INJURY BULLETIN

Queensland Injury Surveillance Unit

No 80 February 2004

QISU collects and analyses data from emergency department injury presentations on behalf of Queensland Health. Participating hospitals represent three distinct areas of Queensland.

QISU publications and data are available on request for research, prevention and education activities.

HOSPITALS:
Mater Children's, Mater Adult, Queen Elizabeth II Jubilee, Princess Alexandra, Redland, Logan, Royal Children's, Mount Isa , Mackay Base, Mackay Mater, Proserpine, Sarina, Clermont, Dysart and Moranbah.

QISU STAFF:
Director – A. Prof. Rob Pitt, Paediatric Emergency Director, QISU Director, Mater Children's Hospital

Manager – Elizabeth Miles

Data Analyst – Richard Hockey

Marketing/Safe Communities Manager – Dawn Spinks

Paediatric Emergency Fellow – Dr Ruth Barker

Coding /Admin –

Contact QISU:
Level 2
Mater Children's Hospital
South Brisbane 4101
Phone 07 38408569
Facsimile 07 38401684
Email mail@qisu.org.au
URL www.qisu.org.au

ISSN 1442-1917

QISU is funded by Queensland Health with the support of the Mater Health Service Brisbane

Toddler Falls from Balconies & Windows

Ruth Barker, Richard Hockey, Elizabeth Miles

Summary

- In the period 1998 to 2002, 3177 children under 5 presented to QISU participating emergency departments with high falls. Falls from balconies or windows represented 8% of all high falls in this age group.
- More than 50% of high falls from balconies or windows resulted in intracranial injury. This group represents 3% of all intracranial injury in this age group.
- More than 90% of these injuries occurred at home.
- These injuries are potentially preventable with simple design considerations and affordable modifications to existing structures.

Introduction

In the period 1998 to 2002, 3177 children under the age of 5 years presented to participating emergency departments in Queensland (QLD) following a high fall (>1m). Children in this age group typically injure themselves at home or at the home of a friend or relative. High falls from home balconies and windows form a significant proportion of these high falls (8%). More than 50% of falls from windows and balconies resulted in intracranial injury and this represents approximately 3% of all intracranial injury presentations due to any cause during this period. In the 10 year period 1992 to 2001 there have been 2 child deaths (less than 15 years) from balcony falls in QLD.

Architectural design in QLD (from traditional to modern) utilises highset houses with open verandahs and accessible windows. Given the slope on which some houses are built, the fall from a first storey window or balcony can be up to 6 metres. This edition of the bulletin analyses high falls from windows and balconies in children under 5 years, and addresses preventable aspects of these injuries.

Methods

Data was collected through the QISU surveillance system from the participating hospitals listed to the left. Injury presentations are coded at the presenting hospital according to the nature and cause of the injury. High falls are defined as falls greater than or equal to 1 metre. Data was extracted from the database by searching for "high falls" in the mechanism of injury and "windows", "balconies", "verandahs" and "decks" in the text descriptions. Falls down stairs were specifically excluded. Additional information about the mechanism of the fall was gleaned from the text descriptions. These descriptions are optional and non-standardised and although they give additional information it is not possible to formally analyse the data using this information. Triage categories are scaled from 1 to 5, with 1 indicating a need for immediate resuscitation, 2 urgent assessment within 10 minutes and 3 to 5 requiring less urgent assessment. An injury code of "intracranial injury" includes minor to more serious diagnoses (concussion, cerebral swelling, intracranial haemorrhage).

Results

During the period 1998 to 2002, there were 3177 presentations with high falls in children under 5 years of age. Falls from balconies or windows accounted for 252 presentations (8% of all high falls). 181 presentations were due to high falls from balconies/ verandahs, 71 presentations were due to high falls from windows. During the 10 year period 1992 to 2001 there were 2 child deaths (0-14 years) from balcony falls in QLD. The children were aged 12 and 4 years and fell 11 and 8 storeys respectively.

The peak age for balcony or window falls is 12-36 months with the majority of falls occurring at age 12-24 months (40%) (Table 1). Males are over-represented with a ratio of males to females of 1.6:1.

Of these 252 falls, 242 (96%) occurred at a home (not specified whether or not it was the child's usual residence) and 10 occurred at another site.

Balcony Falls

Falls from balconies accounted for 181 of the 252 falls analysed. The age distribution is similar with a peak at 12 to 36 months. 43% of children were aged 12 to 24 months and 78% of children were aged 12 to 36 months. 7% were aged less than 12 months (Table 1). Intracranial injury occurred following 52% of these falls, fractures in 18% and superficial injuries in 15% (Table 3).

From the text description, the majority of children were said to have been climbing on the balustrade railing before falling off the balcony. For some children this involved climbing adjacent structures (furniture) to gain access to the railing. Few were said to have fallen between gaps in the balustrade. For some, the balustrade was said to have "given way".

Falls were typically estimated to be between 2 to 3 metres, with a few estimated to have fallen 6 metres. Children were said to have fallen onto underlying grass, garden or soil. Many fell onto concrete or other underlying structures (bins, cars, and furniture).

Over 40% of children were admitted for management their injuries and observation. 8% of presentations were triaged as category 1 (requiring immediate resuscitation) and 23% as category 2 (requiring urgent assessment).

Window Falls

Falls from windows accounted for 71 of the 252 falls analysed. Again the age distribution was similar with 34% aged between 12 and 24 months and 70% were aged between 12 and 36 months. Only 4% were aged less than 12 months (Table 1). Intracranial injury occurred following 44% of high window falls, fracture following 17% and superficial injury in 18% (Table 3).

From the text descriptions, fall distances were similar to those from balconies (typically 2 to 3 metres). Few were said to have fallen 2 storeys (in excess of 6 metres). Landing descriptions were similar to balcony falls, with children landing in the garden/ dirt or on concrete. Some describe the child falling through a fly-screen. In the majority of cases the window was presumably open. Some text descriptions describe the child playing or bouncing on the bed/ other furniture before falling through the window.

Over 50% of children were admitted following falls from windows. 4% were triaged category 1 and 30% category 2.

Pattern of injury

Of the 252 presentations due to balcony and window high falls, 40 children (16%) sustained superficial injuries only. 44 children (17%) sustained fractures. 66% of these children with fractures required admission to hospital. The distribution of fractures is shown in Table 2. 17 children (39% of all fractures in this group) sustained skull fractures. 50% (126/252) of falls from windows and balconies resulted in intracranial injury and this represents approximately 3% of all intracranial injury presentations due to any cause during this period.

Together with the number of children sustaining a skull fracture the proportion of children suffering some form of head injury (skull fracture or intracranial injury) from a balcony or window high fall is 57% (143/252).

Discussion

High falls from windows or balconies have been described as a significant cause of mortality and morbidity in other countries[1,2,3,4,5]. In the United States falls are usually from high rise apartments with a

Age	Balconies		Windows		All	
	N	%	N	%	N	%
0	12	7%	3	4%	15	6%
1	77	43%	24	34%	101	40%
2	52	29%	23	32%	75	30%
3	23	13%	13	18%	36	14%
4	17	9%	8	11%	25	10%
< 5	181	100%	71	100%	252	100%

Table 1 QISU Emergency Department presentations, children aged 0-4 years, high falls from balconies and windows by age, 1998-2002.

Body location of fractures	N	%
Head or face	17	39%
Upper limb	15	34%
Lower limb	12	27%
Multiple sites	8	18%
Total	44	100%

Table 2 QISU Emergency Department presentations, children aged 0-4 years, high falls from balconies and windows by site of fracture, 1998-2002

peak incidence in the summer months (presumably when windows and balcony access points are left open)[1]. In some urban areas falls have accounted for up to 20% of all unintentional injury deaths in children. Deaths usually result from falls of 3 storeys or greater but falls of 1 to 2 storeys still result in significant injury[1,2]. Injury patterns from balcony and window falls in the United States are similar to those seen in our data[1,2]. Fall injury to boys occur more frequently than to girls with a ratio of 1.5:1. Age distribution is bimodal with pre-schoolers tending to fall from windows and older boys falling from dangerous play areas[1]. For children under 15 years of age, 40% suffer intracranial injury and 15% suffer a limb fracture[2].

Standards have been adopted in the United States specifying railing height (36 inches) and width between vertical railing members (no more than 4 inches) to prevent small children from passing between the balustrade members. However, building codes are not standard across the country and there is no requirement for retrofitting in older dwellings. The New York City Board of Health adopted legislation requiring owners of multistorey buildings to provide window guards for all dwellings where children under the age of 10 years reside. The pilot programme resulted in a 35% reduction in deaths attributable to falls from windows and a 50% reduction in incidents, with no child falling from a window that had a window guard fitted[1].

In other countries, lack of standardised housing regulations for structural and safety performance for dwellings have contributed to roof top/ stairway, balcony and window falls in children under 5 years[5].

Queensland has a strong architectural tradition with the "Queenslander" home. It is typically high set, with casement windows and open balconies/ verandahs. Due to the temperate climate, windows are open most of the year. High set windows tend not to be security screened. Flyscreening is not an adequate barrier to prevent a toddler falling through the window. Traditional balustrade heights are 900 to 1000 mm, usually with closely spaced vertical members and wide spacing between any horizontal climbable members. Outdoor living dictates that verandahs frequently house chairs, tables and barbeques, all of which may be used by a toddler to scale the railing.

The only Australian Standard relevant to balcony safety (AS: 1170.1-2002) relates to the load bearing capacity of the balcony and balustrade[6]. There is no Australian Standard relating to climbable members and spacing of members in balustrades. Similarly, there is no Australian standard applicable to toddler accessibility to windows.

The Australian building code specifies limitations for gaps in the balustrading for balconies over 1 metre from the ground. Limitations to the climbability of balustrades only applies to balconies greater than 4 metres off the ground.

The building code specifies that for balustrades on balconies greater than 1 metre from the ground, any members (vertical or horizontal) should not permit a 125 mm sphere to pass between them[7]. This is to avoid small children falling through or getting their head stuck between the members of the balustrade. With regard to horizontal climbable members on balustrades, the specifications apply only once a balcony height of 4 metres has been exceeded. The building code then states that the balustrade should be 1 metre in height and that "any horizontal elements within the balustrade or other barrier between 150 mm and 760 mm above the floor must not facilitate climbing"[7]

Body location	Balconies		Windows		All	
	N	%	N	%	N	%
Head or face	129	71%	46	65%	175	69%
Upper limb	10	6%	6	8%	16	6%
Lower limb	14	8%	9	13%	23	9%
Multiple sites	8	4%	2	3%	10	4%
Total	181	100%	71	100%	252	100%

Table 3 QISU Emergency Department presentations, children aged 0-4 years, high falls from balconies and windows by body part injured, 1998-2002

Nature of Injury	Balconies		Windows		All	
	N	%	N	%	N	%
Superficial	27	15%	13	18%	40	16%
Open wound	5	3%	5	7%	10	4%
Fracture	32	18%	12	17%	44	17%
Sprain or strain	5	3%	1	1%	6	2%
Intracranial	95	52%	31	44%	126	50%
No injury	7	4%	2	3%	9	4%
Total	181	100%	71	100%	252	100%

Table 4 QISU Emergency Department presentations, children aged 0-4 years, high falls from balconies and windows by nature of injury, 1998-2002

Design trends have seen a recent adoption of horizontal tension wires on verandahs of modern dwellings. These (typically spaced 85 to 100 mm apart in keeping with previously mentioned specifications) form an easily climbable "ladder" for toddlers. Toddlers are "top heavy" and having climbed a balustrade, they tend to topple head first over the railing. This style of construction is currently legal in Queensland for first storey balconies.

For windows, there is no relevant Australian Standard relating to preventing access for toddlers. The building code states that a barrier must be provided where it is possible for a person to fall through an openable window where the floor is more than 4 metres from the ground level. An additional barrier is not required if the window is at least 1 metre from the floor level. Where a barrier is required it should be "of a height to protect people from accidentally falling...through the opening" and "capable of restricting the passage of children"[8]. However, this does not apply to standard (non-highrise) residential dwellings.

Prevention

Falls greater than 1 metre are likely to result in significant injury (fracture or intracranial injury) in a young child[1,2]. There are many ways of addressing this risk.

For balconies greater than *1 metre* from the ground, consideration should be given to the balustrade design, making sure that the balustrade is at least 1 metre in height, with no gaps greater than 100 mm between horizontal and vertical members. Horizontal members that permit a toddler to scale the balustrade should be avoided. For balustrades where horizontal members have been used, perspex, ply or fine wire mesh can be used on the inside of the balustrade as a temporary measure to prevent small children from climbing over the railing. Structures (fixed or movable) on the balcony should be avoided where they can provide a climbable access point to the balustrade.

Just as stair guards can be used to protect a child from falling down high set stairs, window guards can be used to protect open high set windows. Lock mechanisms can be used to prevent the window from opening wide enough to permit a child to fall through (less than 10 cm). Standard flyscreening is not adequate to prevent a toddler from falling through. Security screening will provide better protection. Fixed or movable louvres may be used as an alternative to more traditional windows, still allowing outlook and ventilation. Sash windows should be opened from the top rather than at the bottom to provide ventilation when required. Again, structures (fixed or movable) should not be situated below highset windows as these afford an access point for a toddler to climb through the window.

Conclusion

Balcony and window falls are a significant cause of morbidity for toddlers in Queensland. These falls are potentially preventable through housing design modifications. Households with young children should consider these recommendations when designing new houses and can adapt existing structures to prevent such injuries. Landlords should be encouraged to consider these safety aspects when renting to families with young children.

Recommendations

- Real Estate agencies and property owners consider balustrade and window safety when leasing properties to families with small children.
- A public education campaign be developed to inform relevant industry bodies and toddler care givers of the risks of balcony and window falls.

Balconies:

- The Building Code of Australia develop performance specifications for balustrade design to restrict climbability for children under the age of 5 years where the balcony is **1 metre** or more above the ground level.

Windows:

- The Building Code of Australia should develop performance specifications to restrict egress for children under the age of 5 years through any window more than **1 metre** above the ground level.

References:

1. Committee on Injury and Poison Prevention. Falls From Heights: Windows, Roofs and Balconies: American Academy of Pediatrics. Pediatrics, 2001,Vol 107(5), p 1188-91
2. Istre GR et al. Childhood injuries due to falls from apartment balconies and windows. Injury Prevention, 2003, vol 9(4), p 349-52
3. Lehman D et al. Falls from heights: a problem not just in the northeast. Pediatrics, 1993, vol 92(1), p121-4
4. Lallier M et al. Falls from heights among children: a retrospective review. Journal of Pediatric Surgery, 199, Vol 34(7), p 1060-3
5. Ittai et al. Hospitalisations due to falls in Jewish and Arab children in Northern Israel. European Journal of Epidemiology, 2000, Vol 16(1), p 47-52
6. Standards Association of Australia 2002, Australian Standard: Structural design actions- Permanent, imposed and other actions (AS 1170.1-2002), Standards Australia, North Sydney
7. Building Code of Australia, Vol 2, Section 3, Part 3.9.2 Balustrades
8. Building Code of Australia, Vol 1, D 2.16 (a) (ii) (A)

For additional information contact:

Archicentre: Advisory service for building construction and design. www.archicentre.com.au or phone 1300 134 513

Kidsafe email: qld@kidsafe.org.au or go to their home safety checklist at www.greenweb.com.au/kidsafe/html/home_safety_check.html

Smart Housing: www.smarthousing.qld.gov.au or phone 07 3238 3683