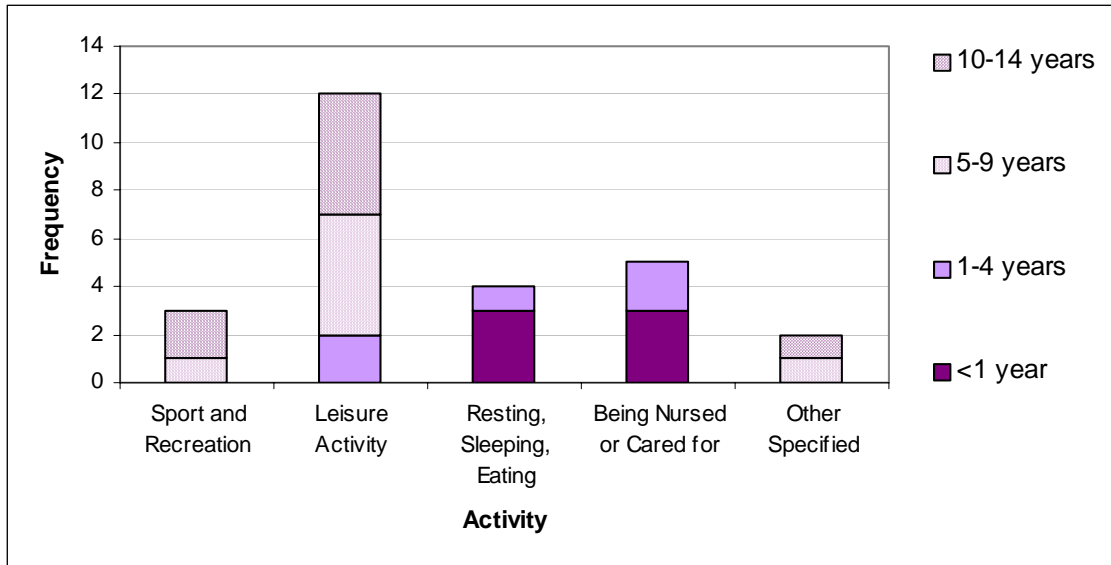


FIGURE 9
Frequency of fall-related deaths by age and activity, Victoria 1989-2002 (n=26)

Object / Substance

Eight of the 26 incidents (31%) involved a fall from a building, building component or fitting. This category included floors, windows, skylights, buildings and shade clothes. Six of the fall-related deaths (23%) were from a ground surface or conformation, which included cliffs, rock formations and snow fields. A further six of the falls were from an animal, plant or person. This included falls from trees, horses and people.

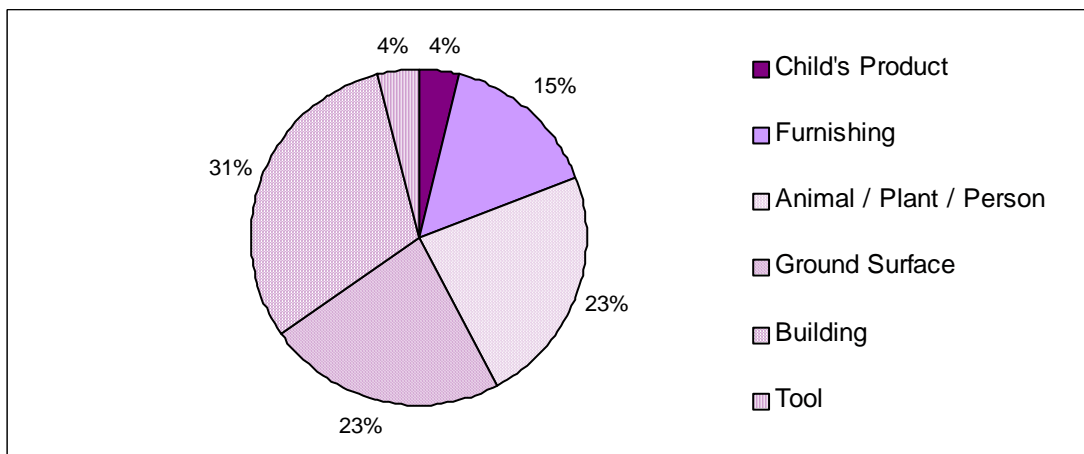


FIGURE 10
Frequency of fall-related deaths by object / substance, Victoria 1989-2002 (n=26)

Furnishings such as beds and coaches were the most common objects associated with fall-related deaths in children < 1 year. This was related to their activity at the time of the incident, sleeping.

In the 1-4 year age group the object the child fell from varied, including from people, toilets and ladders. Falls in the 5-9 year age group were from trees and building components. In the 10-14 year age group, falls were from cliffs / rock formations and buildings, including building components.

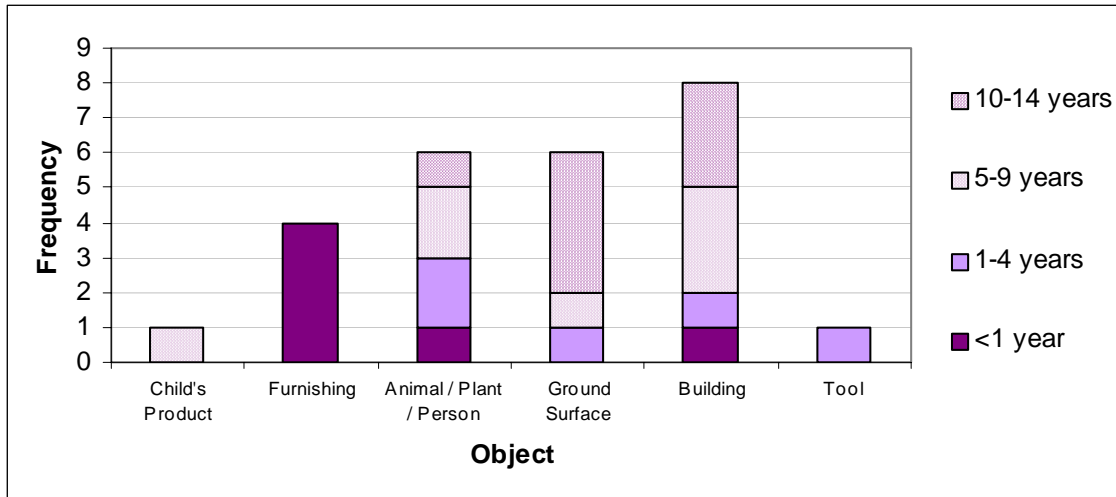


FIGURE 11
Frequency of fall-related deaths by age and object / substance, Victoria 1989-2002 (n=26)

Fall Height and Landing Surface

Fall height was only examined for cases where the fall resulted in injuries directly causing the death, n=20. In nine of the 20 incidents (45%), the height of the fall was between 1 and 3 metres. Thirty percent (n=6) of the children in the 10-14 year age group fell from a height in excess of seven metres.

Figure 12 illustrates that fall height was related to age, in that the two youngest age groups (<1 and 1-4 years) fell from smallest heights and the two older age groups fell from greater heights. Fall height was also related to the object from which the child fell and the activity engaged in at the time of the fall. For example, young children most often fell from furniture while resting or sleeping and older children fell from building components and rock formations while engaged in leisure and recreation.

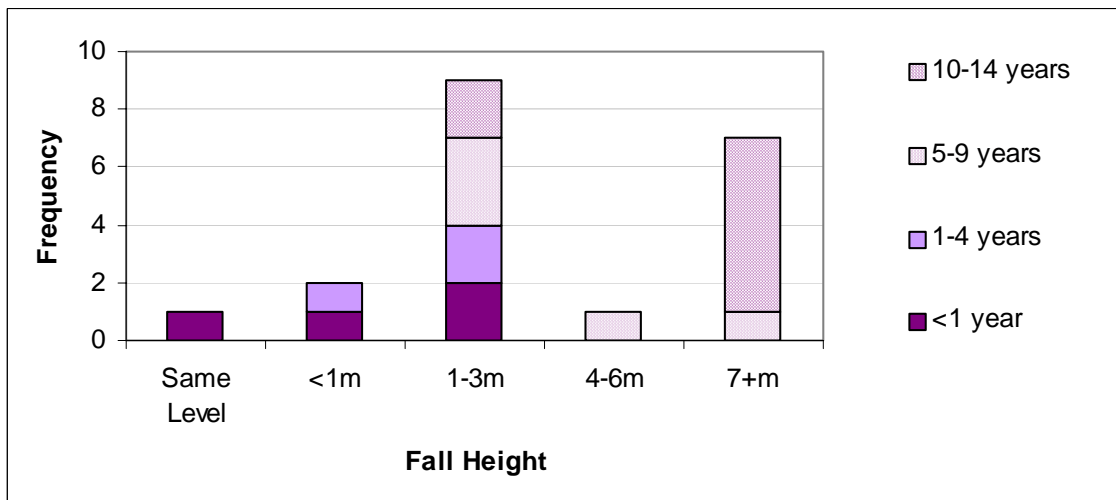


FIGURE 12
Frequency of fall-related deaths by age and fall height, Victoria 1989-2002 (n=20)

Landing surface also varied according to age, which was related to both the object from which the child fell and the location. For example, young children most often fell from furniture inside the home and therefore the landing surface was the floor.

Older children were often located outside or away from the house and fell from building components or rocks landing on the concrete ground.

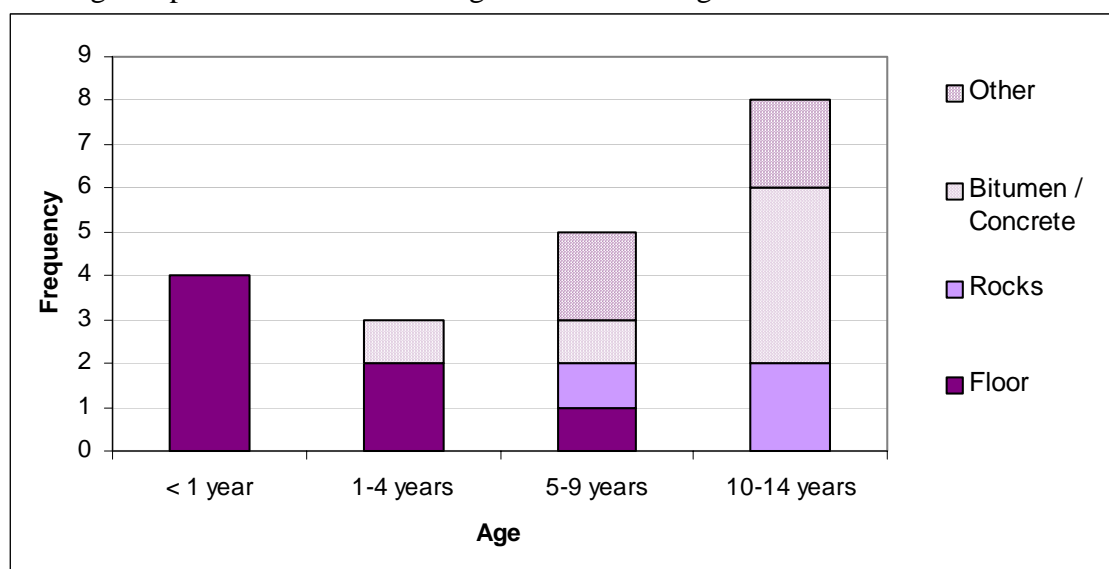


FIGURE 13
Frequency of fall-related deaths by age and landing surface, Victoria 1989-2002 (n=20)

Nature of Injury Resulting in Death

Approximately 70% (n=18) of the injuries sustained that resulted in death were head injuries. Seventeen of the 18 head injuries occurred when the child's head made contact with the floor / ground (direct group) and one death occurred when the child and another object fell to the ground (indirect group). The head injury deaths were fairly evenly distributed amongst the age group categories (<1 year n=4, 1-4 years n=3, 5-9 years n=5, and 10-14 years n=6).

The nature of the head injuries for the direct fall group (n=17) were: 47% (n=8) intracranial injury; 12% (n=2) skull fracture; 41% (n=7) intracranial injury and skull fracture. The remaining three cases in the direct group died as a result of internal injuries (12%). These deaths occurred in the 5-9 and 10-14 year age group.

The remaining five cases in the indirect group resulted from asphyxia and laceration. All four asphyxia deaths were of children in the <1 and 1-4 year age group. The laceration death was of a 5-9 year old.

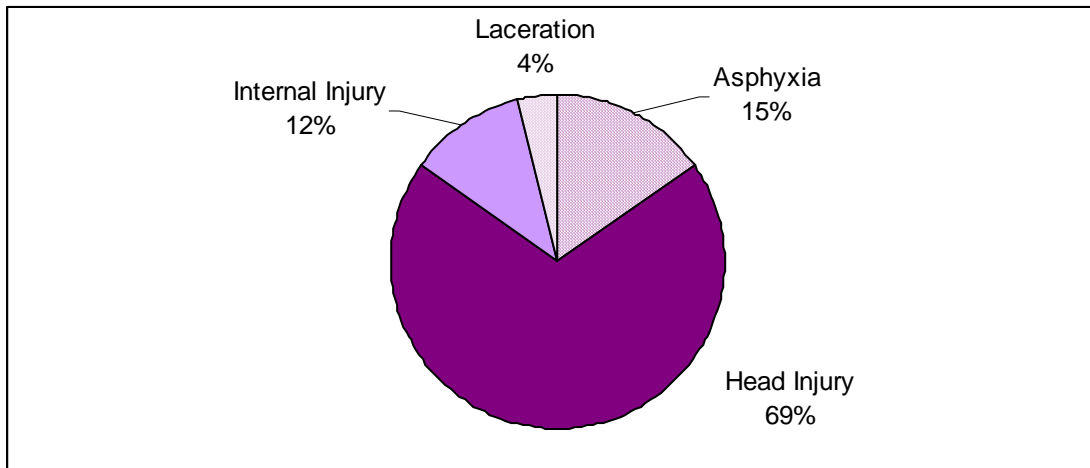


FIGURE 14
Percentage of fall-related deaths by nature of injury, Victoria 1989-2002 (n=26)

Short Distance Falls with Head Injury

TABLE 4
Summary - short distant fall cases

Case Number	Age	Gender	Fell From / Landing Surface	Distance	Witnessed by Non-Carer	Autopsy	Head Injuries	Cause of Death
4558/89	9 months	F	Backwards from sitting position / carpet floor	0.5 metres	No	Yes	- subdural haemorrhage	1(a) Subdural Haemorrhage (operation)
4606/89	6 months	F	Bed / carpet floor	0.48 metres	No	Yes	- intracranial haemorrhage; - subdural haemorrhage; - subarachnoid haemorrhage; - left retina (pale vessels and a few tiny reddish lesions near the disc); - right retina (darker than the left and appears heaped up near the optic disc)	1(a) Head Injury
1945/90	1 year	F	Carer / concrete ground	Height of carer	Yes	Yes	- subdural haemorrhage (right cerebral hemisphere); - subarachnoid haemorrhage (right parietal lobe); - skull fracture	Multiple injuries
4235/91	5 months	M	Carer / wooden floor	1.5 metres	No	Yes	- extensive fracturing of the skull with severe brain injury involving contusion; - further fracturing (right side in the mid parietal region which extended down into the posterior portion of the right middle cranial fossa); - extensive subarachnoid haemorrhage around all surfaces of the brain	Head injuries associated with major trauma
0428/92	4 years	M	Carer / carpeted stairs	Height of carer	No	No	- external injury consisted of a bruise type mark towards the back of right cheek near ear - 8.5 cm diameter irregular subgaleal haematoma (right parietal -occipital region); - 9.5 cm vertical skull fracture (extended in the midline posteriorly from the foramen magnum to the occipital region); - 5.5 cm oblique skull fracture joined the previous skull fracture in the mid occipital region.	1(a) Head Injuries
1730/93	3 years	M	Toilet / tiled floor	0.4 metres	No	Yes	- thin layer of subdural blood (over the hemisphere); - subarachnoid blood (patchily present over both cerebral hemispheres and around the base of the brain)	1(a) Head Injury
2578/95	9 years	F	Tree / concrete	2 metres	No	Yes	- fractured skull; - cerebral contusion; - cerebral infarction.	1(a) Head injury / cerebral infraction
0254/98	8 months	M	Bed / carpeted floor	1 metre	No	Yes	- bilateral subdural haemorrhage; - subarachnoid haemorrhage (over the cerebral hemispheres)	1(a) Subdural haemorrhage

A short distance fall was defined as falls from a distance of less than three metres. There were eight cases where the death resulted from a head injury sustained from a short distance fall. The children ranged in age from five months to nine years, four were male and four were female. Fall height ranged from 0.4 metres to 2.0 metres and included falls from carers, furniture and trees. There was only one case where the fall was witnessed by two non-care givers. The account given by the two witnesses conflict as to whether the child's head hit the concrete ground and were subsequently discounted.

With the exception of one, autopsies were conducted in all cases, which detailed the nature and extent of the head injuries sustained. In four of these seven cases, more detailed comments relating to the nature and extent of the brain injury was provided by a neuropathologist. In four cases the child sustained both a skull fracture and intracranial hemorrhaging. In all cases the child's head contacted a hard surface (i.e. concrete, wooden floor, tiled floor). Table 5 describes the circumstances surrounding these falls.

TABLE 5
Reported circumstances for short distance fall cases

Case Number	Reported Circumstances
4558/89	Deceased was being cared for by a babysitter. An incident occurred in which the child overbalanced and fell backwards from a sitting position on the floor and hit the back of her head on the carpet, under which there was no underlay. The child cried initially but thereafter everything seemed normal to the babysitter and the parents. The following day the child was crying and soon after became drowsy and slumped with her fists clenched.
4606/89	Babysitter was minding the deceased in the main bedroom at her residence. Deceased was placed on the bed whilst babysitter folded washing. Babysitter heard two thumps and then saw that the deceased was on the floor next to the bed, a drop of approximately 48 cm.
1945/90	Mother picked up the child from cot, who didn't move when touched and ran from the bedroom screaming for assistance. Mother fainted and fell to the ground.
4235/91	The mother of the deceased was holding her child in her arms. She walked up the stairs to the doorway of the caravan, when she tripped on the step, the child fell from her arms, head first and struck the floor of the caravan. The mother then continued to fall and fell on top of the deceased.
0428/92	The deceased began to cry, and his cousin threw him into the air, to stop him crying. As he did this he lost balance and only caught one side of deceased who then fell toward the stairwell. One of deceased's feet then clipped the banister at the top of the stairwell and flipped deceased head first down the stairwell quickly.
1730/93	The deceased was in the toilet, fell and hit his head.
2578/95	No eye witnesses to the actual incident, mother found deceased lying on the footpath / nature strip under a large tree which the children from the units regularly play.
0254/98	Deceased's mother was on the telephone and other children in the lounge when her seven-year-old son heard DECEASED cry and went into the master bedroom and discovered DECEASED on the floor. An estimation of the height from the bed to the carpeted floor was approximately 1 metre.

In four of these cases treating medical staff or the Forensic Pathologist raised suspicion with the Coroner that the severity of the child's head injuries was inconsistent with the carer's explanation of the circumstances of the fall. In addition, one of the deaths was investigated by the Homicide Squad. In all cases the Coroner determined that there was insufficient evidence to substantiate the suspicion and concluded that the deaths were unintentional (see excerpt below).

In summary, DECEASED presented as an infant with clinical manifestations of a very severe head injury, which in my opinion, is unlikely to have been caused by a relatively minor fall

described. This, together with bilateral fundal haemorrhages, recent bruising and a CT Scan showing intracranial haemorrhages and gross generalised cerebral oedema, raises the possibility of a non-accidental injury being the cause of DECEASED presentation. [Intensive Care Unit Paediatrician's statement, 4606/1989]

Medical opinion was that there had to be an application of considerable force needed to produce the fractures and brain injury observed, which brought into question doubt as to whether the injuries could have occurred as outlined by the deceased's stepmother. In attempting to evaluate the head injury it must be remembered that there is no evidence as to the nature of the deceased's fall and therefore what forces came into play as a result. Accordingly it cannot be determined whether the deceased was involved in a simple or complicated fall, if the injuries were not inflicted by a caregiver. Whilst evidence was given that non-accidental trauma must be seriously considered in this case, the possibility remains that the injuries occurred as outlined by the stepmother. A complicated fall can result in fractures of the nature observed at autopsy, even though it may be stated to be unlikely. The evidence of brain damage may have resulted from the fall or from the subsequent shaking of the deceased by the stepmother when in a state of panic, in a misguided attempt to revive him. [Coroner's finding, 1730/1993]

It was beyond the scope of the current study to examine further the issue of intentional versus unintentional injury.

Carer Supervision

Carer supervision was examined according to age group using Saluja et al. (2004) conceptual model. Due to small numbers in each age category, it was difficult to draw conclusions as supervision varied according to age, activity and location. As would be expected, the presence of a supervising adult decreased as age increased.

Despite this limitation, it was found that in relation to the youngest children, absence of carer supervision was not a factor in the deaths as the child either fell during sleep or was dropped by the carer. In all the cases in the < 1 and 1-4 category, the carer was present with the child or in the next room (e.g. if the child was sleeping).

In relation to the older children, carer supervision was completely absent in 5 of the 8 cases in the 10-14 year old age group. In these cases, the carer was aware that their child was engaged in informal recreation or "play" in public space and was not present in the immediate vicinity. It cannot be determined from this finding that absence of carer supervision was a factor in the death.