A Comparison of the Sleep–Wake Patterns of Cosleeping and Solitary-Sleeping Infants

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ABSTRACT: This study examined whether 3–15 month-old cosleeping infants displayed differences in time spent in active versus quiet sleep, and in the number/duration of nighttime awakenings when compared with solitary-sleeping infants; and also whether they spent the majority of the night sleeping face-to-face, as previously reported. Nine cosleeping and nine solitary-sleeping infants were matched on age, gender, ethnicity, maternal age, and family SES. Video recordings of nighttime sleep yielded percentage of time in active sleep, quiet sleep, and awake, number of awakenings, and the percentage of time cosleeping infants and mothers spent face-to-face. Across age, cosleeping infants had more awakenings per night (mean 5.8(1.50) versus 3.2(1.95); $t = 3.16$, $p = .006$). The percent of the nighttime spent awake did not differ between groups, suggesting that cosleeping infants had shorter awakenings. Cosleeping infants spent 40% of the night face-to-face with their mothers.

KEY WORDS: cosleeping; infants; sleep.

Introduction

Human infants are born helpless, unable to care for themselves. Without the care and protection of their primary caregivers, they are vulnerable to survival threats for a long early developmental

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period. Constant physical contact, including a cosleeping environment, is thought to have been the evolutionary context in which the infant's homeostatic regulatory systems matured.[1] Until modern times, infants shared the same sleeping environment with their parents.[2] And in many cultures around the world today, parents and their young infants still sleep together. The practice of placing infants to sleep in a separate environment is a relatively recent custom, largely limited to Western industrialized societies.[3]

Within the United States, the incidence of cosleeping varies greatly and appears to be influenced by ethnicity. African American families report the highest incidence of cosleeping, followed by Hispanic families, with Caucasian families reporting the lowest incidence.[4] Lozoff and colleagues[5] found converging results, reporting that 57% of their sample of African American families coslept regularly compared to only 17% of Caucasian families. Among Caucasian families only, cosleeping was also associated with low socioeconomic status.[5] Different factors are cited as the rationale for cosleeping depending on ethnicity. Medoff and Schaefer[4] report that Caucasian families tend to be "reactive cosleepers," who cosleep in reaction to a sleep problem in their infants. African American and Hispanic families, however, tend to cosleep because of cultural tradition.

It is important to keep in mind that the definition of cosleeping varies. In some cultures, parents and infants share the same bed; in others, infants sleep on a separate surface but within arm's reach.[6] Some researchers have included the practice of "room sharing" under the rubric of cosleeping as well. In order to account for the differences in how cosleeping is operationalized, McKenna[7] has suggested that the term, "cosleeping" be used to refer to the broad practice of sharing the same sleep environment, while "bedsharing" be reserved for the specific practice of sharing the same bed.

Given the broad prevalence of cosleeping around the world and the likelihood that it was the predominant sleep experience for infants from an evolutionary perspective, McKenna[8] has hypothesized that cosleeping may be important in influencing the course of healthy infant sleep. Paradoxically, other researchers have cautioned against bedsharing due to epidemiological evidence of its positive association with SIDS or other forms of infant death, such as "overlying" or suffocation.[9–12] These studies have been criticized for failing to control for a number of other confounds such as parental substance use, specific aspects of the bedsharing environment (e.g., bed or couch), and the sleeping position of the infant. At least two carefully

controlled studies have provided evidence that bedsharing in and of itself is not a risk factor for infant death.[13,14]

Among those infants in families who reactively cosleep rather than because of cultural practice, there is a correlation between cosleeping and infant sleep problems such as difficulty falling asleep and waking at night.[5,15] The nature of the relationship is unclear, however. A study that compared the sleep practices and problems of infants in the United States versus Japan found that for Japanese parents, night waking was the only concern associated with cosleeping. For the Japanese infants, however, the level of night waking reported was comparable to the reports of night waking for solitary-sleeping infants in the United States.[16] The results suggest that cosleeping is not the only factor associated with night waking in infants.

There is a limited but compelling body of literature suggesting that bedsharing infants do have more awakenings and spend more time in lighter stages of sleep compared to infants sleeping alone.[17,18] Mosko and colleagues[18] studied the sleep of 20 routinely bedsharing infants and 15 routinely solitary-sleeping infants aged 11–15 weeks of age using polysomnography. Infants were randomly assigned to experience one bedsharing night and one solitary-sleeping night in the laboratory, regardless of their routine sleeping location. The polysomnographic recordings did show a reduction in stage 3–4 non-rapid eye movement (NREM) sleep and an increase in stage 1–2 NREM sleep during the cosleeping night when compared to the solitary-sleeping night. The reduced amount of NREM stage 3–4 sleep suggests that infants spent more time in the "lighter" stages of sleep on the cosleeping night. The amount of rapid eye movement (REM) sleep was the same between the cosleeping and solitary-sleeping nights and the amount of total wakefulness was not different. Interestingly, on the cosleeping nights, infants did tend to wake up more often, but the lack of difference in the total amount of time awake demonstrated that their awakenings were briefer than those of the infants who slept alone.[17] Complementary to the results reported by Mosko and colleagues,[17] when routinely cosleeping infants sleep alone, they display fewer awakenings and more time in quiet sleep at 6 months of age.[19]

Mosko and colleagues[20] also have reported on the proximity and positioning of mothers and their 11–15-week-old infants during bedsharing nights. Video recordings revealed that mothers and infants spent $64 \pm 27\%$ of the time sleeping face-to-face at distances less than 20-cm apart.[20] At these distances, carbon dioxide levels remain

above 0.5%, which is enough to stimulate infant respiration, but not so high that they would cause suffocation. The authors hypothesize that this enriched CO_2 environment keeps infants in a more aroused state while sleeping. These findings suggest that bedsharing infants have more, but briefer, awakenings and spend less time in deep stages of sleep, thus making it less likely that infants will enter a deep sleep from which they cannot emerge when faced with a life-threatening event.

The purpose of the current study was to test whether these results could be replicated in a sample of cosleeping infants who were 3–15 months of age. Rather than using polysomnographic measurements, this study used videosomnography to code infant sleep–wake patterns and positioning. Without polysomnography, this study was not able to assess differences between stages 1–2 and 3–4 of NREM (quiet) sleep, but it was able to examine infant positioning, awakenings, and time spent in active versus quiet sleep. It was hypothesized that cosleeping infants would have a greater number of nighttime awakenings and that they would spend the majority of the night sleeping face-to-face with their mothers, given the results of previous investigations. It was also anticipated that cosleeping infants might spend a greater proportion of the night in active sleep, the lighter of the two sleep states coded by videosomnography.

Method

Participants

Eighteen infants were studied. There were nine routinely cosleeping infants (7 males) and nine solitary-sleeping infants that served as a matched control group. Five of the cosleeping families chose bedsharing as a consistent family practice from the infant's birth. Four families began to cosleep sometime during the child's first year of life. The data for the nine control solitary-sleeping infants came from a larger developmental sleep study. The control infants were matched with the cosleeping infants for maternal age, family socioeconomic status, ethnicity, child's age at sleep measurements, and gender. All participants were recruited by placing flyers in local pediatricians' offices and by asking for volunteers at local "mother and baby" social groups. Each mother gave full informed consent before participating.

Participants were excluded if there was any evidence of an abnormal pregnancy or delivery, or chronic health problems in the mother or infant. Participants were also excluded if either parent had a sleep problem. All of the infants were full term and in good health at the times of study.

The mean maternal age for the cosleeping group was 29.3 years (range 18–36), while the mean maternal age for the solitary-sleeping group was 29.1 years (range 19–35). Five of the cosleeping families (62.5%) were middle-upper class, whereas six of the solitary-sleeping families (66.7%) were middle-upper class. Among the cosleeping infants, five (62.5%) were Caucasian, three (37.5%) were multi-racial, and one infant's ethnicity was unknown. Out of the solitary-sleeping infants, six (66.7%) were Caucasian, two (22.2%) were multi-racial, and one (11.1%) was Hispanic. The infants' ages ranged from 3–15 months in both the cosleeping and the solitary-sleeping group. Since cosleeping has become more popular in the past several years, we attempted to recruit a group of children representative of the ages of the cosleeping population. There were no significant differences between the groups on age, ethnic and sociodemographic characteristics, testifying to the adequacy of the matching procedure.

Design and Procedures

This pilot study used repeated measures to study infants at ages 3, 6, 9, 12, or 15 months. None of the infants were measured at all five ages, but all but one were studied on at least two occasions. As a pilot study, the subjects comprise a sample of convenience, recruited at different ages to encompass a broad age range. Prolonged follow-up recording was not possible for some of the families. Table 1 shows the occasions and ages of videorecording for each of the 9 cosleeping infants. Maternal sleep was not scored as part of this study. As mentioned above, solitary sleeping infants with data at each of these ages were chosen for comparison. All but one of the recorded video nights involved infants 6 months of age or older. At each age data collection consisted of two consecutive nights of videotaping the infants' sleep in their natural environment.

During scheduled data collection times, a research assistant set up the video equipment in the participants' homes. The equipment remained in

Table 1
Data Collection Points for Each Cosleeping Infant*

Subject #	*3 Months*	*6 Months*	*9 Months*	*12 Months*	*15 Months*
1		×	×	×	
2		×	×	×	
3	×	×	×	×	
4			×	×	
5		×		×	
6			×		
7				×	×
8		×	×		
9		×	×	×	

*Solitary-sleeping infants with equivalent sleep data at each age were chosen for comparison with each cosleeping infant.

the home for the 2 days and nights. Mothers were asked to start the recording equipment when their infants were put down for nighttime sleep and to stop recording when their infants awakened for the day.

Measures

Sleep was recorded using a portable time-lapse video recording system, which includes a time-lapse videocassette recorder (Panasonic AG-6740P), a camera requiring low-levels of illumination (Panasonic WV-CD810 or Sanyo VDC-9212) that is placed on a tripod next to the infants' sleeping space, a small video monitor, and a microphone. Video and sound are recorded using the 18-hour mode on the VCR so that 18 hours of recording can fit onto a 2-h VHS tape. Clock time is recorded on the videotape by an internal time-code generator. The camera was primarily focused on the mother–infant dyad in the cosleeping setting. These families followed their usual routine during the night, but third party bed partners were not recorded.

The videotapes were coded using an established coding procedure.[21,22] Trained observers watched the videotapes in fast (2 h) mode and coded for sleep–wake states. The following variables were then derived for both groups: percentages of time spent in active sleep, quiet sleep, and awake, and the number of nighttime awakenings for each of the two nights. The mean percentages of these variables were then calculated by collapsing across the two-night collection period. For the cosleeping group, sleeping position of the infants relative to their mothers also was coded. Sleep position was scored as either "toward" or "away," with a "toward" score requiring that both mother and infant be facing each other. Any other combination constituted an "away" score. The percentage of time the mother and infant spent facing towards each other was only coded for the cosleeping group.

Data Analysis

Due to the small number of infants in each age group (see Table 1), the primary analysis of differences between cosleeping and solitary sleeping infants occurred with data collapsed across age. Inadequate sample size (power) precluded observing statistically significant differences in the smaller, age-relevant sub-groups. An examination of each group's data at each age, nevertheless, revealed findings consistent with the collapsed data (see Table 2). Differences between the cosleeping and solitary sleeping groups were analyzed using independent samples *t*-tests. All data were analyzed using the Statistical Package for Social Sciences (SPSS), version 10 for PC.

Results

Table 2 presents the means and standard deviations for each of the sleep variables at each age for the solitary-sleeping and

Table 2
Sleep Variables of Cosleeping and Solitary Sleeping Infants at 3–15 months of Age

	3-m	*6-m*	*9-m*	*12-m*	*15-m*
Solitary-Sleeping					
n	1	6	7	7	1
AS%	38.5 (n/a)	45.0 (6.6)	45.3 (6.9)	39.9 (2.7)	38.0 (n/a)
QS%	58.5 (n/a)	48.8 (6.2)	47.4 (7.4)	53.9 (4.4)	54.0 (n/a)
AW%	4.5 (n/a)	5.4 (4.5)	7.4 (4.2)	9.1 (7.4)	14.0 (n/a)
# Awakenings	0.5 (n/a)	2.3 (2.0)	3.5 (3.0)	3.6 (2.1)	3.0 (n/a)
Cosleeping					
n	1	6	7	7	1
AS%	52.5 (n/a)	42.8 (4.4)	45.1 (10.2)	43.5 (7.1)	42.5 (n/a)
QS%	39.5 (n/a)	47.5 (8.8)	46.5 (9.8)	47.4 (4.2)**	56.5 (n/a)
AW%	9.5 (n/a)	8.4 (1.4)	8.9 (3.9)	9.2 (4.7)	1.0 (n/a)
# Awakenings	4.5 (n/a)	5.3 (2.6)*	7.5 (3.2)**	6.4 (1.8)**	1.0 (n/a)

Note. Means (Standard Deviations) are presented, where applicable. AS% = percent of the night spent in active sleep; QS% = percent of the night spent in quiet sleep; AW% = percent of the night spent awake; # Awakenings = number of nighttime awakenings. All variables are averaged across 2 nights of data collection.
*$p < 0.06$; **$p < 0.05$.

cosleeping infants. Although at 12 months, the cosleeping infants spent a smaller percentage of the night in quiet sleep than their solitary-sleeping counterparts, this difference was not found at any of the other ages, so was most likely a spurious one. No differences were found in the percent of the night spent in active sleep or awake at any age. Likewise, when the data were collapsed across age to increase the power of the comparisons, no significant differences were found between cosleeping and solitary-sleeping infants for the percent of active sleep, quiet sleep, or total nighttime wakefulness.

A significant difference was found, however, in the number of nighttime awakenings between cosleeping and solitary-sleeping infants. At each age where multiple infants were studied in each group (i.e., 6, 9, and 12 months), cosleeping infants experienced more awakenings than their solitary-sleeping peers (see Table 2). Likewise, when the data were collapsed across age, cosleeping infants had a mean of 5.8 (SD=1.5) awakenings per night, while solitary sleeping infants had a mean of 3.2 (SD=2.0) awakenings per night (t=3.16, $p<.01$) (Figure 1). In addition, cosleeping infants spent an average of 39.9% (SD=12.78) of their time asleep facing their mothers.

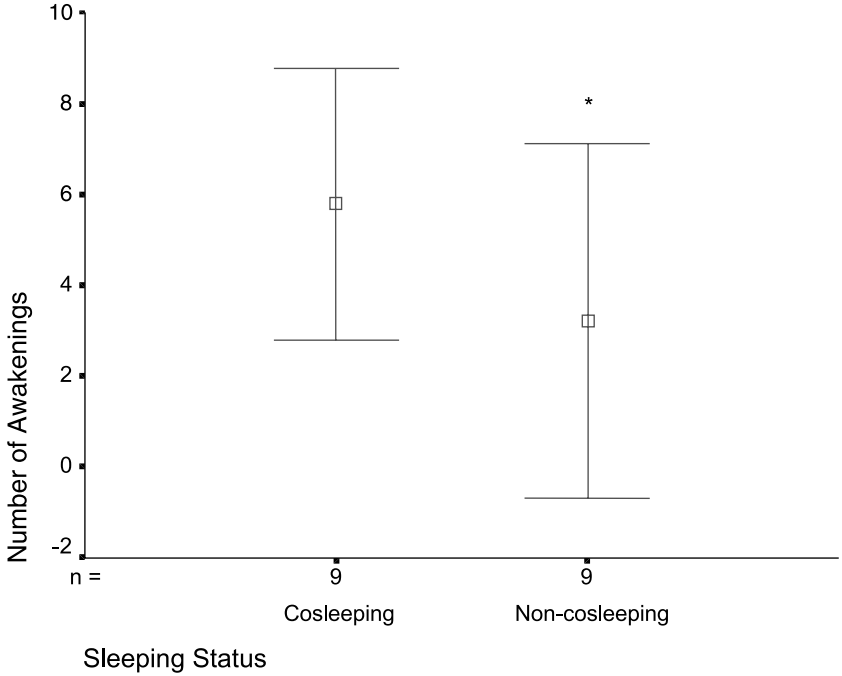

Figure 1. This figure presents the mean (standard deviation) number of awakenings for cosleeping and solitary sleeping infants collapsed across age ($t = 3.16$, $p < 0.01$).

Discussion

This study compared the sleep patterns of cosleeping infants to those of solitary-sleeping infants. Specifically, the two groups were compared on the percentage of time in active sleep, quiet sleep, and awake, and the number of nighttime awakenings. The percent of time spent in active sleep, quiet sleep, and awake was similar between the two groups—the only difference was in the number of awakenings. Cosleeping infants had a greater number of awakenings throughout the night, despite having the same quantity of total nighttime wakefulness as the solitary-sleeping infants. Therefore, although cosleeping infants tended to wake more often, their awakenings were shorter in duration than the awakenings of solitary-sleeping infants.

It has been shown in one previous study using polysomnography that cosleeping infants had more arousals and that they remained

in lighter stages of NREM sleep when sharing the same bed with their mothers in the laboratory, regardless of whether they routinely did so at home or not.[18] The authors conclude that this reduction of time spent in the deep stages of sleep and the increase in number of arousals when cosleeping are potentially protective against SIDS events, which may relate to an infant's ability to arouse from sleep. Recently, however, Hunsley and Thoman[19] challenged this finding using nonpolygraphic methods. These authors reported higher levels of quiet sleep in routinely cosleeping infants who are forced to sleep alone, compared to routinely solitary-sleeping infants, and conclude that this quiet sleep response is an indicator of stress related to cosleeping. This difference in findings is difficult to reconcile given that each study used a different methodology to examine sleep. Our data, using a different methodology still, show no differences in the proportion of the night spent in quiet sleep for the cosleeping and solitary sleeping infants. The data do support the findings of Mosko et al.[18] however, that cosleeping infants experience more awakenings. Clearly, the issue of whether or not cosleeping and solitary sleeping infants experience differences in sleep architecture awaits further research.

Contrary to the finding of Mosko et al.[20] that bedsharing infants spend the majority of their night in face-to-face contact with their mothers, the present study found that mother–infant pairs spent only about 40% of the time sleeping "towards" each other. There could be many reasons for this discrepancy. First, the infants in this study were older than the infants in the previous study. The present sample of infants ranged from 3–15 months of age, while the previous study only looked at infants who were between 3–4 months of age. It is possible that our infants were old enough to move and reposition themselves, while the younger infants remained in the same position in which they had been placed. Second, the infants in the previous study were hooked up to polysomnographic wires while cosleeping, possibly hindering their movement. Nevertheless, because our infants demonstrated more awakenings when cosleeping, it is unlikely that the enriched carbon dioxide environment associated with face-to-face positions accounts for the increased number of awakenings, at least at older ages.

Limitations

There are certain limitations that prevent broad generalization of these results. This study had a small sample size and sleep–wake

data were collapsed across age; a study with more participants is required before the results can be generally accepted and potential age differences can be ascertained. Also, the sample was self-selected from a small University community and was thus relatively homogeneous. The majority of the infants were Caucasian and upper-middle class, so ethnic or socioeconomic influences could not be adequately assessed. In addition, families chose whether to cosleep or not with their infants, and there is no way to assess whether these infants slept differently prior to cosleeping. Clearly, a prospective, longitudinal study would be essential to tease apart potential reasons for cosleeping and the differences in sleep that may ensue because of it. Lastly, using videotapes to code for sleep in this population was difficult in some cases because either a parent or the parents' blankets sometimes obscured continuous viewing of the infant.

Nonetheless, this study provides important further confirmation on the differences and similarities in the sleep–wake patterns of cosleeping and solitary-sleeping infants at ages older than previously reported. More research needs to be conducted with larger samples in order to verify and expand on these patterns.

Summary

Parents frequently consult physicians and infant mental health professionals about problems of night waking in young infants. Often these parents are also concerned about the effects of cosleeping on sleep and waking development. The results of this study confirm a number of previous studies of much younger infants and provide information useful for clinicians advising parents. Specifically, infants who cosleep, at least through 15 months of age, will awaken more frequently but for less duration during the night. That is, they awakened more often, but for shorter durations than solitary sleepers. Contrary to previous reports, the cosleeping infants did not spend the majority of the night face to face with their mothers.

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