Emergency department surveillance of injuries associated with bunk beds: the Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP), 1990–2009

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Abstract

Introduction: Due to space constraints, bunk beds are a common sleeping arrangement in many homes. The height and design of the structure can present a fall and strangulation hazard, especially for young children. The primary purpose of this study was to describe bunk bed-related injuries reported to the Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP), 1990–2009.

Methods: CHIRPP is an injury and poisoning surveillance system operating in 11 pediatric and 4 general emergency departments across Canada. Records were extracted using CHIRPP product codes and narratives.

Results: Over the 20-year surveillance period, 6002 individuals presented to Canadian emergency departments for an injury associated with a bunk bed. Overall, the frequency of bunk bed-related injuries in CHIRPP has remained relatively stable with an average annual percent change of −1.2% (−1.8% to −0.5%). Over 90% of upper bunk-related injuries were due to falls and children 3–5 years of age were most frequently injured (471.2/100 000 CHIRPP cases).

Conclusion: Children with bunk bed-related injuries continue to present to Canadian emergency departments, many with significant injuries. Injury prevention efforts should focus on children under 6 years of age.

Keywords: *injury prevention, injury surveillance, bunk bed Injuries, CHIRPP, furniture-related injuries, product safety*

Introduction

Unintentional injuries are the leading cause of death among Canadian children and youth,[1] and many of these are related to consumer products. Bunk beds have been identified as an injury hazard for over 30 years,[2,3] especially for young children. They are associated with more severe injuries than those associated with conventional beds,[4] the most obvious reason being their height. Other ''hidden'' hazards include guardrail openings of specific dimensions that, given the anthropometry of some young children, could cause entrapment or strangulation. Some decorative components (e.g. the bedpost) can cause certain types of clothing to snag, and coupled with the height, present another potential form of strangulation. Improper assembly, due to unclear instructions, missing parts or faulty components, may also be hazardous.[5,6]

Since 1987, the United States has seen 34 product recalls involving 84 manufacturers and over 1.5 million bunk beds.[7] Recent U.S. estimates for those aged 0 to 21 years indicate an annual average of 35 790 cases of non-fatal bunk bed-related injuries treated in emergency departments (42 per 100 000 population) and, during 1990–1999, 10 fatalities per year.[8]

Since 2007, there have been 4 product recalls involving 4 manufacturers and over 23 000 bunk beds[9] in Canada, the most recent of which were 2 joint recalls with the Consumer Product Safety Commission in the United States (May and September, 2011) involving 21 707 units.[10] Between 1983 and 2011, there were 7 deaths related to the use of bunk beds reported to Health Canada's Consumer Product Safety Directorate. Three of the deaths involved children under 3 years of age, the most recent in 2008.[11,12] There are currently no specific regulations for bunk beds. Health Canada recommends that bunk beds sold, advertised, imported or manufactured in Canada meet the safety requirements of the latest version of the ASTM F1427 Standard Consumer Safety Specification for Bunk Beds.[6,13] While a number of reports from other countries discuss non-fatal bunk bed-related injuries, including hospitalization rate estimates,[8,14–18] there is no comprehensive study of bunk bed-associated injuries in Canada. Further, ICD-10* coding in Canada does not allow identification of deaths or hospitalizations by type of bed, so specific rates are not readily available.

* *International Classification of Diseases, 10th Revision.*

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While the leading cause of bunk bed-related deaths is entrapment/strangulation and all recalls are related to entrapment or collapse,[5,6] most non-fatal injuries involving bunk beds are due to falls.[8]

The primary objective of our study was to describe the Canadian experience of the mechanisms and temporal trends associated with emergency department presentations for bunk bed-related injuries. A secondary purpose was to provide Canadian population-based estimates of the rate of hospitalizations for falls from bunk beds by using the Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP) to develop a scaling factor (based on the ratio of bunk bed injuries to all bed injuries) that can be applied to ICD-coded national hospitalization data.

Methods

Data source

CHIRPP is an injury and poisoning surveillance system presently operating in 11 pediatric and 4 general hospitals across Canada since 1990.[19,20] The CHIRPP system runs on an Oracle platform and currently contains over 2.2 million records. The information collected includes activity at the time of injury; activity leading to the injury; the direct cause of the injury; contributing factors; time and place of the injury event; the patients' age and sex; up to 3 injuries (body part and nature of injury); and the treatment received in the emergency department. Narrative fields provide information to further refine the coding and to identify rare events. Numerous validation programs have been developed to track data quality. Although only selected hospitals report to CHIRPP, previous research has shown that the data collected through the program represent general injury patterns among Canadian youth.[21] Previous investigations have reported on other methodological aspects of CHIRPP.[22–26]

Data extraction, cleaning and analysis

We identified cases by searching the entire CHIRPP database (1990–2009, all ages; extraction date: May 5, 2011) for injuries associated with bunk beds (CHIRPP product code 213). To ensure complete capture, we also searched narratives using variations of the following bilingual text strings: ''BUNK BED,'' ''LIT SUPER,'' ''LIT A 2 ETAGES'' and ''LOFT BED.'' The CHIRPP narratives were used to code a mechanism variable that provided detailed information on the injury event beyond the basic numerical variables. This process is time-consuming for large datasets as the cases have to be reviewed individually. As a result, we used a subset of cases that had been previously coded as part of a student project. On comparing this subset (2002–2006) to the overall dataset, we found that it displayed a similar distribution on a number of key variables (age, sex, nature of injury and temporal variables). The full dataset (1990–2009) was therefore used only for the time-trend analysis.

Since CHIRPP is not population-based, data are usually presented in terms of proportions rather than strict counts. Age, sex and year data were normalized to the total numbers in the database using the following expression (presented as the number per 100 000 CHIRPP cases in the given year, age group or sex):

$$\textit{Normalized proportion} = \left(\frac{N_{BB}}{N_{CHIRPP}}\right) * 100{,}000$$

where N_{BB} is the number of bunk bed cases for the given age group, sex or year and N_{CHIRPP} is the total number of cases of all types in CHIRPP for the same age group, sex or year.

Year-to-year variations, likely due to small sample sizes, were smoothed by applying a three-point central moving average to the normalized proportions.[27] We examined trends in the normalized annual proportions in two ways. We estimated the average annual percentage change (AAPC) in the normalized proportion (with 95% confidence intervals [CIs]) by performing a regression of the natural logarithm of the normalized proportion on year. The slope of this regression line, β, was input into the following formula:[28,29]

$$\text{AAPC} = \left[e^{\beta} - 1\right] * 100$$

The data were also separated into 5-year time blocks and analyzed for period-to-period trends (X^2 test, $p < .05$). Other results are presented in conventional descriptive format.

Bunk bed hospitalization rate estimates

To meet the secondary objective of the study, CHIRPP was used as a data source to develop a scaling factor to be applied to national morbidity data. The scaling factor is a ratio that quantifies the proportion of bunk bed cases to all bed-related cases in CHIRPP. Hospitalization data[30] for the fiscal years 2003/2004 to 2008/2009, where the external cause of injury was ''fall involving a bed'' (ICD-10 code W06), were obtained from the Hospital Morbidity Database (HMDB) for 2003/2004 to 2005/2006 and the Discharge Abstract Database (DAD) for 2006/2007 to 2008/2009 (excluding Quebec). The hospital separation databases (HMDB and DAD) are managed by the Canadian Institute for Health Information (CIHI). The decision to start the analysis at 2003/2004 was due to the complex staggered transition from ICD-9† to ICD-10 prior to that. CHIRPP data were arranged into the same fiscal year ranges and stratified by age group (0–4, 5–9, 10–14, 0–14 years) and type of bed. For ages 0 to 4 years, cribs, conventional beds and bunk bed counts were identified and for ages 5 and older, conventional beds and bunk beds were identified. A CHIRPP scaling factor (F_{CHIRPP}) was developed for each age group based on the ratio of bunk beds to all beds (including cribs for 0–4 year olds). The estimate for the rate of hospitalizations due to falls from bunk beds ($\widehat{R}_{BB}$) was calculated (for each age group) using the following equation:

$$\widehat{R}_{BB} = \left(\frac{F_{CHIRPP} * n_{W06}}{\widehat{N}_{age}}\right) * 100\ 000,$$

where

$$F_{CHIRPP} = \left(\frac{n_{BB}}{N_B}\right),$$

n_{w06} is the number of cases of hospitalization (HMDB/DAD) due to a fall involving a bed, n_{BB} is the number of cases admitted to the hospital for falls from bunk beds

† *International Classification of Diseases, 9th Revision.*

(CHIRPP), N_B is the number of cases admitted to the hospital for falls from all bed types (CHIRPP), and $\widehat{N}_{age}$ is the population estimate for the given age group.[31]

The rates were calculated over the 6-year period 2003/2004 to 2008/2009. The variability was characterized by calculating a 95% CI on F_{CHIRPP}. All analyses were performed using SAS version 9.2 (SAS Institute Inc., Cary, NC, United States) and Microsoft Excel 2007 (Redmond, WA, United States).

Results

Annual trend

Over the 20-year surveillance period, 6002 individuals presented to Canadian emergency departments for injuries associated with a bunk bed. While there were some period-to-period fluctuations in the proportions of cases, the frequency of bunk bed-related injuries in CHIRPP has overall remained relatively stable with an AAPC of −1.2% (−1.8, −0.5; Figure 1).

Overview

Table 1 summarizes the 5-year subset of analyzed cases. Figure 2 shows the normalized age- and sex-distribution by single year. Overall, 60.5% (n = 934) of

TABLE 1
Summary of emergency department surveillance of injuries associated with bunk beds, CHIRPP, all ages, 2002–2006, Canada

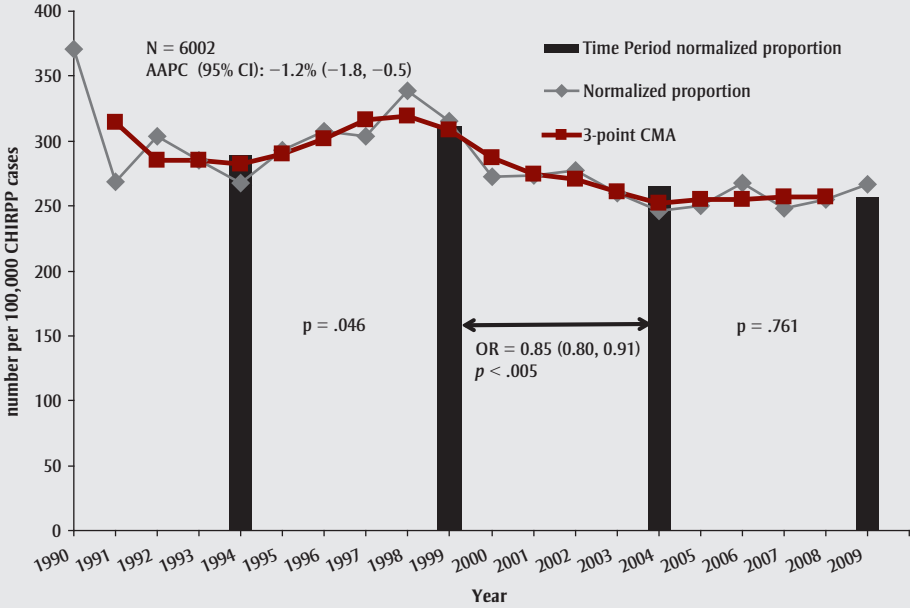
Bunk bed level	Number of cases, n (%)		Falls,[a] %
Upper	934	(60.5)	93.0
Ladder	263	(17.0)	96.6
Lower	53	(3.4)	67.9
Other [b]	28	(1.8)	35.7
Unknown	267	(17.3)	88.3
Total	**1,545**	**(100.0)**	**90.9**

Abbreviation: CHIRPP, Canadian Hospitals Injury Reporting and Prevention Program.

[a] Percentage of all cases for the given bunk bed level that were falls, including jumps.

[b] Patient was not on the bunk bed at the time of injury: contact with bunk bed, other person fell or jumped from the bunk bed and struck the patient who was sleeping on the floor, ladder fell on patient.

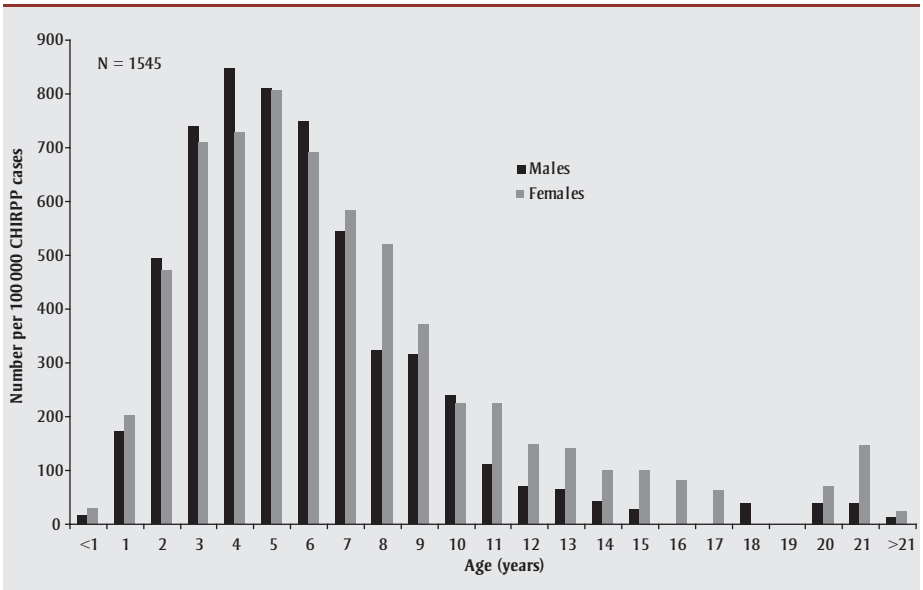
FIGURE 1
Annual trend of emergency department surveillance of injuries associated with bunk beds, CHIRPP, all ages, 1990–2009, Canada (N = 6002)



Abbreviations: AAPC, average annual percent change; CHIRPP, Canadian Hospitals Injury Reporting and Prevention Program; CI, confidence interval; CMA, central moving average; OR, odds ratio.

Note: Counts are expressed as a proportion of all cases in the given year (normalized counts). A 3-point CMA is applied to the normalized counts to smooth year-to-year fluctuations. The vertical bars are overall normalized counts ending on each 5-year period (1990–1994, 1995–1999, 2000–2004 and 2005–2009).

FIGURE 2
Emergency department surveillance of injuries associated with bunk beds according to age and sex, CHIRPP, all ages, 2002–2006, Canada (N = 1545)[a]



Abbreviation: CHIRPP, Canadian Hospitals Injury Reporting and Prevention Program.

[a]Counts normalized to the total number of cases in CHIRPP for the specific age-sex combination.

cases were related to the upper bunk, and of those, 93% were falls. When normalized for their total numbers in the database, girls were slightly more frequent for certain age groups.

The remainder of the analysis relates mostly to the 934 upper bunk-related cases. Other cases will be described briefly.

Upper bunk

Table 2 summarizes select characteristics of the upper bunk-related events. Incidents peaked in the 3- to 5-year age group (38.3%; 471.2/100 000) and 10.8% were admitted to hospital. Where reported, 42.7% (186/436) of the incidents occurred while the child was sleeping. Table 3 summarizes the specific mechanisms involved. Of the falls where the mechanism was known (n = 664), at least 45.9% (305/664) involved an activity which would be considered as appropriate use (sleeping/resting, getting in/out, sitting). Table 4 shows the distribution of all injuries suffered by the patients. Up to 3 injuries can be recorded on the CHIRPP form; Table 4 shows all injuries sustained, that is, that 934 children suffered 1044 injuries. Head, face and neck injuries accounted for 39.2% (409/1044) of all injuries, and brain injuries represented about 20%. Fractures made up about 40% of the total and about 1% were skull fractures.

Ladder and lower bunk

Almost one-fifth of all incidents involved the bunk-bed ladder. As a proportion of all same-age cases, 3- to 5-year-old children were most frequent at 147.4/100 000 CHIRPP cases. About one-third of the injuries were fractures and 5.3% were admitted to hospital. A smaller percentage occurred on the lower bunk. Children aged 10 to 13 years were most frequent at 15.9/100 000, and 3.8% were admitted to hospital.

Estimates of bunk bed-related hospitalizations due to falls

Table 5 shows the results of the methodology used to estimate bunk bed-related hospitalizations due to falls. Using the example of 5- to 9-year-olds in Table 5, the scaling factor (F_{CHIRPP}) is interpreted as follows: In CHIRPP, among those admitted to hospital for an injury involving a fall from any type of bed, 41.2% involved bunk beds. Overall, the estimated rates were relatively low, peaking among children aged 5 to 9 years.

TABLE 2
Emergency department surveillance of injuries associated with upper bunk-related incidents, CHIRPP, all ages, 2002–2006, Canada

Characteristic	Number of cases (n = 934)	
	n	%
Age group, years		
< 3	131	14.0
3–5	358	38.3
6–9	297	31.8
10–13	103	11.1
14–17	30	3.2
18 +	15	1.6
Sex		
Males	527	56.4
Time of day		
12:00 a.m. to 7:59 a.m.	127	13.6
8:00 a.m. to 11:59 a.m.	48	5.1
12:00 p.m. to 3:59 p.m.	69	7.4
4:00 p.m. to 7:59 p.m.	108	11.6
8:00 p.m. to 11:59 p.m.	127	13.6
Unknown	455	48.7
Disposition		
Left without being seen, advice only	202	21.6
Treated, medical follow-up if necessary	226	24.2
Treated, medical follow-up required	368	39.4
Prolonged observation in ED	37	4.0
Admitted to hospital	101	10.8
Direct Cause		
Floor	660	70.7
Bed (including ladder)	73	7.8
Other furniture	40	4.3
Toy	7	0.7
Ceiling fan[a]	5	0.5
Other	24	2.6
Unknown	125	13.4
Type of surface impacted (falls)[b]		
Non-carpeted[c]	343	39.5
Carpeted	109	12.5
Unknown	417	48.0
Usage		
Playing	250	26.8
Sleeping	186	19.9
Other/unknown	498	53.3

Abbreviations: CHIRPP, Canadian Hospitals Injury Reporting and Prevention Program; ED, emergency department.

[a] One other case related to a ceiling fan that resulted in a fall (direct cause was the floor).

[b] Based on falls from the upper bunk (n = 869).

[c] Includes hardwood, ceramic, cement and linoleum/vinyl floors.

TABLE 3
Emergency department surveillance of mechanism of upper bunk-related incidents, CHIRPP, all ages, 2002–2006, all ages, Canada

Mechanism	Number of cases (n = 934)	
	n	%
Falls	***869***	***93.0***
Unintentional fall	**803**	**85.9**
While playing	247	26.4
While sleeping or resting	186	19.9
While getting in or out	99	10.6
While reaching for an object or leaning over	21	2.2
While jumping/standing on bunk bed	21	2.2
While sitting on bunk bed	20	2.1
Due to guardrail collapse	3	0.3
Struck by ceiling fan	1	< 0.3
Not specified	205	21.9
Jumped off	**66**	**7.1**
Non-falls	***65***	***7.0***
Playing (not further specified)	18	1.9
Pushed or interfered with	17	1.8
Struck ceiling or top bunk while jumping on bunk bed	6	0.6
Struck by ceiling fan	5	0.5
Hanging/strangulation[a]	3	0.3
Body part entrapment	2	< 0.3
Other[b]	14	1.5
Total	**934**	**100.0**

Abbreviation: CHIRPP, Canadian Hospitals Injury Reporting and Prevention Program.

[a] The circumstances surrounding these cases are not clear – possibly attempted suicides, unintentional snagging or patient playing the "choking game" or some form of autoerotic asphyxia.

[b] Includes where patient jumped into bunk bed, struck against bunk bed, was jumped on by another person and incidents that do not clearly indicate the circumstance of injury.

Discussion

Our study provides the first comprehensive analysis of children presenting to Canadian emergency departments with bunk bed-related injuries. The narrative of the CHIRPP database was exploited to profile bunk bed-related injuries. The CHIRPP was also used as a tool to develop a scaling factor, or multiplier, that could be used to approximate the crude rates of injury hospitalizations due to falls from bunk beds and gain more insight into national hospitalization data related to these.

Annual trend

Although the CHIRPP data show a significant decline over 2000 to 2004, the trend stabilized over 2004 to 2009. Generally, one must be cautious when interpreting time trends; admissions policies, enhanced capture, changes in exposure and other factors may obscure subtle changes. However, sharp increases, decreases or persistence (slope ≈ 0) can be detected. Although there was an AAPC of -1.2%, this change is small and of little practical significance to injury prevention programs; it is equivalent to a reduction of approximately 4 cases per year.

Age guidelines

Health Canada's Consumer Product Safety Directorate and the U.S. Consumer Product Safety commission recommend that children aged less than 6 years not be allowed on the upper bunk.[5,13] Our results show that 52.3% of all injured patients were aged less than 6 years and that the peak age of falls and injuries is 3 to 5 years.

International literature

There have been a number of reports from other countries about bunk bed injuries.[4,8,14–18,32–33] Belechri et al.[4] compared the fall injury risk of bunk versus conventional beds in children under 15 years old who presented to the emergency departments of four hospitals in Greece over a three-year period (1996–98). Overall, 10.5% of falls were from bunk beds, with a peak age of 0 to 4 years (47.7%). Compared with conventional beds, bunk bed-related injuries were more serious, with a higher proportion of fractures, brain injuries and hospital admissions. Almost one-fifth (18.8%) of the falls occurred while the child was sleeping. D'Souza et al.[8] updated an earlier study by Mack et al.[15] who, using the National Electronic Injury Surveillance System (NEISS), examined bunk bed-related injuries among those aged under 21 years treated in U.S. emergency departments over a 16-year period (1990–2005). During this 16-year period, about 35 790 (42/100 000) cases of bunk bed-related injuries were treated annually, with the peak age at 3 to 5 years (33.2%) and no significant trend. Selbst et al.[14] prospectively studied injuries associated with bunk beds presenting to an emergency department for a one-year period (1987–1988). Of the 68 children who presented, 69% were aged under 6 years and almost one-third (29%) of the injuries occurred while the child was asleep. Mayr et al.[16] retrospectively described 218 bunk bed injuries from a pediatric trauma unit in Graz, Austria, for 1990–1999. The injuries were quite severe, including concussions (20.2%), fractures (27.5%) and 2 lacerated spleens (0.9%). Almost one-quarter (23.8%) of children were aged under 3 years. Macgregor[17] reported on 28 children who had fallen from an upper bunk; most (78%) were aged under 6 years, and 85% of falls occurred while the child was sleeping. Watson et al.[18] reported on bunk bed injuries in Australia, where about 2100 bunk bed-related injuries were treated annually in hospital emergency departments (50/100 000). The majority (86%) of these injuries occurred in

TABLE 4
Emergency department surveillance of injury profile (body part and nature of injury) of upper bunk-related incidents (n = 934), CHIRPP, all ages, 2002–2006, Canada

Injury[a]	Number of cases,	
	n	%
Upper extremity	***411***	***39.4***
Fracture	340	
Soft Tissue	36	
Sprain/strain	16	
Other minor upper extremity injuries	19	
Head, face, neck	***409***	***39.2***
Closed head injuries (brain)	**206**	**19.7**
Minor closed head injury	163	
Concussion	41	
Intracranial	2	
Scalp and facial lacerations	**86**	**8.2**
Fractures	**19**	**1.8**
Skull	10	
Facial	7	
Cervical	2	
Neck sprain/strain	**8**	**0.8**
Other minor scalp, face and neck injuries	**90**	**8.6**
Lower extremity	***148***	***14.2***
Fracture	58	
Soft tissue	43	
Superficial	19	
Sprain/strain	19	
Other minor lower extremity injuries	9	
Trunk	***54***	***5.4***
Bruise, abrasion	25	
Soft tissue	19	
Spinal fracture (thoracic)	2	
Injury to internal organ (abdomen)	1	
Other minor trunk injuries	7	
Asphyxia	***2***	***0.2***
Other/unknown	***20***	***1.9***
Total	**1044**	**100**

Abbreviation: CHIRPP, Canadian Hospitals Injury Reporting and Prevention Program.

[a] Up to three injuries can be reported per case, all injuries are indicated in this table (i.e. the 934 patients suffered 1044 injuries)

children aged under 10 years, peaking in the 5- to 9-year age group. Falls from the upper bunk resulting in a fracture accounted for 33% of injuries and concussions, 10%. Johnson[33] described a pediatric Lisfranc injury, commonly called a ''bunk bed'' fracture. The injury is considered major as there is ligamentous involvement and deformity. While only 14.2% of all injuries in our study were to the lower extremity, of those 53% of lower extremity fractures were to the foot. However, there was insufficient anatomical detail to classify the foot fractures as a Lisfranc injury.

The results of our investigation align with that of many international studies: [4,8,14–18,32–33] a high proportion of fractures and head injuries, more admissions compared to falls from conventional beds and peak age of injury under 6 years. In addition, a significant proportion of incidents occurred while the child was sleeping (19.9%; 186/934), which has implications for regulations and standards. Although insufficient information was available in the narratives, for a fall to have occurred from the upper bunk while the child was sleeping, the guardrails were either not attached or broke off during the fall or the child fell through the guardrail opening or through the portion of the bed frame that has no guardrail (the entrance).

Admissions to hospital are often used as a proxy for injury severity. The admission rates recorded in the above-referenced international studies [4,8,14–18] ranged from 2.9% to over 30% of all bunk bed-related injuries. It is difficult to compare admission rates between countries—or even within a country—due to different administrative policies and other factors. The most reliable comparison is between different injury mechanisms within the same surveillance system. In our study, cases involving the upper bunk had an admission rate of 10.8%, whereas those involving the ladder and the lower bunk had admission rates of 5.3% and 3.8%, respectively. Injuries associated with conventional beds, which are about 8 times as frequent as bunk-bed injuries in CHIRPP, have an admission rate of 3%. A comparison of injuries of lower bunk users and those of conventional beds users would be of interest; even though height would not be a factor, there may be a higher severity of injury for the lower bunk user due to the presence of the upper structure.

Short-distance free-falls

There is ample literature on free falls from a height.[34–47] Based on this literature, short falls are defined as less than 1.2 m to 1.5 m (4–5 feet) whereas significant fall height for the purposes of triage and injury severity is greater than 3.0 m to 4.6 m (10 to 15 feet). Bunk beds, at 1.7 m to 2.0 m (5.5–6.5 feet), are generally slightly higher than the cut-off for short distance falls. Nevertheless, there is a 50% difference in kinetic energy between a 1.2 m (4 feet) and a 2.0 m (6 feet) fall. The results of this study and others show that

TABLE 5
Estimates of the crude rate of hospitalizations (per 100 000 population) associated with falls from bunk beds, 0–14 years, fiscal years 2003/2004 to 2008/2009, Canada

Age group, years	F_{CHIRPP}[a], mean (SD)	Hospitalizations (all bed types)[b]		Bunk bed Falls	
		Count $_{ICD\text{-}10\ W06}$	Crude rate	Estimated rate ($\hat{R}_{BB}$)	95% CI[c]
0–4	0.117 (0.038)	1286	16.72	1.95	1.44–2.45
5–9	0.412 (0.088)	461	5.41	2.23	1.85–2.61
10–14	0.656 (0.216)	114	1.18	0.78	0.57–0.98
0–14	**0.242 (0.048)**	**1861**	**7.20**	**1.74**	**1.47–2.02**

Abbreviations: CHIRPP, Canadian Hospitals Injury Reporting and Prevention Program; CI, confidence interval; CIHI, Canadian Institute for Health Information; ICD-10 W06, *International Classification of Diseases, 10th Revision* code W06; SD, standard deviation.

[a] Scaling factor developed from case ratios (bunk bed injuries to all bed injuries, admitted for falls from a bed) in CHIRPP, fiscal years 2003/2004 to 2008/2009, ages 0–14 years.

[b] Source: Health Surveillance and Epidemiology Division (Centre for Chronic Disease Prevention) analysis of PHAC holdings of CIHI morbidity data. Bed types include cribs, toddler beds, conventional beds and bunk beds.

[c] Variability is calculated with respect to the scaling factor rather than the rate per se.

serious injuries are indeed possible from bunk-bed falls.

Other events

Although most of the non-fatal injuries are caused by falls, there are a number of rare and/or serious non-fall injury mechanisms associated with bunk beds, principally to do with intentional or unintentional strangulation. Our investigation found 3 (0.3%) cases of hanging/strangulation. However, it was not clear whether these were attempted suicides, unintentional snagging of clothing or possibly a result of playing a ''choking game,'' the cause of death in one fatal case of a 12-year-old girl found hanging from her bunk bed.[48]

Another mechanism involves head injury from ceiling fan blades. We found 6 cases, one of which lead to a fall. Mack et al.[15] found that 8% of cases involved ceiling fans. Alias et al. [49] found jumping on a bunk bed to be a mechanism of such injuries.

Rate estimation and exposure

In this study, we used the CHIRPP database in a different way to help overcome the limitations of ICD coding and to form estimates of the rates of hospitalization due to falls from bunk beds. We found these to be fairly low: 1.74/100 000 (ages 0–14 years) with a peak at age 5 to 9 years (2.23/100 000). D'Souza et al.[8] reported a rate of 42/100 000 for all emergency department presentations (0–21 years) and Watson et al.[18] found this rate to be 50/100 000 for Australia and 22/100 000 for the Netherlands (0–14 years). Since hospital admission rates vary between countries, it is not possible to compare estimates. As a comparison, Canadian hospitalization data for falls from playground equipment[30] over the same time period demonstrate rates ranging from about 16/100 000 for those aged under 4 years to 55/100 000 for 5–9 year-olds.

Although these rates for bunk bed-related falls are population-based, they are not the true population rates since we do not know the number of children sleeping in bunk beds who do not get injured. A first step in calculating a true population rate would be to have a reliable measure of the number of Canadian households with bunk beds. We were unable to find any Canadian data, but there were a small number of surveys from other countries. Based on two Australian surveys, Watson et al.[18] found the prevalence of bunk beds to be 11% to 15%, while Senturia et al.[50] indicating that, based on a cross-sectional survey of 679 Chicago families, 24% used bunk beds.

Limitations

CHIRPP data do not represent all injuries in Canada. Older teenagers and adults, native people, people living in rural areas and those fatally injured are all under-represented.

Conclusions

Young children continue to present to Canadian emergency departments suffering from bunk bed-related injuries, including serious ones. Injury prevention programs would best be served by a two-pronged approach. First, the high proportion of children falling out of the upper bunk while they are sleeping indicates that further attention is needed in the areas of manufacturing and standards and regulation. The second arm of the mitigation approach relates to education with respect to appropriate/inappropriate use of the bunk (age, playing). CHIRPP surveillance will continue to help inform prevention/mitigation programs.

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