

Crib Bumpers Continue to Cause Infant Deaths: A Need for a New Preventive Approach

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Objectives To assess whether clutter (comforters, blankets, pillows, toys) caused bumper deaths and provide an analysis of bumper-related incidents/injuries and their causal mechanisms.

Study design Bumper-related deaths (January 1, 1985, to October 31, 2012) and incidents/injuries (January 1, 1990, to October 31, 2012) were identified from the US Consumer Product Safety Commission (CPSC) databases and classified by mechanism. Statistical analyses include mean age, 95% CIs, χ^2 test for trend, and ANOVA with a paired-comparisons information-criterion post hoc test for age differences among injury mechanisms.

Results There were 3 times more bumper deaths reported in the last 7 years than the 3 previous time periods ($\chi^2_{(3)} = 13.5, P \leq .01$). This could be attributable to increased reporting by the states, diagnostic shift, or both, or possibly a true increase in deaths. Bumpers caused 48 suffocations, 67% by a bumper alone, not clutter, and 33% by wedgings between a bumper and another object. The number of CPSC-reported deaths was compared with those from the National Center for the Review and Prevention of Child Deaths, 2008-2011; the latter reported substantially more deaths than CPSC, increasing the total to 77 deaths. Injury mechanisms showed significant differences by age ($F_{4,120} = 3.2, P < .001$) and were caused by design, construction, and quality control problems. Eleven injuries were apparent life-threatening events.

Conclusion The effectiveness of public health recommendations, industry voluntary standard requirements, and the benefits of crib bumper use were not supported by the data. Study limitations include an undercount of CPSC-reported deaths, lack of denominator information, and voluntary incident reports. (*J Pediatr* 2015; ■: ■-■).

In 2007, Thach et al¹ published a case series of 27 deaths attributable to crib bumpers and concluded that bumpers should not be used. In January 2008² and again in 2011,³ the American Academy of Pediatrics (AAP) recommended against their use. The Canadian Paediatric Society,⁴ the National Institutes of Health,⁵ and sudden infant death syndrome (SIDS) experts⁶ also recommended against their use, and 2 jurisdictions banned their sale.^{7,8} Others disagreed,⁹⁻¹¹ contending that factors such as clutter in the crib (comforters, blankets, pillows, toys) are the primary cause of the deaths and believe that eliminating crib bumpers may encourage caregivers to use products such as pillows as a substitute to protect infants from head injuries and limb entrapment.

There are no federal regulations for crib bumpers. There is a long-standing industry voluntary standard that was revised in 2012 to improve crib bumper safety.¹² In 2012, the US Consumer Product Safety Commission (CPSC) was petitioned to develop a mandatory standard to “distinguish and regulate pillow-like crib bumpers from non-hazardous traditional crib bumpers” and recommended the voluntary standard as a basis for such a rule.⁹ In June 2013, the Commission directed CPSC staff to explore all rulemaking options in addition to those requested in the petition before making a decision. This could be as little as adopting the current voluntary standard to as much as banning the product.¹³ To date, there has been no further public action.

The purpose of this study is to identify the extent to which clutter in the crib is the cause of infant deaths based on new information and an update of the study of Thach et al¹ and provide a new analysis of nonfatal bumper-related incidents to document the extent of the problem more fully.

Methods

Four CPSC databases were searched by CPSC staff from January 1, 1985, to October 31, 2012, for bumper deaths and from January 1, 1990, to October 31, 2012, for incidents/injuries. To be complete, we included the years covered by the study of Thach et al¹ but limited to deaths in cribs. The Death Certificate

AAP	American Academy of Pediatrics
ALTE	Apparent life-threatening event
CPSC	US Consumer Product Safety Commission
NCRPCD	National Center for the Review and Prevention of Child Deaths
SIDS	Sudden infant death syndrome

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file contains death certificates purchased by CPSC from the 50 states and the District of Columbia and includes deaths for all suffocation codes except for “falling earth.” The Injury and Potential Injury Incidents file contains product-related incidents from sources such as consumer complaints, media articles, medical examiners, coroners, and police and fire departments. The In-Depth Investigations file contains CPSC follow-up investigations. The National Electronic Injury Surveillance System, a probability sample of US hospitals with emergency departments, contains reports of product-related injuries and some deaths.

Data analyses were conducted with SPSS version 17.0 (SPSS Inc, Chicago, Illinois). Statistical analyses included mean age and 95% CIs, χ^2 test for trend, and ANOVA test with a paired-comparisons information-criterion post hoc test¹⁴ for mean age differences among injury mechanisms. *P* values $\leq .05$ (2-sided) were judged to be statistically significant.

Results

We identified 48 infant deaths; 42 were specifically attributed to crib bumpers on the death certificate, autopsy, or investigation and diagnosed by the medical examiners or pathologists as asphyxia or suffocation. We also included 6 additional deaths as likely bumper-related; 5 were originally diagnosed as SIDS and 1 as a sudden unexplained infant death. The documents available for review included autopsies (98%), death scenes and other investigations (98%), death certificates (75%), and photographs (62.5%), including 23 re-enactment photographs. The search also produced 182 nonfatal incidents. We classified these as 146 injuries and 36 “concerns” of caregivers who identified problems with bumpers, but with no injury. We further classified the injuries by mechanism.

Deaths

Over time, there was a significant increase in the number of crib bumper deaths reported to CPSC, with 23 deaths reported from 2006 through 2012 and an average of 8 deaths reported in the previous 3 time periods ($\chi^2_{(3)} = 13.5$, $P \leq .01$; **Figure 1**).

The mean age at death was 4.6 months, with a range of 1-22 months (95% CI 3.5-5.8). Approximately 50% were ≤ 3 months and 90% were ≤ 7 months. Three infants were noticeably older than others (14, 19, and 22 months). Two had significant illnesses (cerebral palsy; chronic anoxic encephalopathy caused by meconium aspiration), and the 14-month-old infant was healthy with a recent history of cold symptoms.

Complete sleep position information was available for 34 infants and partial information for 9 infants. Placing infants prone to sleep was the most stable position. Of the 14 infants placed prone, 13 infants were found prone and 1 position found was unknown. Placing infants supine or on their sides was less stable. Of the 16 infants placed supine to sleep, 8 were found prone, 3 on their sides, and 5 supine. Of the 4 infants

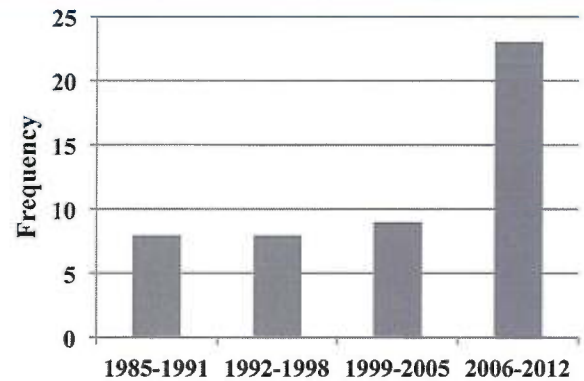


Figure 1. Crib bumper deaths by year.

placed on their sides to sleep, 2 were found prone, 1 on its side, and 1 position found was unknown. Finally, of the 13 infants whose position placed to sleep was unknown, 7 were found prone, 2 on their sides, and 4 infants had no sleep position information available.

To identify whether clutter in the crib contributed to the deaths, we evaluated whether the deaths were caused by the bumper alone or occurred with another object. In the “bumper alone” category, approximately 67% of the total deaths ($n = 32$) could have been prevented if a crib bumper had not been used in the crib: 13 deaths from infants wedged between a bumper and crib mattress; 12 deaths with the infant’s face against a bumper without wedging; 3 deaths with the infant’s arm caught between the bumper and the mattress/side rails found with their faces pressed against a bumper; 1 death where an infant likely climbed out of the crib using the bumper and was found wedged between a crib and bureau; and 3 strangulations from bumper ties wrapped around an infant’s neck. Strangulation deaths have not occurred since the 1980s.

In the “bumper and other object” category, approximately 33% of the total deaths ($n = 16$) could have been prevented if either the bumper or other wedging surface had not been present in the crib. These were 9 deaths from wedgings between a pillow and a bumper; 5 deaths from infants wedged between a bumper and a recliner; 1 death in a crib depression where the bumper prevented the infant from turning her face to the side to breathe; and 1 wedging between a cosleeping twin and a bumper.

We also attempted to determine whether only thick or pillow-like bumpers were implicated in the deaths. Although most investigators did not measure the thickness of the bumpers involved, there were 3 investigations that reported a measured thickness of 1-2 inches uncompressed and several other scene photographs that showed apparently thin bumpers (**Figure 2**; available at www.jpeds.com).

Nonfatal Incidents/Injuries

We reviewed 146 nonfatal incident reports and classified them by the mechanism likely to have caused the infant’s

injury (Table). Three cases were classified by 2 mechanisms (near-suffocation and limb entrapment).

At least 11 of the 146 nonfatal incidents were apparent life-threatening events (ALTEs). Four ALTEs were near suffocations: 2 infants found with their faces pressed into bumpers, 1 found blue, limp, and not breathing and another found after a monitor indicated that the infant stopped breathing; a third infant found wedged between a bumper and mattress diagnosed with “transient cyanosis probably second to position”; and a fourth infant found under a bumper with red face from not being able to breathe. Two ALTEs were chokings: 1 infant swallowed a piece of plastic from a bumper, and another choked on a bumper tie. One ALTE was a near strangulation, with an infant experiencing “temporary anoxia.” For 4 ALTEs, infants fell from the crib after climbing on a bumper and went to the emergency department with a head injury.

The average age of infants involved in the incidents was 7.4 months but varied significantly by mechanism ($F_{4,120} = 3.2, P < .001$), excluding the miscellaneous category. A cluster analysis of mean ages by use of the paired-comparisons information-criterion post hoc test method identified the best model that minimized the Akaike information criterion (= 691.9) and comprising 3 distinct clusters. The first cluster, infants involved in near-suffocations, was the youngest ($\bar{X} = 5.0$ months). The middle cluster, infants involved in choking/ingestion or strangulation/entrapment incidents ($\bar{X} = 7.7$ months each), were older than those involved in near-suffocation incidents and younger than those involved in limb entrapments or falls. The last cluster, infants involved in limb entrapments or falls, were the oldest ($\bar{X} = 11.3; \bar{X} = 11.4$ months, respectively).

Near-suffocation incidents (37.6% of 149) often resulted from poor bumper design, with 36% reporting bumpers with inadequate ties, many with missing bottom ties. Infants in near-suffocation incidents were found under a bumper, face covered by a bumper, wedged between a bumper and crib slats, entangled in a bumper, and in 3 cases, wedged with a positioner.

Choking/ingestion and strangulation/entrapment incidents (33.6% of 149) most often resulted from poor construction quality, including bumper ties and decorations that detached, seams with stuffing that came loose, and fraying threads. In all choking/ingestion incidents, infants

were found either with bumper parts down their throats or in their mouths. In 43% of the strangulation/entrapment incidents, the bumper part was wrapped around the infant's neck or head.

Limb entrapments and falls (21.5% of 149) were reported for the oldest infants. Soft-tissue injury was reported most frequently for limb entrapments and occurred with a bumper in the crib. Several caregivers noted that they bought a bumper to be protective but the infant “still managed to get stuck” by putting their legs over or under the bumper. Falls were reported for 8 infants who fell outside the crib and 1 inside the crib after climbing on a bumper. Two were diagnosed with a closed head injury, 2 with a head injury, 1 fell to the floor hitting his head, 1 fell on his back, and 1 sustained a lower trunk injury and 1 a leg injury. All 8 infants went to the emergency department, and all but one was >8 months of age.

We categorized incidents that did not fit elsewhere as miscellaneous. Of particular concern were 3 reports of finding needles in bumpers, likely a failure of quality control procedures. One incident resulted in a puncture of an adult, another with an infant's scratched eye, and a third with no injury.

Discussion

Our analysis of 48 deaths found that most of the deaths were caused by the bumper alone and would have been prevented if a bumper had not been in the crib. Although the cribs were not free of other objects (eg, comforters, blankets, pillows, toys), this clutter was not in contact with or near the infants' nose and mouth in approximately 67% of the deaths.

This study documents a significant increase in bumper death reports, with 3 times the number of deaths reported in the most recent time period. This increase could represent increased reporting by the states, diagnostic shift, or both, or possibly a true increase in deaths. However, there appears to be a substantial CPSC undercounting of these deaths. The National Center for the Review and Prevention of Child Deaths (NCRPCD),¹⁵ under confidentiality agreements with states in their network, has reports of 32 bumper-related deaths from 2008 to 2011 from 37 states (personal communication, Director, NCRPCD. Because of confidentiality agreements with the states, the NCRPCD was unable to share their cases with CPSC or us). For this same time period, CPSC has 13 reports of bumper deaths from 26 states, with only 3 that were from the same states as the NCRPCD cases. Combining reports from these 2 sources would increase the overall total to 77 deaths. This study, along with NCRPCD, ALTE, and injury data, suggests that crib bumpers present a much greater problem than originally indicated by the study of Thach et al.¹

Our study has several limitations. Of significant concern is the apparent undercount of CPSC reports of bumper-related deaths compared with NCRPCD data. This difference could result from the lack of specific diagnoses on some death

Table. Nonfatal crib bumper mechanisms by age

Mechanisms	n	Age, mo	
		Mean	95% CI
Near suffocation	56	5.0	4.2-5.8
Choking/ingestion	27	7.7	6.7-8.8
Strangulation/entrapment	23	7.7	6.2-9.1
Limb entrapment	24	11.3	8.5-14.1
Falls	8	11.4	8.9-13.9
Miscellaneous	11	4.9	2.9-6.9
Total	149	7.4	6.6-8.1

certificates that may not identify a bumper or pad as a contributing cause and thus may not be captured by CPSC's data search procedures. Another limitation includes the lack of denominator information that was not available to calculate a death rate over time. We also had no way of knowing whether the bumpers in question complied with any or all of the voluntary standard requirements. Finally, nonfatal crib bumper injury reports may not be representative of nonfatal incidents that occur nationwide. These reports are provided to CPSC by the public, should be considered a minimum number of those that occurred, and are limited to the detail provided by the caregivers. However, the strength of this study is the complete case information for each death, many with scene recreations, which allowed for a detailed evaluation of how each death occurred, and injury information documenting a variety of potentially serious injury mechanisms compared with suffocation as the primary death mechanism.

One approach to reducing bumper-related deaths and injuries has been for public health organizations, such as the AAP and others, to warn against bumper use and publicize their warnings. The AAP first recommended against crib bumper use in January 2008,² and as early as 2007 and 2008, media articles,¹⁶⁻¹⁸ publications for parents,^{19,20} SIDS experts,^{6,19} and injury lawyers²¹ recommended against their use or reported the deaths. Despite this nationwide publicity that continued each year, deaths have not decreased, likely because bumpers remain widely available in the marketplace, media articles commonly show cribs with bumpers,²² and parents often believe bumpers are necessary for comfort and safety.^{6,23}

Another approach has been for the industry to develop voluntary safety requirements (standards) for safe bumper design and use. Even though many of these requirements have been in effect for a number of years, the number of manufacturers who comply with the voluntary standard requirements is unknown.²⁴

The voluntary standard was revised in 2012 to limit bumper thickness to ≤ 2 inches compressed. We found that this requirement would not have prevented 3 suffocation deaths on bumpers measuring 1-2 inches uncompressed found in this study. Carleton et al²⁵ tested comforters for re-breathing and found that "Surprisingly, the only comforter which fell into the high range ($>20\%$) was of about the same thickness as most of the other infant comforters (1/2 to 1 inch, 1.25 to 2.5 cm, uncompressed)." Assuming bumpers act like comforters, this study suggests that thickness alone is unlikely to address suffocations from re-breathing.

Other voluntary standards requirements include packaging labels with instructions for bumper use and installation. The label warns to discontinue use when infants can sit up or pull to a standing position to address infants using a bumper to climb out of a crib, which usually occurs between 4 and 8 months according to the World Health Organization.²⁶ We found this labeling did not prevent 1 death and 8 injuries of infants who fell after climbing on a bumper and that many parents continued to use bumpers with older infants. Removing bumpers to prevent falls would not have prevented

21 deaths of infants who were ≤ 3 months of age and who suffocated in crib bumpers. The label also instructs users to "position ties to the outside of the crib and be sure they are secure," "keep top of the bumper up and in position," and "do not allow the bumper to sag down or in toward the sleeping surface." There were several deaths in which the bumpers appeared to be installed incorrectly or sagged.

Injury reports cited a number of design, construction, and quality control problems. There are also no requirements for bumper ties to be present on both the top and bottom of the bumper; strength tests to prevent some decorations such as appliques from detaching; thread from breaking or ribbons from fraying; and quality control procedures to prevent needles in bumpers.

Proposed benefits to bumper use include the following¹¹: preventing entrapment of head, neck, or limbs between crib slats with resultant trauma to bone or strangulation; mitigation of head injuries from the crib's hard sides; and allowing parents a possibly safer option who could pad the crib sides with softer, more dangerous materials.

As to the first benefit, preventing entrapment, we found no reports of head or neck entrapment. Crib regulations²⁷ reduced the space between the slats to less than the width of a soda can in the 1970s, making it highly unlikely that an infant's head or neck could be caught between the slats of an intact crib. Although in this study and others^{28,29} limb entrapment was found to be a frequent occurrence, this is the first study to document that limbs can become entrapped with a bumper in the crib. As to the second benefit, we found 2 reports of infants hitting their heads on the side of the crib with a bumper present, one sustaining a bruise and one with no injury reported. Other studies^{28,29} found more incidents of injuries inside the crib but did not report if a bumper was present. We found that serious head injuries resulted from infants falling from a crib after climbing on a bumper. Despite these incidents, cribs remain safer for sleeping infants than other sleeping environments.³⁰

For the last proposed benefit, that parents will substitute more dangerous products such as pillows if they cannot buy safe bumpers, is possible. However, without bumpers for sale, the message that bumpers and other soft bedding should not be placed in the crib would be reinforced through store displays, the media, and other venues providing parents with a unified, consistent message.^{7,22} Finally, none of the proposed benefits outweigh well-established evidence that crib bumpers can cause deaths and serious injuries.²⁹

Two new nontraditional bumper designs seem to mitigate some of the problems found with traditional crib bumpers. Mesh bumpers are breathable and thin and may reduce the likelihood of slat entrapment and climb outs. Vertical bumpers tightly wrap each slat individually, allowing for airflow, and also may reduce the likelihood of slat entrapment and climb outs. These 2 designs were excluded from the State of Maryland's ban⁷ on the sale of crib bumpers.

Although 2 US jurisdictions^{7,8} banned the sale of crib bumpers, such a ban is also possible at the federal level. Only CPSC can promulgate a ban nationwide to make it illegal to sell

traditional crib bumpers. Deliberations concerning such a ban would likely take into account how caregivers have used crib bumpers. Misuse, not following labeling instructions for installing and using bumpers or recommended safe sleep practices, is not an obstacle to such a ban. CPSC can issue a mandatory standard when there is evidence of reasonably foreseeable misuse and has done so in the past.³¹

Other than removing traditional bumpers from cribs, it is unlikely that voluntary standard requirements or safe sleep practices (eg, back sleeping) can address the risk of suffocation when infants' faces become covered by bumpers and who may suffocate or nearly suffocate from occlusion or re-breathing. To prevent these deaths and ALTEs, we recommend that CPSC ban traditional crib bumpers for sale in the US quickly. Preventing bumper deaths and injuries will only be possible if traditional bumpers are removed from the marketplace at the national level. ■

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Figure 2. Examples of "thin" bumpers from death scene recreations.

