ARTICLE

Infant Sleep Position and Associated Health Outcomes

Carl E. Hunt, MD; Samuel M. Lesko, MD, MPH; Richard M. Vezina, MPH; Rosha McCoy, MD; Michael J. Corwin, MD; Frederick Mandell, MD; Marian Willinger, PhD; Howard J. Hoffman, MA; Allen A. Mitchell, MD

Background: The incidence of sudden infant death syndrome has decreased in the United States as the percentage of infants sleeping prone has decreased, but persisting concerns about the safety of supine sleeping likely contribute to prone sleeping prevalence rates that remain higher than 10%.

Objective: To document health outcomes in infants aged 1 to 6 months in relation to sleep position.

Design: Prospective cohort study.

Setting: Massachusetts and Ohio, from February 21, 1995, to December 31, 1998.

Study Participants: A total of 3733 infants with consistent sleep positions at ages 1, 3, and 6 months.

Main Outcome Measures: Descriptive statistics and multiple logistic regression analysis relating sleep position at each follow-up age to symptoms in the prior week (fever, cough, wheezing, stuffy nose, trouble breathing or sleeping, diarrhea, vomiting, or spitting up) and outpatient visits in the prior month (ear infection, breathing problem, vomiting, spitting up, colic, seizure, accident, or injury).

Results: No symptoms or outpatient visits were significantly more common among infants sleeping on the side or supine than in infants sleeping prone, and 3 symptoms were less common: (1) fever at 1 month in infants sleeping in the supine (adjusted odds ratio [OR], 0.56; 95% confidence interval [CI], 0.34-0.93) and side positions (OR, 0.48; 95% CI, 0.28-0.82); (2) stuffy nose at 6 months in the supine (OR, 0.74; 95% CI, 0.61-0.89) and side positions (OR, 0.82; 95% CI, 0.68-0.99); and (3) trouble sleeping at 6 months in the supine (OR, 0.57; 95% CI, 0.44-0.73) and side positions (OR, 0.69; 95% CI, 0.53-0.89). Also, outpatient visits for ear infections were less common at 3 and 6 months in infants sleeping in the supine position (OR, 0.64; 95% CI, 0.46-0.88; and OR, 0.73; 95% CI, 0.58-0.92, respectively) and at 3 months in the side position (OR, 0.68; 95% CI, 0.49-0.96).

Conclusions: No identified symptom or illness was significantly increased among nonprone sleepers during the first 6 months of life. These reassuring results may contribute to increased use of the supine position for infant sleeping.

Arch Pediatr Adolesc Med. 2003;157:469-474

SUDDEN INFANT death syndrome (SIDS) is the sudden death of an infant, unexpected by history and unexplained by a thorough postmortem examination, including a complete autopsy, death scene investigation, and review of the medical history.[1] The decreased risk of SIDS associated with nonprone sleep positions led to the recommendation in 1992 by the American Academy of Pediatrics that infants be placed to sleep on the side or back.[2] In 1994, the national public education campaign "Back to Sleep" was launched, and the supine position is now recommended.[3] Sudden infant death syndrome rates in the United States have decreased by about 40% as prone prevalence has decreased from 70% in 1992 to 17% in 1998.[3,4]

Multiple concerns were raised regarding the safety of nonprone sleep positions, especially the supine, following dissemination of the American Academy of Pediatrics recommendation. These concerns included trouble sleeping and complications from gastroesophageal reflux, including aspiration.[5,6] We now report findings from the first study, to our knowledge, of non-SIDS health outcomes related to infant sleep position in the United States.

Author affiliations are listed at the end of this article.

METHODS

Health outcomes information was obtained prospectively from February 21, 1995, to Decem-

ber 31, 1998, as part of the Infant Care Practices Study, a longitudinal study conducted in Boston, Lowell, in Lawrence, Mass, and in Toledo, Ohio. The principal aims of the study were to describe infant sleep practices, document secular and age-related changes in sleep position, and identify potential health consequences associated with infant sleep position during the first 6 months of life. Mothers were contacted at selected birth hospitals in these cities and invited to participate, as previously reported.[7] Consenting mother-infant pairs were enrolled and followed up until the child's first birthday. Descriptive data (eg, maternal age, ethnicity, parity, and infant birth weight) and information on SIDS risk factors (eg, history of maternal smoking during pregnancy) were collected by interview at the time of enrollment. Follow-up data were collected by mailed questionnaire or by telephone at ages 1, 3, and 6 months.

At each follow-up interval, sleep position was ascertained by response to the question: "Last evening, when you put your baby to bed for the night, how did you place him or her?"

On the stomach, face down
On the stomach, face turned to the side
On the back
On the side
Propped in the sitting position
Other (specify)

We also asked parents if the previous 24 hours were typical for their infant.

Exposure to environmental tobacco smoke was recorded as the number of hours (during the previous 24 hours) spent in a room with someone smoking cigarettes. Infant health status was ascertained by inquiring about symptoms during the past week (fever, cough, wheezing, trouble breathing, trouble sleeping, stuffy nose, spitting up, diarrhea, or vomiting) and reasons for any outpatient medical visit in the previous month, including visits to a physician's office, emergency department, or clinic. The list of recorded reasons for an outpatient visit included ear infections, breathing problems, vomiting, spitting up, colic, seizures (fits or convulsions), accident, or injury. A separate question ascertained whether the infant had been admitted to the hospital after the newborn admission; if so, information was requested regarding the date, reason, and hospital.

The χ^2 test was used to compare proportions across groups. Odds ratios (ORs) and 95% confidence intervals were used to describe the relationships between sleep position and health outcomes. Multiple logistic regression analysis was used to control for confounding. The following variables were included in the logistic regression models: maternal ethnicity, age, marital status, education, breastfeeding, parity, language spoken at home, exposure to environmental tobacco smoke, annual household income, infant sex, daycare, and season. Indicator terms for unknown values were included in the logistic models, as needed. No more than 10 subjects were excluded from the models because of missing data. The relationship between sleep position and ear infections at 6 months was examined within strata defined separately by maternal ethnicity, feeding method (breastfeeding or non-breastfeeding), and season.

Among the 14 206 enrolled infants weighing more than 2500 g at birth, mothers of 9773 (68.8%) had completed questionnaires at 1, 3, and 6 months. Of these infants, 3733 (38.2%) were reported to sleep in the same position at all 3 follow-up intervals and are the subjects for this analysis of health outcomes. Among all respondents, 92.7% indicated that the previous 24 hours were typical for the infant. Maternal and infant characteristics of the 3733 mother-infant pairs included in this analysis were not different from those of pairs in which infants changed sleep position between ages 1 and 6 months.

RESULTS

The mean ± SD birth weight was 3493 ± 460 g and did not differ among the 3 sleep position groups. Maternal and infant characteristics are summarized in **Table 1**. The population was largely (77.6%) white non-Hispanic but included 8.7% black non-Hispanic, 8.4% Hispanic, and 4.0% Asian women. The participants who identified themselves as Hispanic were largely of Dominican or Puerto Rican origin. Supine sleeping was less common among blacks and Hispanics and more common among infants of older mothers and mothers with low parity. Among all infants, 54.0% were breastfed at some time during the first 6 months, 11.5% were exposed to environmental tobacco smoke, 18.6% were in daycare, and 77.4% had used a pacifier by age 3 months.

The median age of the infants was 1.0 month at the 1-month follow-up, 3.2 months at the 3-month follow-up, and 6.3 months at the 6-month follow-up. The prevalence rates of reported symptoms and outpatient visits are given in **Table 2**. The frequency of fever and cough symptoms increased with increasing age, whereas spitting up and vomiting decreased with age. Outpatient visits for respiratory problems and ear infections increased between 1 and 3 months and between 3 and 6 months; visits for colic decreased between 1 and 3 months and between 3 and 6 months.

The relationship of symptoms and outpatient visits to sleep position is given in **Table 3**. Compared with infants sleeping in the prone position, infants sleeping in the supine and side positions were not at significantly increased risk for any of the symptoms studied. No upper confidence bound exceeded 1.6, and for most comparisons, upper bounds were less than 1.4. Indeed, infants sleeping in the supine and side positions at 1 month had significantly fewer maternal reports of fever, and at 6 months they had significantly fewer reports of trouble sleeping and of stuffy nose.

Compared with infants sleeping in the prone position, infants sleeping in the supine and side positions were not at increased risk for an outpatient visit for any reason (**Table 4**). Similar to what was observed for symptoms, upper confidence bounds were 1.7 or less, and for most comparisons, they were less than 1.4. Infants sleeping in the supine position had significantly fewer reported visits for ear infections at 3 and 6 months, and infants sleeping in the side position had fewer visits for ear infections at 3 months. The percentage of infants having a well-child visit varied from 86.0% to 90.6% before age 1 month, 56.8% to 62.2% between ages 1 and 3 months, and 49.2% to 61.9% between ages 3 and 6 months. At each of these ages, there was no difference in the reported frequency of a well-child visit among infants sleeping in the supine position vs the side and prone sleeping positions.

To further explore the apparent relation between sleep position and ear infections at 6 months, the age at which this outcome was most common, we performed

Table 1. Maternal and Infant Characteristics for 3733 Infants Maintaining a Consistent Sleep Position at Ages 1, 3, and 6 Months*

Characteristic	No. (%)	Sleep Position		
		Prone	Supine	Side
Total	3733 (100)	884 (23.7)	1745 (46.7)	1100 (29.5)
Maternal				
Ethnicity				
White non-Hispanic	2898 (77.6)	613 (69.3)	1506 (86.3)	776 (70.5)
Black non-Hispanic	325 (8.7)	135 (15.3)	47 (2.7)	142 (12.9)
Hispanic	312 (8.4)	111 (12.6)	81 (4.6)	120 (10.9)
Asian	150 (4.0)	14 (1.6)	86 (4.9)	50 (4.5)
Other	30 (0.8)	4 (0.5)	19 (1.1)	7 (0.6)
Age, y				
14-17	114 (3.1)	31 (3.5)	35 (2.0)	48 (4.4)
18-24	676 (18.1)	214 (24.2)	248 (14.2)	211 (19.2)
25-34	2089 (56.0)	483 (54.6)	991 (56.7)	614 (55.8)
≥35	660 (17.7)	117 (13.2)	353 (20.2)	190 (17.3)
Marital status				
Never married	792 (21.2)	237 (26.8)	273 (15.6)	280 (25.5)
Married	2845 (76.2)	616 (69.7)	1439 (82.5)	788 (71.6)
Separated, divorced, or widowed	91 (2.4)	29 (3.3)	33 (1.9)	29 (2.6)
Live births				
1	1646 (44.1)	297 (33.6)	890 (51.0)	459 (41.7)
2	1254 (33.6)	320 (36.2)	536 (30.7)	396 (36.0)
≥3	830 (22.2)	267 (30.2)	317 (18.2)	244 (22.2)
Household income, $				
<16 000	402 (10.8)	126 (14.3)	137 (7.9)	138 (12.5)
16 000-34 999	574 (15.4)	164 (18.6)	232 (13.3)	177 (16.1)
35 000-54 999	754 (20.2)	188 (21.3)	369 (21.1)	196 (17.8)
≥55 000	1580 (42.3)	292 (33.0)	869 (49.8)	419 (38.1)
Sex				
Male	1916 (51.3)	503 (56.9)	865 (49.6)	547 (49.7)
Female	1817 (48.7)	381 (43.1)	880 (50.4)	553 (50.3)
Breastfed in first 6 mo				
No	1705 (45.7)	476 (53.8)	719 (41.2)	508 (46.2)
Yes	2028 (54.3)	408 (46.2)	1026 (58.8)	592 (53.8)
Passive smoke exposure in first 6 mo				
No	3265 (87.5)	740 (83.7)	1551 (88.9)	971 (88.3)
Yes	430 (11.5)	130 (14.7)	186 (10.7)	114 (10.4)
Daycare				
No	2202 (59.0)	433 (49.0)	1144 (73.6)	625 (56.8)
Yes	725 (19.4)	144 (16.3)	410 (26.4)	171 (15.5)
Pacifier use in first 3 mo				
No	828 (22.2)	197 (22.3)	396 (22.7)	233 (21.2)
Yes	2890 (77.4)	684 (77.4)	1341 (76.8)	863 (78.5)

*Data are given as number (percentage). Some percentages do not sum to 100 because of rounding. The number of infants varies because of missing data. Missing data for individual maternal and infant characteristics were typically less than 1%, but were 27.7% for daycare.

analyses stratified independently by maternal ethnicity, breastfeeding, and season. Adjusted ORs comparing supine and prone sleeping infants were calculated, and there was no evidence of effect modification. That is, the ORs for ear infection in relation to sleep position did not vary significantly by ethnicity, breastfeeding, or season.

Hospital admissions were reported in 246 infants (6.6%). The all-cause hospitalization rates at 1, 3, and 6 months did not differ by sleep position and ranged from 2.7% to 3.5% at 1 month, 4.0% to 4.9% at 3 months, and 5.3% to 6.3% at 6 months. Six (2.4%) of 246 admissions were related to an apparent life-threatening event, but there was no relationship with usual sleep position (2 prone, 3 side, and 1 supine). The present analysis was restricted to infants surviving to age 6 months and therefore does not include any infants in the original study cohort who died at younger than 6 months. However, 1 death reported as SIDS occurred at 8 months in an infant who slept in the supine position at ages 1 to 6 months.

COMMENT

This longitudinal follow-up of 3733 infants in eastern Massachusetts and northwest Ohio documents that infants in the United States sleeping in the supine and side positions do not have a higher risk for any of the adverse health outcomes we studied. Indeed, infants whose reported sleep position was consistently supine or side through age 6 months had fewer reports of fever at 1 month and fewer reports of stuffy nose at 6 months than infants sleeping in the prone position. Because one of the barriers to the use of nonprone sleep positions has been the belief that infants sleep better prone,[4,5,7] it is note-

worthy that sleep problems were not more frequent in infants sleeping in the supine position at any age and, in fact, were significantly less frequent at 6 months. Infants continuing to sleep in the supine or side position at 3 months had fewer outpatient visits for ear infections, and this association persisted at 6 months for infants sleeping supine. Furthermore, the findings for infants sleeping in the side position tended to be intermediate between those of the prone and supine sleep position groups.

Our findings support and extend reports from other countries. A prospective study[8] of a Tasmanian high-risk birth cohort of 6213 infants reported no increase in cyanosis, pallor, or breathing symptoms at age 5 weeks for infants sleeping in the supine position, and, in fact, the risk for these symptoms was increased among infants sleeping in the prone position. In addition, hospital admissions for apnea or cyanosis during infancy did not differ by sleep position.

A longitudinal study[9] in the United Kingdom ascertained the prevalence of 43 health outcomes at 1 month and again at ages 6 to 8 months in 8524 infants. Sleep position was ascertained by maternal report of position placed for sleep at 1 month. Based on logistic regression analyses and adjusted ORs, diaper rash and cradle cap occurred with modestly increased frequency in infants placed supine for sleeping, but there was no clinically significant adverse health outcome during the first 6 to 8 months associated with supine or side sleeping. A decreased risk associated with supine and side sleep positions, however, was observed for some health outcomes, including cough and possibly fever. Infants sleeping supine or on the side had a decreased risk for earaches and apparent hearing problems at ages 6 to 8 months (unadjusted OR), but the adjusted ORs were not different from the null.

A subsequent study from the United Kingdom included additional subjects and additional follow-up assessments at 18 and 30 months.[9,10] Adjusted risk estimates revealed that the risk of ear infections at 18 and 30 months was related to infant sleeping position at age 1 month. Compared with infants sleeping prone, infants sleeping supine had an OR for ear infections of 0.54 (95% confidence interval, 0.31-0.95). In a separate study[10] of United Kingdom children aged 3½ to 7 years referred to otolaryngologists for otitis media with effusion and including a balanced distribution of infant sleep positions, the strongest predictor of otitis media and its severity was a history of prone sleeping at 1 month (OR, 3.9; 95% confidence interval, 1.8-8.8). This relationship persisted into mid childhood.

No studies, to our knowledge, have addressed mechanisms by which supine sleeping might reduce risk for ear infections, but several hypotheses may be plausible. Gan-

Table 2. Prevalence of Symptoms Among 3733 Infants in Past Week and Outpatient Visits in Past Month as Determined by Parental Reports at Ages 1, 3, and 6 Months*

Variable	1 mo	3 mo	6 mo
Symptoms			
Fever	99 (2.7)	252 (6.8)	470 (12.6)
Cough	414 (11.1)	778 (20.8)	1022 (27.4)
Respiratory problem†	183 (4.9)	189 (5.1)	284 (7.6)
Trouble sleeping	274 (7.3)	233 (6.2)	458 (12.3)
Stuffy nose	1019 (27.3)	1198 (32.1)	1299 (34.8)
Spitting up or vomiting	1459 (39.0)	1317 (35.3)	888 (23.8)
Diarrhea	146 (3.9)	195 (5.2)	255 (6.8)
Other	83 (2.2)	54 (1.4)	57 (1.5)
Outpatient visits			
Ear infection	63 (0.2)	269 (7.2)	668 (17.9)
Respiratory problem†	107 (2.9)	180 (4.8)	212 (5.7)
Spitting up or vomiting	160 (4.3)	190 (5.1)	120 (3.2)
Colic	145 (3.9)	82 (2.2)	12 (0.03)
Seizure	9 (0.02)	8 (0.02)	9 (0.02)
Accident or injury	14 (0.04)	20 (0.05)	17 (0.05)

*Data are given as number (percentage).
†Combination of wheezing and trouble breathing.

Table 3. Adjusted Odds Ratios (95% Confidence Intervals) for Symptoms at Ages 1, 3, and 6 Months for Supine and Side Sleeping Infants Compared With Prone Infants*

Sleeping Position	1 mo	3 mo	6 mo
Supine			
Fever	**0.56 (0.34-0.93)**	1.10 (0.74-1.50)	0.87 (0.67-1.10)
Cough	1.20 (0.92-1.60)	0.98 (0.79-1.20)	1.10 (0.86-1.30)
Respiratory problem†	0.90 (0.60-1.40)	0.85 (0.57-1.30)	0.83 (0.60-1.20)
Trouble sleeping	0.74 (0.53-1.00)	0.76 (0.53-1.10)	**0.57 (0.44-0.73)**
Stuffy nose	0.97 (0.79-1.20)	0.83 (0.68-1.00)	**0.74 (0.61-0.89)**
Spitting up or vomiting	1.10 (0.92-1.30)	0.92 (0.77-1.10)	0.91 (0.74-1.10)
Diarrhea	0.91 (0.60-1.40)	0.86 (0.58-1.30)	0.78 (0.55-1.10)
Side			
Fever	**0.48 (0.28-0.82)**	1.00 (0.73-1.50)	0.96 (0.74-1.30)
Cough	1.30 (0.96-1.70)	0.88 (0.70-1.10)	0.99 (0.81-1.20)
Respiratory problem†	0.88 (0.59-1.30)	0.86 (0.58-1.30)	0.82 (0.59-1.10)
Trouble sleeping	0.90 (0.64-1.30)	0.86 (0.61-1.20)	**0.69 (0.53-0.89)**
Stuffy nose	0.94 (0.77-1.20)	0.85 (0.70-1.00)	**0.82 (0.68-0.99)**
Spitting up or vomiting	1.10 (0.94-1.40)	1.20 (1.00-1.50)	1.10 (0.85-1.30)
Diarrhea	0.77 (0.49-1.20)	1.00 (0.68-1.50)	0.83 (0.59-1.20)

*Computed by multiple logistic regression analysis controlling for maternal ethnicity, age, marital status, education, breastfeeding, parity, language spoken at home, household income, exposure to environmental tobacco smoke, infant sex, daycare, and season. Significant differences are in boldface.
†Combination of wheezing and trouble breathing.

Table 4. Adjusted Odds Ratios (95% Confidence Intervals) for Outpatient Visits at Ages 1, 3, and 6 Months for Supine and Side Sleeping Infants Compared With Prone Infants*

Sleeping Position	1 mo	3 mo	6 mo
Supine			
Ear infection	1.0 (0.54-2.00)	**0.64 (0.46-0.88)**	**0.73 (0.58-0.92)**
Respiratory problem†	1.2 (0.72-2.00)	0.89 (0.59-1.30)	0.72 (0.50-1.10)
Spitting up or vomiting	0.85 (0.55-1.30)	0.79 (0.53-1.20)	1.0 (0.62-1.70)
Colic	0.78 (0.50-1.20)	1.1 (0.61-2.00)	0.22 (0.04-1.30)
Side			
Ear infection	1.0 (0.51-1.90)	**0.68 (0.49-0.96)**	1.0 (0.80-1.30)
Respiratory problem†	1.0 (0.59-1.70)	0.96 (0.64-1.40)	1.1 (0.76-1.60)
Spitting up or vomiting	1.1 (0.76-1.70)	1.1 (0.76-1.60)	1.3 (0.76-2.10)
Colic	0.94 (0.61-1.50)	0.92 (0.50-1.70)	0.92 (0.23-3.60)

*Computed by multiple logistic regression controlling for maternal ethnicity, age, marital status, education, breastfeeding, parity, language spoken at home, household income, exposure to environmental tobacco smoke, infant sex, daycare, and season. Significant differences are in boldface.
†Combination of wheezing and trouble breathing.

non et al[10] speculated that higher airway temperature in infants sleeping prone would favor bacterial colonization and hence respiratory and ear infections. Our observations of reduced fever at 1 month and reduced stuffy nose at 6 months associated with nonprone sleep positions are consistent with this hypothesis, as is the reported observation that adults with upper respiratory tract infections have lower nasal bacterial counts after lying supine for 1 hour vs lying prone for 1 hour.[11] Also, infants sleeping supine swallow more frequently than infants sleeping prone in response to a pharyngeal fluid stimulus, suggesting more effective clearing of nasopharyngeal secretions in the supine position and, hence, less potential for eustachian tube obstruction and fewer ear infections.[12]

The strengths of our study include a well characterized group of more than 3700 infants, with varying demographic characteristics drawn from 2 discrete geographic regions, and longitudinal follow-up for 6 months, including reports of infant sleep position at 1, 3, and 6 months. By restricting our analyses to infants maintaining the same sleep position at ages 1 to 6 months, the reported health outcomes can be associated with the same "customary" sleep position during early infancy. Our study has limitations. First, the position placed for sleep the previous evening was used as a surrogate for sleep position since the last survey interval. If some infants had sleep positions that were more variable than reported at 1, 3, and 6 months, our estimates of association could be biased toward the null. We consider this unlikely, however, because the previous 24 hours were described as typical (including sleep position) for most infants. Furthermore, although we did not ask about position found on awakening, almost all infants placed supine and prone for sleep are found in the same position when waking up.[9]

The second potential limitation is bias in study eligibility and group assignment. For example, an adverse consequence of supine sleeping before 4 weeks of life could have led to a change to the side or prone sleep position, and infants would be classified only according to the new position. Supine-related symptoms having their onset before 1 month would likely be missed or incorrectly associated with the new sleep position maintained at 1, 3, and 6 months.

What This Study Adds

The American Academy of Pediatrics and the national "Back to Sleep" campaign recommend that infants be placed to sleep on their backs to reduce the risk of SIDS. Because of concerns about safety of the supine sleep position for infants, this study was conducted to determine if infants sleeping in the supine position in the first 6 months of life (peak risk period for SIDS) are at greater risk for specific non-SIDS adverse health consequences compared with those placed to sleep prone.

This study provides important new information about the safety of supine sleeping for infants through age 6 months. No identified symptom or illness was increased in frequency among nonprone sleepers, and some symptoms and ear infections appear to be less common among infants sleeping supine. Because concerns about possible health risks associated with the supine sleep position may have limited compliance with Back to Sleep recommendations, these results should facilitate adoption of this important public health intervention.

A third potential limitation is that any adverse consequence of supine sleeping leading to a change in sleep position after age 1 month would be missed in these analyses restricted to infants maintaining the same sleep position at ages 1 to 6 months. These analyses were limited to nonchangers to avoid temporal ambiguity in the relationship between sleep position and health outcomes. Had we included infants who changed sleep position, it would not have been possible to distinguish those who changed position before the health outcome occurred from those who changed sleep position as a consequence of the health problem. It is unlikely that we missed any significant adverse consequences by excluding infants changing from supine to nonsupine after the 3-month report, because only 3% of all infants with complete data were excluded for this reason.

Fourth, these analyses considered a limited number of symptoms and diagnoses; it is not possible to draw any conclusions from these data regarding other conditions. Finally, our data about ear infections are based on parental report. Parental reporting, however, was accu-

rate in a previous study.[13] Because of the number of comparisons in these analyses, some of the significant associations could have occurred by chance. It is reassuring, however, that we observed no statistically significant associations suggestive of a harmful effect of supine or side sleeping.

The principal value of these data is the reassurance that placing infants to sleep on the side or back does not increase any of a wide range of health risks. Of particular importance is the fact that the study sample was sufficiently large for most health outcomes to rule out even modest increases in risk. A secondary observation of a decrease in reported ear infections associated with infants sleeping in the side and supine positions warrants further study.

Concerns about possible health risks associated with supine sleep have limited the degree to which some health care providers advocate and some parents comply with Back to Sleep recommendations. Our findings should therefore lead to more widespread adoption of this important public health intervention.

Accepted for publication December 12, 2002.

From the Department of Pediatrics, Medical College of Ohio, Toledo (Drs Hunt and McCoy); Slone Epidemiology Center, Boston University (Drs Lesko, Corwin, and Mitchell and Mr Vezina), Department of Pediatrics, Boston University School of Medicine (Drs Corwin and Mitchell), and Department of Pediatrics, Children's Hospital, Harvard Medical School (Dr Mandell), Boston, Mass; and National Institute of Child Health and Human Development (Dr Willinger) and National Institute on Deafness and Other Communication Disorders (Mr Hoffman), National Institutes of Health, Department of Health and Human Services, Bethesda, Md. Dr Hunt is now affiliated with the National Center on Sleep Disorders Research, National Heart, Lung, and Blood Institute, Bethesda

This study was funded by grant N01-HD-4-3221 from the National Institute of Child Health and Human Development and National Institute on Deafness and Other Communication Disorders, National Institutes of Health, and was conducted with the cooperation of the Massachusetts Department of Public Health, Boston.

We thank Sandra Hatfield, BA, Dottie Powers, AA, and Debra Zagaeski, BA, for research assistance; Maria Francescon, MPH, Chris DeArmond, BSN, Cynthia Nagle, BSN, Heather Wightmann, MPH, and Grace Adeya, MPH, for recruiting patients and conducting the interviews; Leonard Gaetano, MS, for programming assistance; and Theodore Colton, ScD, for advice on study design and data analysis. We are indebted to the physicians and nurses at the following hospitals: Boston Medical Center and Beth Israel Hospital, Boston; Lowell General Hospital, Lowell; Lawrence General Hospital, Lawrence; and St Vincent Mercy Medical Center and Toledo Hospital, Toledo.

The content of this publication does not necessarily reflect the views or policies of the Department of Health and Human Services, nor does mention of trade names, commercial products, or organizations imply endorsement by the US government.

Corresponding author and reprints: Carl E. Hunt, MD, National Center on Sleep Disorders Research, National Heart, Lung, and Blood Institute, Two Rockledge Centre, Room 1003, 6701 Rockledge Dr, MSC 7920, Bethesda, MD 20892-7920 (e-mail: huntc@nhlbi.nih.gov).

REFERENCES

1. Willinger M, James LS, Catz C. Defining the sudden infant death syndrome (SIDS): deliberations of an expert panel convened by the National Institute of Child Health and Human Development. *Pediatr Pathol*. 1991;11:677-684.
2. American Academy of Pediatrics (AAP) Task Force on Infant Positioning and SIDS. Positioning and SIDS. *Pediatrics*. 1992;89:1120-1126.
3. American Academy of Pediatrics Task Force on Infant Sleep Position and Sudden Infant Death Syndrome. Changing concepts of sudden infant death syndrome: implications for infant sleeping environment and sleep position. *Pediatrics*. 2000;105:650-656.
4. Willinger M, Ko CW, Hoffman HJ, Kessler RC, Corwin MJ. Factors associated with caregivers' choice of infant sleep position, 1994-1998: the National Infant Sleep Position Study. *JAMA*. 2000;283:2135-2142.
5. Hunt CE, Shannon DC. Sudden infant death syndrome and sleeping position. *Pediatrics*. 1992;90:115-118.
6. Orenstein SR, Mitchell AA, Ward SD. Concerning the American Academy of Pediatrics recommendation on sleep position for infants. *Pediatrics*. 1993;91:497-499.
7. Lesko SM, Corwin MJ, Vezina RM, et al. Changes in sleep position during infancy: a prospective longitudinal assessment. *JAMA*. 1998;280:336-340.
8. Ponsonby AL, Dwyer T, Couper D. Sleeping position, infant apnea, and cyanosis: a population-based study. *Pediatrics* [serial online]. 1997;99:e3. Available at: http://www.pediatrics.org/cgi/content/full/99/1/e3. Accessed February 4, 2003.
9. Hunt L, Fleming P, Golding J, and the ALSPAC Study Team. Does the supine sleeping position have any adverse effects on the child? I: health in the first six months. *Pediatrics* [serial online]. 1997;100:e11. Available at: http://www.pediatrics.org/cgi/content/full/100/1/e11. Accessed February 4, 2003.
10. Gannon MM, Goncalves MS, Haggard MP, Golding J. Replication of infant sleeping position as an OM risk factor. In: Proceedings of the Seventh International Symposium on Recent Advances in Otitis Media; June 1-5, 1999; Fort Lauderdale, Fla.
11. Bell S, Crawley BA, Oppenheim BA, Drucker DB, Morris JA. Sleeping position and upper airways bacterial flora: relevance to cot death. *J Clin Pathol*. 1996;49:170-172.
12. Jeffery HE, Megevand A, Page H. Why the prone position is a risk factor for sudden infant death syndrome. *Pediatrics*. 1999;104:263-269.
13. Daly KA, Lindgren B, Giebink GS. Validity of parental report of a child's medical history in otitis media research. *Am J Epidemiol*. 1994;139:1116-1121.