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Where Should Infants Sleep? A Comparison of Risk for Suffocation of Infants Sleeping in Cribs, Adult Beds, and Other Sleeping Locations

N. J. Scheers, PhD*; George W. Rutherford, MS‡; and James S. Kemp, MDS

ABSTRACT. *Objectives.* To ascertain whether the number of sudden infant deaths as a result of suffocation in cribs, in adult beds, on sofas or chairs, and on other sleep surfaces was increasing whether attributable to increased reporting, diagnostic shift, or an actual increase in suffocation deaths and to compare the risk of reported accidental suffocation for infants on sleep surfaces designed for infants with the risk on adult beds.

Methods. We reviewed all accidental suffocation deaths among infants ≤ 11 months of age reported to the United States Consumer Product Safety Commission from 1980 through 1983 and 1995 through 1998. We compared infants' ages and other demographic data, the sleep location and surface used, and the reported mechanism or pattern of death. For 1995–1998, we used data on sleep location from an annual survey of randomly selected households of living infants younger than 8 months, collected as part of the National Infant Sleep Position Study at the National Institute of Child Health and Human Development, to calculate risk for death as a result of suffocation in cribs, in adult beds, and on sofas or chairs.

Methods. The number of reported suffocation deaths by location were compared between the 1980s and 1990s using logistic regression modeling to calculate odds ratios (OR), 95% confidence intervals (CI), and *P* values. Comparative risks for suffocation deaths on a given sleep surface for infants in the 1990s were examined by calculating rates of death per 100 000 exposed infants and comparing the 95% CI for overlap.

Results. From the 1980s, 513 cases of infant suffocation were considered; from the 1990s, 883 cases. The number of reported suffocation deaths in cribs fell from 192 to 107, the number of reported deaths in adult beds increased from 152 to 391, and the number of reported deaths on sofas or chairs increased from 33 to 110. Using cribs as the reference group and adjusting for potential confounders, the multivariate ORs showed that infant deaths in adult beds were 8.1 times more likely to be reported in the 1990s than in the 1980s (95% CI: 3.2–20.3), and infant deaths on sofas and chairs were 17.2 times more likely to be reported in the 1990s than in the 1980s

(95% CI: 5.0–59.3). The sleep location of a subset of cases from the 1990s, 348 infants younger than 8 months at death, was compared with the sleep location of 4220 living infants younger than 8 months. The risk of suffocation was approximately 40 times higher for infants in adult beds compared with those in cribs. The increase in risk remained high even when overlying deaths were discounted (32 times higher) or the estimate of rates of bedsharing among living infants doubled (20 times higher).

Conclusions. Reported deaths of infants who suffocated on sleep surfaces other than those designed for infants are increasing. The most conservative estimate showed that the risk of suffocation increased by 20-fold when infants were placed to sleep in adult beds rather than in cribs. The public should be clearly informed of the attendant risks. *Pediatrics* 2003;112:883–889; *sudden death, infant; suffocation, infant; consumer product safety; sleep, infant.*

ABBREVIATIONS. SIDS, sudden infant death syndrome; CPSC, US Consumer Product Safety Commission; NICHD, National Institute of Child Health and Human Development; e-code, external cause of death; CI, confidence interval; NCHS, National Center for Health Statistics; OR, odds ratio.

No epidemiologic studies have directly compared the risk of suffocation for infants who sleep in cribs, in adult beds, and on sofas. Although the rate of death from sudden infant death syndrome (SIDS) has declined substantially as the result of campaigns to foster back sleeping in the United States and elsewhere, the proportion of sudden, unexpected deaths diagnosed as accidental suffocation and related preventable causes may be increasing.¹ For example, a recent study using US-linked birth/death data found that whereas other infant deaths were decreasing, overall approximately 20% a year, deaths diagnosed as mechanical suffocation were increasing, on the average approximately 3.7% a year.² During a similar period, Drago and Dannenberg³ found increasing trends for specific hazards leading to suffocation, such as wedging and oronasal obstruction.

Other studies have described how suffocation deaths may have occurred in various infant sleeping environments,^{3–5} but these studies were “numerator-based” and did not have a denominator for comparison. Thus, they did not permit calculation of the risk of sleeping in different locations such as cribs and adult beds. In this analysis, we used data describing sleep practices for 348 infants whose death was identified as suffocation in cribs and adult beds (we use

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The opinions expressed in this article are those of the authors in their private capacities (N.J.S., G.W.R.) and do not necessarily represent the views of the Consumer Product Safety Commission.

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the term "adult" beds because approximately 98% of the bed-related deaths outside of cribs were on beds designed for adults) from 1995 to 1998 and compared their sleeping locations with comparable data from a study of 4220 living infants from 1995 to 1998. Information about the infant deaths was obtained primarily from death certificates for deaths reported to the US Consumer Product Safety Commission (CPSC). Information about living infants was obtained from a survey of caregivers for infants conducted by the National Institute of Child Health and Human Development (NICHD) during the same period.^{6,7}

We also compared reported infant deaths diagnosed as suffocation from 1980 through 1983 with those from 1995 through 1998 to examine any changes in infant characteristics, sleeping locations, and suffocation patterns that may have occurred over the decades. We were interested in changes over the past 20 years, although we know that reporting changes and diagnostic shifts have occurred during this period. This attempt at describing changes in victims and patterns of suffocation is worthwhile because the proportion of deaths diagnosed as accidental suffocation seems to be increasing.

METHODS

Deaths

We identified deaths diagnosed as suffocation among infants through 11 months of age. We chose this age interval to be sure that we were comparing infants of the same age; during the 1980s, some infants older than 12 months [eg, 1 year] were incorrectly coded as 12 months in CPSC databases. Cases were obtained from January 1980 through December 1983 (1980s) and from January 1995 through December 1998 (1990s) through a search of 3 CPSC databases: Death Certificate, Injury and Potential Injury Incidents, and In-depth Investigations databases. These databases contain information about deaths that are unique to each database as well as duplicate reports of cases that may provide additional information about the deaths.

The Death Certificate database contains information from death certificates that CPSC obtains from all 50 states, the District of Columbia, and New York City.⁸ Death certificates that fall within specified external cause of death categories (e-codes) are obtained⁹ because they are likely to report specific consumer products. CPSC receives all suffocation e-codes, with the exception of the e-code for "suffocation by falling earth." CPSC also collects information on deaths through its Medical Examiners and Coroners Alert Project and through other sources (eg, police and fire reports, media articles). This information is stored in the Injury and Potential Injury Incidents database. The In-depth Investigations database contains information from CPSC follow-up investigations of specific injuries and deaths.

Searches of the 3 databases produced 3081 cases. After removing duplicate and out-of-scope cases (eg, fire and high-chair deaths) and limiting age to ≤ 11 months, 1396 cases were available for analysis: 513 deaths from the 1980s and 883 deaths from the 1990s. Identifying information in CPSC databases is maintained following formal procedures that ensure confidentiality.

Suffocation Patterns

Two raters (N.J.S., G.W.R.) independently classified each death as to the specific suffocation pattern based on the narrative in the report. The agreement rate was 96.4% for all sleeping locations and 98.4% for cribs, adult beds, and sofa/chairs. The criteria for classification for each specific pattern were as follows:

1. Entrapment/wedging: body caught between 2 products or between components of a single product, including suspensions or hangings

2. Overlying: narrative reported diagnosis of "overlay" or head/body reportedly covered by part of or all of another person's body
3. Respiration compromised by bedding: face and/or head covered by bedding such as pillows, comforters, blankets, or sheets
4. Respiration compromised by plastic: face covered by plastic
5. Strangulation (strangulation deaths are categorized as suffocation under the e-code classification system): suffocation by a cord, strap, clothing, etc, encircling the neck
6. Other: falls, collapse of sleep surface, etc, resulting in suffocation
7. Nonspecific suffocation: not otherwise specified. Diagnosed as suffocation but with insufficient detail provided to allow for classification by specific suffocation pattern. This category includes reports of bed sharing and other co-sleeping deaths diagnosed as suffocation but not specifically reported as overlying. For example, the report might read, "Sleeping in bed with adult-suffocation," without additional details offered.

Information was available for a number of variables including, age, sex, race, state, e-code, and date of death. Sleeping location was identified from the narrative in the death certificate, injury and potential injury report, or in-depth investigation. Race was dichotomized into white and minority categories consistent with accepted practice¹⁰; within the minority category, blacks represented approximately 92.3% of the total. Season of the year was categorized as winter (for the months October to March) and summer (April to September).

Living Infants

Information was obtained from the 1990s for both living and deceased infants who died in the 1990s, but we are unaware of comparable information for living infants for the 1980s. Thus, our risk analysis is restricted to the 1990s.

Information on the sleep practices for a cohort of living infants was obtained from the NICHD's National Infant Sleep Position Study,^{6,7} a survey conducted annually from 1994 to 1998. Telephone interviews were completed by nighttime caregivers of infants younger than 8 months from a randomly selected annual sample of >1000 households (range: 1043–1050 households per year). We used data from this survey on sleeping location for 1995–1998, the years that coincided with the deaths in our study. Infants' sleeping locations were identified by responses to the question, "Where did your infant usually sleep during the past 2 weeks?" Details of the methods used in the study have been reported elsewhere.^{6,7}

Statistical Analyses

All analyses, with the exception of risk, were calculated for infants ≤ 11 months old. For risk calculations, we used infants who died of suffocation at younger than 8 months during 1995–1998 to be consistent with the sample from the National Infant Sleep Position Study.

For univariate analyses, χ^2 was used to test for differences in relative frequency distributions, with the Fisher exact test or Yates corrected χ^2 used for 2×2 tables. Differences among means were tested using analysis of variance. Logistic regression modeling was used to estimate univariate odds ratios (ORs), 95% confidence intervals (CIs) and *P* values for comparisons between the 1980s and 1990s. Trends in suffocation rates over time were tested using Poisson regression analysis.

For the 1990s cohort, we calculated the risk of sleeping in adult beds or cribs by separate ratios using the number of deaths in cribs or beds as the numerator and an appropriate exposure measure as the denominator, along with 95% CIs. Exposure, the number of living infants who slept in cribs or beds, was based on the NICHD data showing the distribution of various sleeping locations for 1995–1998 and the number of living infants from census data for 1995–1998.¹¹ CIs for rates based on <100 deaths were computed using the Poisson distribution; otherwise, CIs were computed using the binomial distribution. The difference between 2 rates from these distributions is considered to be statistically significant when there is no overlap between the 95% CIs.¹¹

TABLE 1. Characteristics of Infants Dying of Suffocation: 1980s and 1990s

Characteristic	Statistics	1980–1983	1995–1998	All Years	<i>P</i>
Sex (male)	% (<i>n</i>)	58.9 (301)	60.8 (536)	60.1 (837)	NS
Minority status	% (<i>n</i>)	30.9 (148)	30.5 (239)	30.7 (387)	NS
Season (winter)	% (<i>n</i>)	36.1 (185)	41.4 (366)	39.5 (551)	NS
Age (mo)	Mean (SE)	5.1 (0.12)	4.2 (0.09)	4.5 (0.07)	<.0001

SE indicates standard error; NS, not significant.

RESULTS

Changes From the 1980s to the 1990s

Characteristics of Infants and Sleeping Locations

Infants who were identified from the 3 databases searched from 1980 through 1983 as having died of suffocation were similar to those identified from 1995 through 1998 for sex, minority status, and season of the year when they died (Table 1). Boys accounted for 60.1% of the deaths for the combined time periods, infants with minority status accounted for 30.7%, and deaths during winter months accounted for 39.5%. Using our selection criteria of infants 11 months old or younger, those who were reported to have died of suffocation in the 1990s were, on average, 1 month younger (4.2 months) compared with those in the 1980s (5.1 months, analysis of variance, $P < .0001$).

Most infants who died were sleeping in cribs, adult beds, and sofas or chairs in both decades: these 3 sleeping locations accounted for approximately 73% of the reported suffocation deaths in the 1980s and 68% in the 1990s (Table 2). Changes between the decades were primarily attributable to a decrease in reports of suffocation deaths in cribs, from 37% of the deaths in the 1980s to 12% in the 1990s (χ^2 analysis, $P < .0001$); an increase in reports of suffocation deaths in adult beds, from 30% in the 1980s to 44% in the 1990s (χ^2 analysis, $P < .0001$); and an increase in reports of suffocation deaths on sofas or chairs, from 6% in the 1980s to 12% in the 1990s (χ^2 analysis, $P < .0001$).

Using cribs as the reference group and adjusting for potential confounders (age, sex, race, and season and their interactions), the multivariate ORs comparing suffocation deaths in the 1990s with the 1980s showed that infant deaths in adult beds were 8.1 times more likely to be reported in the 1990s than in the 1980s (95% CI: 3.2–20.3), and infant deaths on sofas and chairs were 17.2 times more likely to be reported in the 1990s than the 1980s (95% CI: 5.0–59.3). ORs from the multivariate analysis were ap-

proximately 2 to 3 times higher than those found with the univariate analyses. Although all of the potential confounding variables were nonsignificant in the univariate analyses with the exception of age, we retained them in the multivariate model to allow for any suppressor effects. There was little change in the ORs when these nonsignificant variables were eliminated from the calculations.

The interaction of age of the infant with adult beds and the interaction of age with sofa or chairs in the multivariate model described above both were significant. Figures 1 and 2 show that this change was primarily attributable to the increase in the number of reported deaths in the first month of life for infants sleeping in adult beds and sofas or chairs. For these 2 sleeping locations, more infants in the 1990s were reported to have died of suffocation during the first month of life (25.5%) than any other month, compared with 13.2% who died during the first month of life in the 1980s.

Sleeping location was not reported for 20% of the deaths in the 1980s and 14% in the 1990s (Table 1). Infants with unreported sleeping locations did not differ by age, sex, and season compared with those infants whose sleeping locations were reported (χ^2 analyses, $P \geq .23$). Table 3 shows the suffocation patterns for the 3 most common sleeping locations where suffocation occurred.

Suffocation Deaths From Crib-Related Hazards

Two suffocation patterns associated with potentially dangerous sleeping environments were found in approximately 78% of the deaths in cribs in the 1980s and 82% in the 1990s: entrapment and soft bedding (Table 3). For deaths in cribs, 144 of 192 were entrapment reported in the 1980s, and 64 of 107 reported in the 1990s were entrapment. Among deaths in cribs linked to soft bedding, 5 of 192 deaths in cribs reported in the 1980s were linked to soft bedding, and 24 of 107 reported in the 1990s.

Although there were fewer crib-related entrapment deaths in the 1990s, approximately 72% of the reports noted that the entrapments were the result of a failure of the crib's structure or hardware (eg, entrapment from loose or broken slats, broken crib rails, loose screws); a mattress that was too small; an old crib with slats that were too wide; or in a few cases, a crib that was misassembled.

Suffocation Deaths From Adult Bed Hazards

The primary suffocation pattern associated with deaths in adult beds was entrapment in both decades (Table 3). In the 1980s, there were 89 reports of entrapments in adult beds compared with 188 deaths

TABLE 2. Sleeping Locations for Infant Suffocation Deaths: 1980s and 1990s (Age ≤ 11 Months)*

Location	1980–1983 (<i>N</i> = 513)	1995–1998 (<i>N</i> = 883)
Crib	192 (37%)	107 (12%)
Adult bed	152 (30%)	391 (44%)
Sofa/chair	33 (6%)	110 (12%)
Playpen/portable crib	17 (3%)	45 (5%)
Bassinet	7 (1%)	22 (2%)
Other	10 (2%)	81 (9%)
Not reported	102 (20%)	127 (14%)

* Totals may not add to 100% because of rounding.

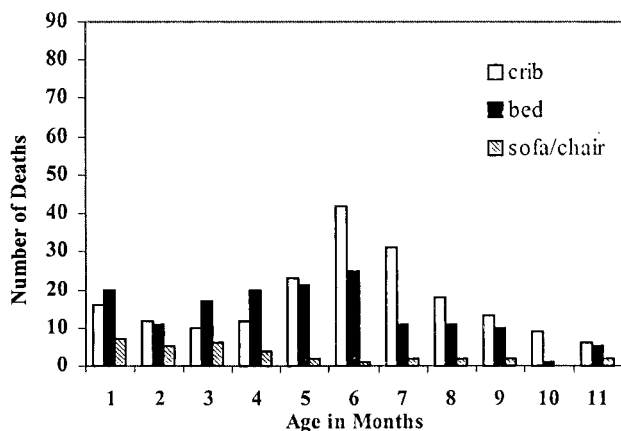


Fig 1. Suffocation deaths reported: 1980–1983.

in the 1990s. Most of the deaths in both decades occurred from entrapment between the bed and the wall (52.3%), or the infant was wedged (29.6%) between the headboard or footboard and mattress or between the bedrail and another bed component.

The diagnosis by medical examiners and coroners that overlying of an infant while sharing an adult bed was the “cause of death” remains controversial. More overlying deaths were reported by medical examiners and coroners in the 1990s (70 deaths) than in the 1980s (7 deaths). In approximately 40.3% of the cases (31 of 77), the narratives reported that a third party found the infant covered by an adult or a child, there were compression marks on the infant, or other findings suggesting the likelihood of overlying (eg, infant sleeping in twin bed with 2 adults). In both decades, overlying deaths were associated with very young infants, with an average age of 1.9 months. Only 1 overlying death occurred after 6 months of age, a report of a 10-month-old found with another child over him.

Suffocation Deaths From Sofa/Chair-Related Hazards

The primary suffocation patterns associated with deaths on sofas and chairs were entrapment and overlying (Table 3). Entrapment deaths occurred in 11 of 33 reported in the 1980s, and 31 of 110 reported in the 1990s. For deaths in sofas/chairs, overlying

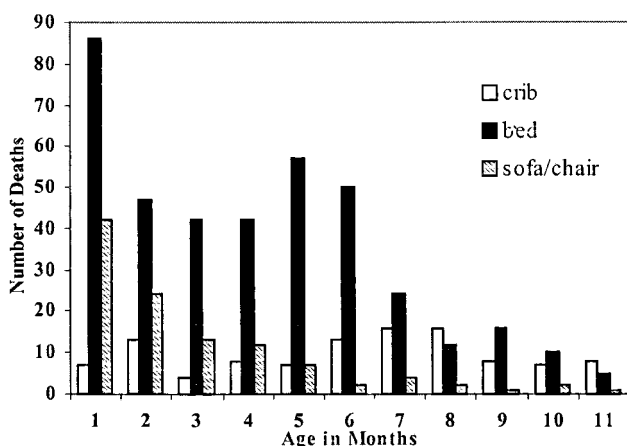


Fig 2. Suffocation deaths reported: 1995–1998.

reported for 3 of 33 in the 1980s, and 33 of 110 in the 1990s. The average age of these infants reported to have suffocated from entrapment or overlying in sofas or chairs in the 1990s was 2.8 months. Sixty percent (66 of 110) were 2 months old or younger.

There were 7 reports of nonspecific suffocations on sofas or chairs in the 1980s and 33 deaths in the 1990s (Table 3). Reports from the 1990s show that 60.6% of the deaths on sofa and chairs classified as nonspecific suffocations also reported that the infant was sharing a sofa or a chair with another person, usually an adult. The average age for these deaths was 3.2 months.

Comparison of Risk in Cribs With Risk in Adult Beds

As noted above, we compared the risk of suffocation in cribs and adult beds by restricting the deaths to infants younger than 8 months to be comparable with the NICHD study of the sleep practices of living infants younger than 8 months. Both data sets pertain to the years 1995–1998. Comparison of risk was calculated by comparing deaths of infants in cribs or adult beds with the NICHD estimate of infants usually sleeping in cribs or adult beds (Table 4). For deaths from CPSC databases for infants younger than 8 months, there were a total of 68 suffocation deaths in cribs and 348 suffocation deaths in beds during the 4-year period. During that same time period, NICHD data shows that approximately 70% of infants usually slept in cribs, whereas 9% usually slept in beds. Applying the percentages from the NICHD study to the number of live births, we estimate that in the 1990s, on average, 2.6 million infants usually slept in cribs and 340 000 infants usually slept in adult beds.

On the basis of deaths reported to the CPSC, we found that the risk of death in cribs during the 4-year period (1995–1998) was significantly lower than the risk of death in adult beds. For infants younger than 8 months, the risk for cribs was 0.63 deaths per 100 000 infants and the risk for adult beds was 25.5 deaths per 100 000 infants. There was no significant trend in the risk during the 4 years for either cribs or beds.

We conducted 2 sensitivity analyses to examine the effect on the risk calculations for adult beds. The first analysis restricted the cases to nonoverlying deaths, resulting in a decreased numerator for the risk calculations. The second analysis doubled the estimated number of living infants sleeping in adult beds, resulting in an increased denominator for the risk calculations (Table 5).

For the first sensitivity analysis, we removed deaths reported as overlying from the total number of deaths in adult beds because some researchers believe that the diagnosis of overlying is unreliable. For example, because some overlying deaths are not witnessed (eg, no third person found the infant overlain by another person) or show no evidence of overlying, such as compression marks, the diagnosis may be based solely on the judgment of the medical examiner or coroner. Removing the 70 deaths diagnosed as overlying from the numerator, the adjusted risk of nonoverlying deaths in beds was approxi-

TABLE 3. Suffocation Patterns Associated With Three Sleeping Locations by Decade (Age ≤11 Months)

Pattern	Total		Crib		Adult Bed		Sofa/Chair	
	1980s (N = 377)	1990s (N = 608)	1980s (N = 192)	1990s (N = 107)	1980s (N = 152)	1990s (N = 391)	1980s (N = 33)	1990s (N = 110)
Entrap/wedge	64.7% (244)	46.5% (283)	75.0% (144)	59.8% (64)	58.6% (89)	48.1% (188)	33.3% (11)	28.2% (31)
Overlying	2.9% (11)	16.9% (103)	0.5% (1)	–	4.6% (7)	17.9% (70)	9.1% (3)	30.0% (33)
Bedding	3.7% (14)	9.0% (55)	2.6% (5)	22.4% (24)	5.3% (8)	5.9% (23)	3.0% (1)	7.3% (8)
Plastic	6.4% (24)	4.6% (28)	5.2% (10)	3.7% (4)	8.6% (13)	5.9% (23)	3.0% (1)	0.9% (1)
Other	11.4% (43)	4.4% (27)	3.1% (6)	1.9% (2)	17.7% (27)	5.4% (21)	30.3% (10)	3.6% (4)
Strangulation	4.0% (15)	1.6% (10)	6.8% (13)	7.5% (8)	1.3% (2)	0.5% (2)	–	–
Nonspecific	6.9% (26)	16.8% (102)	6.8% (13)	4.7% (5)	3.9% (6)	16.4% (64)	21.2% (7)	30.0% (33)

– indicates no deaths reported.

TABLE 4. Risk of Suffocation Death in Cribs Compared With Adult Beds per 100 000 Infants <8 Months Old: 1995–1998

Year	Cribs				Adult Beds			
	Deaths	Living Infants in Cribs	Risk	95% CI	Deaths	Living Infants in Adult Beds	Risk	95% CI
Total	68	10 851 403 (70%)	0.63	0.49–0.79	348	1 366 184 (9%)	25.5	22.8–28.2
1995	23	2 846 700 (73%)	0.81	0.51–1.21	79	272 971 (7%)	28.9	22.9–36.1
1996	13	2 685 131 (69%)	0.48	0.26–0.83	91	272 404 (7%)	33.4	26.9–41.0
1997	13	2 677 817 (69%)	0.49	0.26–0.83	92	388 089 (10%)	23.7	19.1–29.1
1998	19	2 640 841 (67%)	0.72	0.43–1.12	86	433 571 (11%)	19.8	15.9–24.5

TABLE 5. Sensitivity Analysis for the Risk of Suffocation Death in Adult Beds per 100 000 Infants <8 Months Old: 1995–1998

Year	Adult Beds: Overlying Deaths Removed				Adult Beds: Estimated No. of Living Infants Using Adult Beds Doubled			
	Deaths	Living Infants in Adult Beds	Risk	95% CI	Deaths	Living Infants in Adult Beds	Risk	95% CI
Total	279	1 366 184 (9%)	20.4	18.0–22.8	348	2 732 368 (18%)	12.7	11.4–14.1
1995	65	272 971 (7%)	23.8	18.4–30.4	79	545 942 (14%)	14.5	11.5–18.0
1996	73	272 404 (7%)	26.8	21.0–33.7	91	544 809 (14%)	16.7	13.4–20.5
1997	65	388 089 (10%)	16.8	12.9–21.3	92	776 178 (20%)	11.8	9.6–14.5
1998	76	433 571 (11%)	17.5	13.8–21.9	86	867 142 (22%)	9.9	7.9–12.2

mately 20.4 deaths per 100 000 infants younger than 8 months for 1995–1998 and remained much higher than the risk of death in cribs (Table 5).

For the second sensitivity analysis, we doubled the estimated number of living infants sleeping in adult beds because of concerns that bed sharing is underreported. This increased the denominator from 9.0% to 18.0% of living infants sleeping in adult beds for the 4-year period. The adjusted risk was approximately 12.7 deaths per 100 000 infants younger than 8 months from 1995 to 1998 and again remained significantly and substantively higher than the risk of death in cribs.

DISCUSSION

Our principal findings are that the number of infant suffocation deaths reported to CPSC, particularly involving younger infants in adult beds or on sofas or chairs, increased dramatically in the 1990s (Figs 1 and 2, Table 2). Most of these deaths were attributed to entrapment. During this same time period, there has also been a substantial decline for suffocation deaths in cribs. We also found that the risk for suffocation among infants in adult beds was 40 times higher than the risk for suffocation in cribs (Table 4). This risk in adult beds remains high even when correcting for possible underreporting of bed-

sharing or when deaths attributed to overlying are removed from the analysis (Table 5). This suggests that those who wish to bedshare should be aware of particular risks, such as wedging between the bed and wall and the hazards associated with soft bedding.

The increase in the number of reported suffocation deaths from the 1980s to the 1990s involving adult beds may have several explanations, including increased reporting and diagnostic shift, in addition to the possibility of a real increase in the number of suffocation deaths. One obvious example is that suffocation hazards linked to soft bedding were not well known in the 1980s, and thus a reported increase in deaths linked to soft bedding may be partially attributable to underreporting that occurred in the 1980s. Thus, it is likely that some deaths in adult beds, which may have been diagnosed as SIDS until the early or mid-1990s, are now being designated as accidental suffocation.^{12,13} This diagnostic shifting is likely attributable to a new appreciation of how infants might subtly suffocate¹⁴ and to greater reliance on death scene information to document the occurrence of accidental deaths that were once considered unexplained and thus attributed to SIDS.¹² The net result of these 2 changes in the understanding and investigation of sudden, unexpected infant death

may be an increase in the reporting of suffocation deaths, particularly among younger infants sleeping in adult beds and other noninfant sleep surfaces.

Younger infants may be at greater risk in adult beds¹⁵ (Figs 1 and 2, Table 4) because they lack motor skills to escape potential threats within the sleep environment (Table 3, both decades).^{16,17} Also, in a recent case-comparison study in Cleveland, Ohio, from 1992 to 1996, Carroll-Pankhorst et al¹⁸ found that infants who died of SIDS while bedsharing were significantly younger than those who died while sleeping alone (9.1 weeks vs 12.7 weeks). These investigators speculated that some infant deaths diagnosed as SIDS were actually suffocation and that "younger, less vigorous infants" may be more susceptible. Our results are consistent with these findings from Cleveland.

In large epidemiologic studies of SIDS, it seems that sleeping in the parents' room without bedsharing confers the least risk, compared with sharing a sleep surface (most risk) and sleeping in another room (intermediate risk).¹⁹ There are obvious advantages to recommending cribs, bassinets, and other infant products that are designed for use by infants. For beds not designed for infants only, it is difficult to control potential hazardous arrangements causing suffocation, with or without entrapment. In contrast, relatively straightforward safety standards for cribs have been used successfully since 1973 to reduce crib-related suffocation deaths. Mandatory standards developed during the 1970s include requirements for side height, slat spacing, and mattress fit.^{20,21} Voluntary standards developed since 1985 include requirements to prevent entanglement on corner posts and collapse of the crib.²²⁻²⁴

The question regarding the usual sleeping location of living infants from the NICHD study may not have identified infants who sometimes or occasionally slept on an adult bed. For this reason, the results may understate the exposure to adult beds slightly. Given that the difference between the risks for adult beds and cribs is approximately 40:1, it is unlikely that this would make much difference in the conclusion that adult beds have a higher risk for infants than cribs. The published data suggest a probable increase in risk associated with bed sharing for the previous night compared with usual sleep,^{25,26} suggesting that the risk may be underestimated when a question about bedsharing for "usual sleep" is asked.

There are several limitations of the data sets used in this study. CPSC receives most but not all of the deaths reported to NCHS, and therefore the deaths in this study should be considered a minimum number. A study of the completeness of CPSC death data for all e-codes found that CPSC received an average of 82% of the number of cases in the NCHS mortality file.²⁷ Data extracted from death certificates also do not provide information on other potentially important factors, such as the position of the infant, or whether a death-scene investigation was completed. However, Malloy²⁸ noted that this lack of information about the completion of a death scene may "allow for an overestimation of the number of SIDS deaths that are recorded and an underestimation of

other related causes of death, such as asphyxia and accidental suffocation." Despite these limitations, the data used in this study provide a comprehensive view of suffocation deaths in the United States for 2 time periods. There is no alternative database in the United States that captures product-related deaths at the national level.

Although the deaths reported to CPSC are a minimum number of known deaths, the number of deaths in cribs is likely to be a fairly complete count of all crib-related deaths. The CPSC actively seeks information on all crib-related deaths and deaths related to other children's products from death certificates, through medical examiners and coroners, and from other sources. These data are monitored daily. For this reason, the suffocation data for cribs and other products intended for use by children may be more complete than the data for adult beds and other products not designed for children. We also believe that the number of deaths in adult beds or on sofas or chairs is likely to be an undercount, because for many overlying deaths, the sleeping location was "not reported" (Table 2) and thus may have involved deaths on adult beds or sofas and chairs for which more specific data were lacking. Thus, we speculate that our risk calculations (Tables 4 and 5) include fairly complete data for suffocation deaths in cribs, whereas the number of suffocation deaths in adult beds may be undercounted.

Infant deaths diagnosed as suffocation in adult beds and on sofas or chairs are being increasingly reported in the United States, whereas suffocation deaths in cribs are declining. This may be attributable to a diagnostic shift or increased reporting of adult bed and sofa or chair suffocations, or there may be a real increase in the number of these deaths. Whatever the explanation, these data indicate that there are more infants dying in adult beds and on sofas or chairs than we were aware of in the 1980s. Suggestions from some²⁹ that the risk associated with falling and entrapment might be lessened by, for example, pushing an adult bed near the wall are of unproven efficacy, have been known to result in infant deaths,³ and should be discouraged.

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“Between 1977 and 1996, for portion sizes increased both inside and outside the home for all categories except pizza. The energy intake and portion size of salty snacks increased by 93 kcal (from 1.0–1.6 oz [28.4–45.4 g]), soft drinks by 49 kcal (from 13.1–19.9 fl oz [387.4–588.4 mL]), hamburgers by 97 kcal (5.7–7.0 oz [161.6–198.4 g]), french fries by 68 kcal (3.1–3.6 oz [87.9–102.1 g]), and Mexican food by 133 kcal (6.3–8.0 oz [178.6–226.8 g]).”

Nielsen SJ, Popkin BM. Patterns and trends in food portion sizes. *JAMA*. 2003;289:450–453

Submitted by Student

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