ARTICLE

Review of Hazards Associated With Children Placed in Adult Beds

Suad Nakamura, PhD; Marilyn Wind, PhD; Mary Ann Danello, PhD

Objective: To identify and assess dangers associated with placing children younger than 2 years to sleep in adult beds. This article focuses on overlying, wedging, and strangulation hazards and the relationship of these hazards to children's sleeping environments.

Design: A retrospective review and analysis of data collected by the US Consumer Product Safety Commission on deaths of children younger than 2 years in standard adult beds, daybeds, and waterbeds. The review included incident data from January 1990 through December 1997.

Results: The 8-year records showed a total of 515 deaths of children younger than 2 years who were placed to sleep on adult beds. Of these deaths, 121 were reported to be due to overlying of the child by a parent, other adult, or sibling sleeping in bed with the child and 394 were due to entrapment in the bed structure. Most of these deaths seem to have resulted from suffocation or strangulation caused by entrapment of the child's head in various structures of the bed.

Conclusion: Placing children younger than 2 years to sleep in adult beds exposes them to potentially fatal hazards that are generally not recognized by the parent or caregiver. These hazards include overlying by a parent, sibling, or other adult sharing the bed; entrapment or wedging of the child between the mattress and another object; head entrapment in bed railings; and suffocation on waterbeds. Parents and caregivers should be alerted to these avoidable hazards.

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Editor's Note: The results of this study should be shared with all parents of infants and toddlers younger than 2 years. I was surprised by the extent of the problem; can you just imagine the state of a parent who overlays a child, resulting in his or her death?

Catherine D. DeAngelis, MD

From the US Consumer Product Safety Commission, Bethesda, Md.

DURING THE past few years, considerable attention has been paid to the potential hazards associated with the sleeping environment of infants. In 1994, the American Academy of Pediatrics, the US Department of Health and Human Services, and the US Consumer Product Safety Commission (CPSC) joined in "Back to Sleep," a national campaign aimed at reducing the risk of sudden infant death syndrome (SIDS) and suffocation of infants on soft bedding.[1-5] Since the launch of this educational campaign, the incidence of SIDS in the United States has decreased by 38%.[6] This article, however, focuses on another area of concern: the death of infants placed to sleep in standard adult beds, waterbeds,[7-12] and daybeds. The present study revealed an average of 64 deaths per year associated with this scenario, a fairly constant rate for the 8 years in which data were collected.

Unlike adults, the limited physical and developmental capabilities of infants and young children render them susceptible to danger from suffocation in certain sleeping environments. Mechanical asphyxia can occur when an adult sleeping with a child rolls on top of the child, smothering him or her. Asphyxia can also result from the wedging of a child's head between the mattress and other components of the bed. The face may become pressed against the mattress such that the mouth and nose are blocked, resulting in suffocation. A similar blockage may occur when a child becomes trapped face down in a space or depression in the mattress and bedding, and is unable to lift the head to breathe. This is due in part to the relative mass of the infant head compared with the total body (8%-10% of the total body weight) and weakness of the neck muscles.[13,14] Asphyxia can also oc-

MATERIALS AND METHODS

A retrospective review and analysis of data collected by the CPSC on deaths of children younger than 2 years in standard adult beds, daybeds, and waterbeds was undertaken. The CPSC databases IPII, INDP, and DTHS were searched for the review. The IPII file contains data on consumer product–related incidents extracted from consumer complaints, as reported to CPSC through letters and telephone calls. The IPII database also includes media articles, medical examiner reports, reports from fire and police departments nationwide, and referrals from other federal agencies.[17]

The INDP file contains data from follow-back investigations reported by CPSC staff in an effort to gather detailed information on death or injury associated with a particular consumer product.[18] The DTHS file includes information from death certificates purchased by CPSC from all 50 states and the District of Columbia. Death certificates that fall within specified external cause of death (E code) categories, in accordance with the *International Classification of Diseases, Ninth Revision (ICD-9)*, with a narrative section that is likely to mention a specific consumer product, are purchased.[19] The review included incident data from January 1990 through December 1997. The deaths reported in these databases do not represent a complete count of all bed-related deaths for children younger than 2 years, nor do they represent a statistical sample of known probability.

Cases were assigned to 4 major incident scenarios involving adult beds based on the narrative provided in the case reports or by the medical examiner or coroner: (1) death by smothering due to overlying of a parent or another adult or child on the victim, (2) wedging between the mattress and the wall or bed frame and wedging between the bed and an adjacent piece of furniture; (3) suffocation on waterbeds due to airway obstruction when the child is face down on the mattress; and (4) strangulation due to neck compression between the side railings of a daybed, the railings of the headboard, or the railings of the footboard. Deaths that were described by the medical examiner or coroner as "probable overlay" or "overlay, probable SIDS" were not included in the analysis.

It should be noted that there were several limitations in this study because all 3 databases provide anecdotal information and are not denominator based. Thus, they do not provide a basis for statistical inferences on the frequency of a specific injury. These deaths do not represent a sample of known probability of selection or a complete count of bed-related deaths for children younger than 2 years. We recognize that the deaths reported in the databases are underestimates; ie, the databases provide the minimum number of known deaths. Because it is not possible to determine how many children are actually put to sleep on adult beds, the data cannot be used to calculate relative risks. We are aware of these limitations; however, these unique databases are likely to provide the most extensive source of information on these types of death.

cur when an infant's neck is pressed against a bed frame or railing. Blood vessels that take blood to and from the brain and the carotid sinuses are located in soft tissues of the neck. These vessels are relatively unprotected and vulnerable to compression. As little as 2 kg (4.4 lb) of pressure exerted on the neck can result in vascular occlusion.[15] This can cause unconsciousness and death. Inadequate oxygen supply to the lungs and impairment of oxygen transport to tissues due to obstruction of blood circulation leads to brain hypoxia and can also result in cardiac arrest when the carotid sinus-vagal reflex is stimulated.[16]

The CPSC has long been concerned with ensuring that infants and young children have safe sleeping environments and has developed mandatory federal crib standards to protect against entrapment and strangulation. Commission staff actively participate in the development of and improvements to voluntary standards for cribs. The CPSC has also issued public safety alerts to inform the public about hidden hazards of children's sleeping environments.

Several studies have reported that suffocation and strangulation of infants have occurred in various types of adult beds, including waterbeds.[8,11,12] In an attempt to understand the incident scenarios and to investigate whether they might be prevented by specific intervention strategies, staff conducted a preliminary analysis of these deaths by examining the data collected by CPSC

Three CPSC databases were used for this purpose: Injury and Potential Injury Incidents (IPII), In-Depth Investigations (INDP), and Death Certificates (DTHS). The review included incident data from January 1990 through December 1997. Information provided in these databases is anecdotal and useful in describing features of a pattern of injury. However, it cannot be used for making statistical inferences because it does not represent a sample of known probability of selection or a complete count of all bed-related deaths for children younger than 2 years. We are unaware, however, of any alternative source that is as comprehensive.

RESULTS

The search of records from the 3 CPSC databases, IPII, INDP, and DTHS, between January 1990 and December 1997 showed a total of 515 deaths of children younger than 2 years who were placed to sleep on adult beds. Examination of these 515 records indicated that there were 4 major incident scenarios involved in these deaths: (1) suffocation due to overlying of a parent or another adult or child on the victim; (2) positional asphyxia due to wedging of the head between the mattress and the wall, bed frame, or an adjacent piece of furniture; (3) suffocation on waterbeds due to airway obstruction caused by the child being face down on the mattress; and (4) strangulation between the side railings of a daybed, the railings of the headboard, or the railings of the footboard.

Of the 515 deaths, 121 were reported to be due to overlying of the child by a parent, other adult, or sibling sleeping in bed with the child and 394 were due to en-

Deaths of Children in Adult Beds Between January 1990 and December 1997

	Sleeping Environment				
Hazard Pattern	Adult Beds	Waterbeds	Daybeds	Bed Railings	Total
Entrapments					
Wedging between mattress and wall	125	3			128
Entrapment between mattress and bed frame	128	8	6	3	145
Entrapment between mattress and adjacent furniture	20			2	22
Strangulation between bed railings	23		4	4	31
Suffocation on waterbeds		68			68
Total entrapments	296	79	10	9	394
Overlying	108	13			121
Total (overlying + entrapment)	404	92	10	9	515

trapment in the bed structure. Of the 394 bed entrapment deaths, 296 deaths were on regular adult beds, 79 were on adult waterbeds, 10 were on adult daybeds, and 9 were on adult-sized beds fitted with bed rails (an "add-on" product designed to keep a child from falling out of the bed). Most of these deaths seem to have resulted from suffocation or strangulation caused by entrapment of the child's head in various structures of the bed (**Table**).

OVERLYING

The co-sleeping of mother and infant to encourage breastfeeding and the strengthening of the bond between a mother and child has been advocated by some.[20] However, there is some evidence to suggest that the practice may introduce a hazard of death by overlying.[7,11,20] The CPSC data for January 1990 through December 1997 revealed 121 incidents where the cause of death was reported on the death certificate to be "death due to overlying." There were 18 deaths where the cause of death was listed as "probable overlay" or "overlay, probable SIDS," but because of the ambiguity in the cause of death in these 18 cases they were not included in this analysis. Death due to overlying is not always distinguishable at autopsy, and therefore these data were based solely on the medical examiner's or coroner's determination of the cause of death. While death certificates often provide only limited information on the cause of death, the circumstances surrounding the 121 deaths clearly specify overlying as the cause. The certificates often included additional descriptions such as "compressed beneath mother's body," "sleeping mother overlay child's body," "compressing from overlying," "found under parent," "accidentally rolled over by mother," "rolled-upon compression," "traumatic compression," and "fell asleep while nursing." The age of the infants ranged from 1 to 12 months, with 93 of the deaths (77%) occurring in infants younger than 3 months (**Figure 1**). While an earlier study reports that deaths due to overlying by a parent occurred mainly on waterbeds,[12] this study found only 13 of the incidents (11%) involved waterbeds. Similarly, while an earlier report had found alcohol consumption was involved in a significant number of cases, this study found only 2 incidents (0.2%) in which prior alcohol or other drug consumption was reported. However, death certificates often provide limited information in this regard and therefore it is not known whether alcohol consumption was a contributing factor in other cases.

ADULT BEDS

A review of CPSC data files from January 1990 to December 1997 identified 296 deaths of children younger than 2 years on regular adult beds (standard twin-, queen-, and king-size beds). Three major hazard patterns were associated with these deaths. Of the 296 deaths, 125 (42%) were due to wedging of the infant between the bed mattress and a wall adjoining the bed, 128 (43%) were due to wedging between the bed mattress and the headboard or footboard of the bed, 23 (8%) were due to strangulation when the infant became entrapped at the neck between the railings of a footboard or headboard, and 20 (7%) were caused by entrapment between the mattress and an adjacent piece of furniture. Two hundred three (69%) of these deaths occurred in infants younger than 6 months, with 264 of the deaths (89%) occurring in infants younger than 1 year (**Figure 2**).

WATERBED-RELATED DEATHS

Between January 1990 and December 1997, CPSC had reports of 79 waterbed-related deaths for children younger than 2 years. There were 2 modes of death associated with waterbeds. In 68 deaths (86%), the cause of death was listed as airway obstruction. The infants were found in the prone position, face down on the soft, nonpermeable surface of the waterbed, and death was apparently caused by airway obstruction. The remaining 11 (14%) were due to positional asphyxia caused by wedging of the infant between the mattress and waterbed frame or wall. The ages of children ranged from 1 to 18 months; however, 69 (87%) were infants younger than 6 months

DAYBEDS

The CPSC databases for the same 8-year period identified 10 deaths involving daybeds. Daybeds are adult beds, generally the size of a standard twin bed, that are surrounded on 3 sides by a decorative frame that is often metal. In 6 incidents, the death was caused by mechanical asphyxia due to wedging of the infant between the

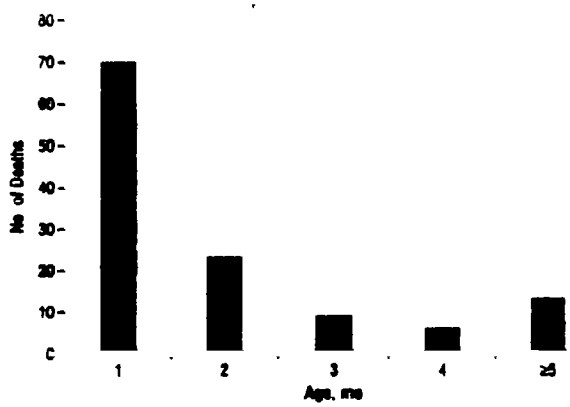

Figure 1. *Deaths due to overlying, January 1990 to December 1997.*

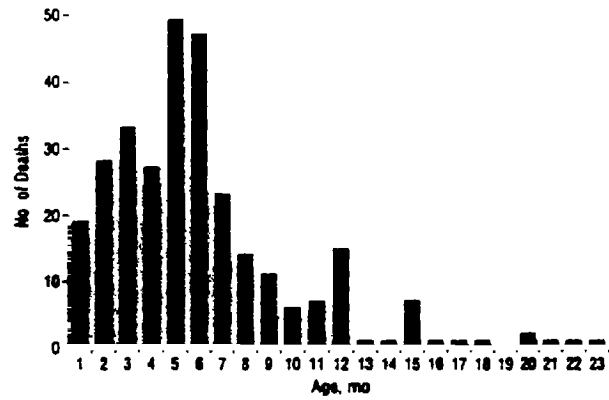

Figure 2. *Children's deaths in adult beds between January 1990 and December 1997.*

mattress and railing. The 4 remaining deaths were caused by strangulation when the child's head was caught between the railings of the daybed. The infants ranged in age from 3 to 15 months with all except 1 being younger than 12 months.

BED RAILS

The CPSC databases for the same 8-year period revealed 8 deaths in children younger than 2 years involving bed rails. Bed rails are portable railings that can be installed on toddler and adult beds to protect toddlers from falling out of the beds. Examination of these incidents indicates the principal hazard is entrapment of the infant between the bed rail and mattress, resulting in mechanical asphyxia due to neck compression. Despite the fact that these rails are not intended for use on beds for children younger than 1 year, 7 of the 8 deaths occurred in children younger than 1 year. The CPSC is working with the industry on the design of these products to reduce the hazard.

COMMENT

In reviewing data available to the CPSC on children's deaths associated with adult beds from January 1990 through December 1997, it is clear that the greatest number of deaths among infants occur in those younger than 12 months. The death rate during the 8-year period was fairly constant, with an average of 64 deaths per year. One of the most troubling aspects of these deaths is that they are largely preventable. In many cases, the adult placing the child in the adult bed was unaware or underestimated the danger posed by placing an infant to sleep in an adult bed. Also, while mothers should be encouraged to breast-feed because of the positive benefits to the infant's health, they should be alerted to the hazard of overlying when the infant remains in bed with the mother after feeding.

Death associated with sleeping in adult beds seems to be greatly reduced once children reach the age of 2 years. In addition to the deaths of children younger than 2 years that were reviewed for this analysis, a CPSC study of deaths occurring on adult beds in children older than 2 years for the same 8-year period from January 1990 to October 1997 revealed only 17 deaths.[21] Notably, 8 of these incidents involved children who were severely disabled. Disabled children, regardless of age, are more vulnerable if their disability prevents them from freeing themselves from a compromised position such as entrapment. The continued danger to these children should be made clear to caregivers.

While it would be useful to compare the number of deaths in adult beds with the number of deaths in cribs, the current study was not designed to address this question, and there are no studies on which to make such comparisons. Any direct comparisons between this and other studies would be confounded by the following: deaths would not necessarily have been recorded during the same time frame, the study would not reflect a sample of known probability of selection or a complete count of all bed-related deaths for children younger than 2 years, and the amount of time spent in adult beds vs cribs is unknown. Nevertheless, another CPSC study on crib-related deaths[22] between 1989 and 1991 using the same 3 databases showed an average of 50 reported accidental deaths per year in cribs. This is less than the 64 deaths per year in adult beds found in the present study. It is important to note that in most of these crib-related cases, the deaths were due to defects or broken parts in older cribs, often at least 10 years old. These are cribs that do not comply with current federal safety standards[23,24] and industry voluntary standards for cribs.[25]

One approach to addressing the problem associated with children's sleeping environments is to educate parents and caregivers about the potentially fatal hazards associated with placing infants in adult beds. Parents and caregivers need to be aware of the principal dangers associated with this practice. These include the hazard of suffocation associated with co-sleeping with infants younger than 5 months, asphyxia where an infant becomes entrapped between the mattress and another object, asphyxia due to airway obstruction when the child is face down on the mattress, and strangulation in vertical rails or openings on beds that allow an infant's body to pass through while entrapping the head. Parents and caregivers should be advised that infants should be placed to sleep in cribs that meet federal safety standard and the

industry voluntary standard. While the present study indicates that the most of the deaths occurred in children younger than 1 year, it seems prudent to adopt CPSC's recommendation that children sleep in cribs until they are 2 years old or reach a height of 89 cm (35 in) [26] (The latter is based on the increased dangers of a child climbing over the crib railing and falling) Currently, there are federal safety standards and industry voluntary standards in place for cribs that are designed to prevent the types of entrapment and strangulation that are described in this article.[23-25]

Efforts to get information to parents and caregivers concerning the hazards described in this article should be promoted. The dissemination of this information by health care providers in the context of a health educational program for parents is one possible route.[27,28] The success of such a program will depend on the parents receiving frank warnings about the potentially fatal consequences for children left to sleep on adult beds.

RECOMMENDATIONS

Health care providers can use the following recommendations to educate parents about the danger of placing infants to sleep in adult beds.

- Children younger than 2 years should sleep in cribs that meet the federal safety standards and industry voluntary standard.
- Children younger than 2 years, or disabled children whose movements are restricted, should not be put to sleep in adult beds (including waterbeds) that present a risk of entrapment between the bed mattress and a wall, headboard, footboard, side railings, or adjoining furniture.
- Children younger than 2 years, or disabled children whose movements are restricted, should not be put to sleep in adult beds with railings (headboard, footboard, or side railings) that present a risk of strangulation by head entrapment.

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Corresponding author: Suad Nakamura, PhD, Directorate for Epidemiology and Health Sciences 600-18, US Consumer Product Safety Commission, 4330 East-West Hwy, Bethesda, MD 20814-4408 (e-mail. snakamura@cpsc.gov)

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