

Infant Sleep Location: Associated Maternal and Infant Characteristics with Sudden Infant Death Syndrome Prevention Recommendations

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Objective To identify factors associated with infant sleep location.

Study design Demographic information and infant care practices were assessed for 708 mothers of infants ages 0 to 8 months at Women, Infants and Children centers. Generalized linear latent mixed models were constructed for the outcome, sleeping arrangement last night (room-sharing without bed-sharing versus bed-sharing, and room-sharing without bed-sharing versus sleeping in separate rooms).

Results Two-thirds of the mothers were African-American. A total of 48.6% mothers room-shared without bed-sharing, 32.5% bed-shared, and 18.9% slept in separate rooms. Compared with infants who slept in separate rooms, infants who room-shared without bed-sharing were more likely to be Hispanic (odds ratio [OR], 2.58, 95% CI 1.11-5.98) and younger (3.66- and 1.74-times more likely for infants 0-1 month old and 2-3 months old, respectively, as compared with older infants). Compared with infants who bed-shared, infants who room-shared without bed-sharing were more likely to be 0 to 1 month old (OR, 1.57; 95% CI, 1.05-2.35) and less likely to be African-American (OR, 0.43; 95% CI, 0.26-0.70) or have a teenage mother (OR, 0.37; 95% CI, 0.23-0.58).

Conclusions Approximately one-third of mothers and infants bed-share, despite increased risk of sudden infant death syndrome (SIDS). The factors associated with bed-sharing are also associated with SIDS, likely rendering infants with these characteristics at high risk for SIDS. (*J Pediatr* 2008;153:503-8)

The incidence of sudden infant death syndrome (SIDS) in the United States has declined 50% since 1992, when the American Academy of Pediatrics (AAP) first recommended that infants be placed in a non-prone position for sleep.¹ Despite the tremendous success of the subsequent "Back to Sleep" campaign, the initial decline in SIDS rates has leveled off in the last 5 years.² In 2004, 2246 infants died of SIDS in the United States.³ SIDS remains the third most common cause of death in infants, and the most common cause of death in infants from 1 month to 1 year of age.^{4,5}

As the rate of prone positioning has declined, other previously unrecognized risk factors for SIDS have emerged. Despite bed-sharing (BS) between an infant and adult facilitating breastfeeding and enhancing parent-infant interactions,^{6,7} this sleeping arrangement has been identified in epidemiologic studies as being hazardous in certain situations, particularly when one or both parents are smokers,⁸⁻¹² when on excessively soft surfaces, such as waterbeds, sofas, and armchairs,^{9,10,13-15} or when the infant is <2 to 3 months of age.^{9,12,14-17} In addition, there is an increased risk for sudden unexpected infant death when there are multiple bedsharers¹³ and when BS occurs for the entire night.^{9,11} The risk for infant death may also be increased when the bed-sharer has consumed alcohol or is overtired.^{11,16} Although it may not be BS itself but the accompanying conditions that are hazardous, BS may increase the risk in certain circumstances for overheating,¹⁸ rebreathing,¹⁹ and exposure to tobacco smoke,²⁰ all of which are known risk factors for SIDS. Currently, approximately half of all sudden and unexpected infant deaths in the United States occur when the infant is sharing a sleep surface with someone else.²¹⁻²⁴

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AAP	American Academy of Pediatrics	RS	Room-sharing
BS	Bed-sharing	SIDS	Sudden infant death syndrome
OR	Odds ratio	WIC	Women, Infants and Children program

There is growing evidence that room-sharing (RS) without BS is associated with a reduced risk of SIDS.^{9,15,16} Several countries, including the United States, currently recommend that infants sleep in a crib or bassinet next to the parents' bed. The AAP recommends a separate but proximate sleep environment (ie, the infant should be in a crib/bassinet in the parent's room), or RS without BS, to reduce the risk of SIDS.²⁵

Because of this increased emphasis on the importance of the infant's sleep location, it is necessary to understand factors associated with BS, RS without BS, and solitary sleeping (ie, infant sleeps in a separate room from parents). The primary aim of this study was to determine the maternal and infant characteristics associated with each of these sleeping arrangements.

METHODS

Interviews

Face-to-face interviews were conducted between June and August 2005 with 708 mothers of infants recruited at Women, Infants and Children program (WIC) centers in Dallas, New Haven, Atlanta, and Savannah. WIC is a federal grant program that provides supplemental nutrition for low-income women, infants, and children. Caregivers who were eligible to participate in the study received benefits from WIC, had an infant <8 months old, and spoke English. Interviews were conducted by research assistants local to each WIC center who received extensive, standardized training. All participants received information on current recommendations for safe infant sleep practices according to the "Back to Sleep" guidelines. Institutional review board approval was obtained for all sites.²⁶

Statistical Analysis

Data were analyzed for caregivers who identified themselves as mothers, because we believed this was a relatively homogeneous group most likely to have consistent contact with the infants. *A priori* and on the basis of findings from earlier studies of risk factors for SIDS,²⁵ we selected these as potential predictor variables: maternal age, race, education, smoking status, infant's age, health status, usual sleep position, usual intake (includes breast milk or excludes breast milk), and place of well-child care. There is evidence that when mothers have more trust in their infant's healthcare provider, they are more likely to follow their provider's advice on safe infant sleep practices.²⁶ The variable place of well-child care explores whether particular types of healthcare provider (free-standing clinic, hospital-based clinic, private practice, or none) are associated with safe infant sleep practices more than others. Descriptive statistics, including frequencies and percentages for categorical predictor variables and means and SDs for continuous variables were calculated. The relationship of each predictor variable to the 3 possible infant sleeping arrangements last night (BS, RS without BS, or solitary sleeping) was examined by using the χ^2 test. Sleeping arrangement "last night" (ie, on the night before the interview) was chosen to reduce recall bias. Test levels for

Table 1. Demographic characteristics of participants

Characteristic	All groups (n = 708)
Maternal age, median (interquartile range), years	23 (20, 28)
Infant age, median (interquartile range), months	3 (1, 6)
Infant sex, % female	51
Maternal race, %	
African-American	66
Hispanic	14
White	15
Other	5
Maternal education, %	
Less than high school	21
High school/GED	39
Some college	29
College/more	11
Site, %	
Dallas	27
New Haven	26
Atlanta	24
Savannah	23

significance were *P* values <.05. Next, by using the Stata gllamm procedure, we constructed generalized linear latent mixed models to examine multinomial outcomes (BS versus RS without BS, and solitary sleeping versus RS without BS). The typical multinomial logistic regression model requires that the outcome is categorical and the observations are mutually independent. In contrast, the gllamm model used here assumes that underlying the categorical outcome, there is an unobserved or latent continuous outcome (probability of being of a level of outcome) and allows for clustering effects (or dependence among observations) within the same study site.²⁷ By allowing a random intercept of study site, we consider the sites in this dataset to be randomly sampled from the population of many sites. We started with full models that included all 9 predictors aforementioned and study site. Then we removed 1 predictor at a time, starting with the predictor with the largest *P* value. We stopped when the remaining predictors were at least marginally significant (*P* <.10) in 1 of the outcome levels (BS versus RS without BS, or solitary sleeping versus RS without BS), except when exclusion increased the standard error of the other predictors remaining in a model. Odds ratios (ORs) with 95% CIs were calculated for the co-variables for each outcome level. All analyses were conducted with STATA/SE software version 9 (College Station, Texas).

RESULTS

Demographics

A total of 817 caregivers were enrolled in the study. Of the caregivers interviewed, 723 (88.7%) were mothers. Data were analyzed for the 708 mothers for whom there was response to the question of where their infant slept last night. Participants were fairly evenly distributed among the 4 study

Table II. Association of potential risk factors for SIDS by using univariate analysis with roomsharing without bedsharing, solitary sleeping, and bedsharing

Variable	Total	RS without BS n (%)	Solitary sleeping n (%)	BS n (%)	P value
Total sample	708	344 (48.6)	134 (18.9)	230 (32.5)	
Maternal age, years					<.001
≤19	120	41 (12.0)	18 (13.7)	61 (26.5)	
≥20	583	301 (88.0)	113 (86.3)	169 (73.5)	
Maternal race					<.001
African-American	465	205 (60.3)	87 (66.9)	173 (75.5)	
Hispanic	96	59 (17.3)	9 (6.9)	28 (12.2)	
Other	32	19 (5.6)	6 (4.6)	7 (3.1)	
White	106	57 (16.8)	28 (21.6)	21 (9.2)	
Maternal education					.01
Less than high school	145	64 (18.7)	21 (16.0)	60 (26.1)	
High school/GED	276	131 (38.2)	48 (36.7)	97 (42.2)	
Some college	206	101 (29.4)	46 (35.1)	59 (25.6)	
College/more	77	47 (13.7)	16 (12.2)	14 (6.1)	
Infant age, months					<.001
0-1	256	146 (42.5)	24 (18.0)	86 (37.4)	
2-3	145	72 (20.9)	27 (20.3)	46 (20.0)	
4-8	306	126 (36.6)	82 (61.7)	98 (42.6)	
Infant health status					.95
Chronic/acute illness	59	28 (8.2)	12 (9.1)	19 (8.3)	
Healthy	646	315 (91.8)	120 (90.9)	211 (91.7)	
Usual infant sleep position					.02
Non-supine	269	118 (34.3)	47 (35.1)	104 (45.2)	
Supine	439	226 (65.7)	87 (64.9)	126 (54.8)	
Maternal smoking status					.64
Smoker	114	59 (17.2)	18 (13.6)	37 (16.1)	
Non-smoker	591	284 (82.8)	114 (86.4)	193 (83.9)	
Place of well-child care					.06
Free-standing clinic	112	55 (16.0)	25 (18.9)	32 (14.0)	
Hospital-based clinic	262	122 (35.5)	37 (28.0)	103 (45.0)	
None	13	5 (1.4)	3 (2.3)	5 (2.2)	
Private-practice/Other	318	162 (47.1)	67 (50.8)	89 (38.8)	
Usual infant intake					.34
Includes breast milk	109	56 (16.3)	24 (17.9)	29 (12.7)	
Excludes breast milk	598	288 (83.7)	110 (82.1)	200 (87.3)	

sites (Table I). The median age for the mothers was 23 years. Most mothers were African-American (66%). The percentage of non-white participants (85%) was greater compared with the percentage of non-white population overall in the 4 study cities (39%) and compared with the United States overall (26%). The percentage of mothers who had not completed a high school education or the equivalent at the time of the study (21%) was slightly less compared with the percentage overall in the 4 cities (26%), but greater compared with that in the United States overall (16%).²⁸ Of the infants, the median age was 3 months, and roughly half the infants were female.

Infant Sleeping Arrangement

Approximately half the mothers (48.6%) reported that their infant slept in the same room and in a separate bed last night (ie, room-shared without BS), as advised by the AAP. Almost one-third of respondents reported that their infants

bed-shared. The least common sleeping arrangement for infants was solitary sleeping (18.9%; Table II). With univariate analysis, teenage mothers were more likely to report that their infants were BS as compared with other sleep arrangements, whereas mothers who were at least 20 years old were more likely to report that their infants were RS without BS ($P < .001$). There was also a significant difference in choice of sleeping arrangement by maternal race ($P < .001$). Although RS without BS was the most common sleeping arrangement reported by all races, the percentage of infants BS was higher in African-American mothers than in mothers of other races, with 37.2% of the African-American mothers reporting BS. For all other races, at least twice as many mothers reported RS without BS versus BS with their infants. The amount of education reported by mothers was also associated with where their infants slept ($P = .01$). Higher levels of maternal education were associated with higher percentages that reported RS without BS and lower percentages that reported BS.

Table III. Odds ratios on the basis of generalized linear latent mixed modeling of factors associated with roomsharing without bedsharing versus solitary sleeping and bedsharing

Variable	RS without BS (versus solitary sleeping) OR (95% CI)	RS without BS (versus BS) OR (95% CI)
Maternal age, years		
≤19	0.71 (0.38-1.32)	0.37 (0.23-0.58)*
≥20		
Maternal race		
African-American	1.26 (0.76-2.09)	0.43 (0.26-0.70)*
Hispanic	2.58 (1.11-5.98)*	0.79 (0.41-1.52)
Other		
White		
Infant age, months		
0-1	3.66 (2.16-6.22)*	1.57 (1.05-2.35)*
2-3	1.74 (1.01-3.00)*	1.28 (0.79-2.06)
4-8		

Models have been adjusted for study site.

*OR is statistically significant at $P < .05$.

There was also a significant difference in sleeping arrangement in infants of different age groups ($P < .001$). With increasing age of the infant, the percentage of infants RS without BS decreased, and the percentage of infants sleeping solitary increased. In addition, the position infants were placed to sleep was also associated with their sleeping arrangement ($P = .02$). Almost 40% of infants sleeping non-supine were BS, whereas approximately half the infants sleeping supine were RS without BS. Finally, there was no difference in sleeping arrangements by maternal smoking status, place of well child care, or by usual infant feeding (breast milk or formula).

With multinomial modeling, compared with those infants who slept solitary, infants who room-shared without BS were more likely to be Hispanic (OR, 2.58; 95% CI, 1.11-5.98) and also younger. Infants at 0 to 1 month of age were 3.66 times more likely to room-share without BS and infants 2 to 3 months of age were 1.74 times more likely to room-share without BS compared with infants 4 to 8 months of age (Table III). Compared with infants who bed-shared, those who room-shared without BS were more likely to be a newborn, ages 0 to 1 month (OR, 1.57; 95% CI, 1.05-2.35) and less likely to be African-American (OR, 0.43; 95% CI, 0.26-0.70) or have a teenage mother (OR, 0.37; 95% CI, 0.23-0.58).

DISCUSSION

The AAP first advocated RS without BS as the preferred sleeping arrangement for infants in 2005.²⁵ Although this recommendation has been somewhat controversial, our study, which interviewed parents at approximately the same time the recommendations were published, indicates that RS

without BS is common practice. It was the most common sleeping arrangement reported by mothers in our study.

Another reassuring finding of our study, because 90% of the cases of SIDS occur in the first 6 months of life,²⁵ was that younger infants were more likely to room-share without BS as compared with the other sleeping arrangements. It is possible that parents are reluctant to have very young infants sleep in a separate room, because it is more difficult to monitor what is happening with the infant from a different room.

However, approximately one-third of the infants in our study were BS on the night before the interview. BS was more common in African-American and teenage mothers. This is consistent with the findings of other studies. The National Infant Sleep Position study reported that African-American infants are 4 times more likely to routinely bed-share than white infants.²⁹ African-American infants who die from SIDS or sudden unexpected infant death are also more likely to be BS. Hauck et al, in a case-control study of SIDS, found that 58% of African-American infants bed-shared, compared with 29.2% of non-African-American infants.³⁰ Similarly, in a retrospective population-based cohort of sudden unexpected infant deaths, Unger et al found BS deaths to be nearly twice as common in African-American infants.²⁴ Other studies have found BS to be linked to measures of poverty. Teenage motherhood may be an indicator of lower socioeconomic status that may explain why BS was more common in these younger mothers in our study. In an Oregon cohort, Lahr found that BS was most prevalent in families with annual incomes $< \$30,000$.³¹ Other studies have found this sleeping arrangement is more common if the parent is a teenager,³² did not attend college,^{33,34} or has moved at least once since the baby's birth.³³ Although these are all potential markers of lower income, it should be noted that these studies were conducted in populations that were predominantly urban and indigent, which was also true for our study.

One notable observation about our study population is that all the mothers who reported BS with an infant on the night before the interview stated that the infant had slept on an adult bed or mattress. However, 1 mother also reported that she usually put her infant to sleep on a sofa, and 31 other mothers stated that their infants sometimes slept on sofas. Soft surfaces such as sofas have been found to be particularly hazardous for infants.^{13,14,35}

With increased awareness of the risk factors associated with BS, it is important to try to understand why people in certain demographic categories bed-share more than others. For some families, the reason may be purely economic; they lack the funds to purchase a separate crib or bassinet for their child. Many states are initiating free crib distribution programs,³⁶ and it will be important to evaluate the effectiveness and acceptability of these programs. In addition, it is likely that for some families, cultural practices and expectations also are involved in the decision to bed-share. Although our study population was predominantly urban and indigent, African-American mothers more commonly reported BS, whereas

Hispanic mothers more commonly reported RS without BS. In the National Infant Sleep Position study, more than twice as many African-American mothers reported “usually” BS compared with Hispanic mothers.²⁹

Regardless of race, most studies have found that BS is more common when the infant is being breastfed.^{31,32} The rate of breastfeeding in our study population (15.4%) was slightly lower than the rate of breastfeeding at 6 months of age found in 1 study for WIC participants overall in 2003 (21.0%), which in turn was lower than for all 6-month-old infants in the United States (42.7%).³⁷ Studies in low-income African-American mothers have not found a correlation between breastfeeding and BS.^{33,34} However, McCoy found that breastfeeding and BS were correlated in the African-American subset of her cohort,³² and Lahr found this to be true only in higher income African-American mothers.³¹ Breastfeeding advocates cite ease of breastfeeding as an advantage of BS,⁶ and some have expressed concern that the recommendation for RS without BS will negatively impact on breastfeeding rates.³⁸ Our study did not find an association between breastfeeding and the infant’s sleep location. This is important because, whereas some studies have found that breastfeeding confers protection against SIDS,³⁹⁻⁴¹ thus providing a rationale for encouraging BS, a recent study by Ruys et al found that the risk caused by BS is not significantly modified by the presence or absence of breastfeeding.¹²

We also did not find an association between maternal smoking and BS. However, one-third of mothers who smoked bed-shared with their infants. Multiple studies have demonstrated that BS is particularly hazardous if 1 or both parents smoke.^{10,12,16,17}

A potential limitation of this study is that data collection occurred in only 4 cities, although demographic data indicate that infant mortality rates in Dallas, New Haven, Atlanta, and Savannah of 6.3, 5.5, 7.1, and 11.0 deaths per 1000 live births, respectively, were similar to the national average of 6.8 in 2006, the last year for which this information is available (infant mortality data is available at the public health district level only for Atlanta and Savannah).^{28,42} Our study population was limited to WIC clients. National surveys have shown that in the United States, low-income populations such as those serviced by WIC are more likely to bed-share.²⁹ Although high rates of BS are often associated with markers of social deprivation in the United States, this is not universally true. In some cultures, including many Asian and European cultures, BS is the norm.⁴³ However, BS in these cultures may look very different from BS as commonly practiced in the United States; infants in Asian cultures typically sleep on a firm surface (such as a futon) in the supine position, and prenatal and postnatal exposure to tobacco smoke is rare.^{44,45} In many Western societies, including in the United States, the incidence of BS has recently increased in higher socioeconomic classes, partly because of the increase in breastfeeding.²⁹

In conclusion, BS in a low-income population is associated with African-American race and having a teenage

mother. Because these are also risk factors for SIDS, it will be important for future studies to investigate parental reasons for BS to identify effective interventions to change typical practices of infant sleep location.

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