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Parental behaviors and sleep outcomes in infants and toddlers: A cross-cultural comparison

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ABSTRACT

Background: To assess the prevalence of parental behaviors and other factors of sleep ecology and to analyze their relationships with sleep outcomes in a large sample of children ages birth to 36 months in multiple countries/regions.

Methods: Parents of 29,287 infants and toddlers (48% boys; Australia, Canada, China, Hong Kong, India, Indonesia, Korea, Japan, Malaysia, New Zealand, Philippines, Singapore, Taiwan, Thailand, United Kingdom, United States, and Vietnam) completed an internet-based expanded version of the Brief Infant Sleep Questionnaire.

Results: Overall, there is a high level of parental involvement in sleep onset and sleep maintenance for young children, with significant differences in parenting behaviors across cultural groups. For predominantly-Caucasian, the most common behavior occurring at bedtime is falling asleep independently in own crib/bed (57%), compared to just 4% of those children living in predominantly-Asian regions. Parental behaviors and sleep ecology, including parental presence at sleep onset, bedtime, and bedtime routine, significantly explain a portion of the variance in sleep patterns. Overall, parental behaviors are more highly predictive of nighttime sleep outcomes in predominantly-Caucasian regions. Finally, parental involvement in sleep onset mediates the relationship between cosleeping and sleep outcomes.

Conclusions: Overall, the best predictors of nighttime sleep are related to parental behaviors at bedtime and during the night. Furthermore, sleep disruption and decreased total sleep associated with bed sharing and room sharing are mediated by parental presence at bedtime. These findings provide additional support for addressing parental behaviors in behavioral interventions for infant and toddler sleep problems.

1. Introduction

Sleep patterns change over time for young children and differ throughout the world, with a significant portion of parents (10–75%) reporting sleep problems [1,2]. Studies to date have found that sleep problems in young children, primarily bedtime difficulties and night wakings, are often related to a lack of self-soothing. For example, Sadeh and Anders [3] developed a transactional model for self-soothing (falling asleep independently), theorizing that infant self-soothing is a key component to the development of sleep-wake patterns and results in decreased sleep disturbances and increased sleep consolidation. This model encompasses four domains, including the infant domain (e.g., gender, temperament), sleep-wake domain (e.g., longest sleep period, percent awake), caregiver domain (e.g., feeding status, parenting stress), and sleep context domain (e.g., caregiver interventions, sleep onset state, sleep location). Furthermore, a recent review of parenting and infant sleep notes that the link between parental behaviors and infant sleep is the most immediate and direct path of a transaction model, which also includes parental cognitions/psychopathology/well being, intrinsic infant factors, and cultural/environmental/social factors [4].

Results from studies of this transactional model [5] and a number of other studies have indicated the contribution of sleep-related parenting practices to sleep outcomes. For example, research has consistently demonstrated that parental involvement and lack of infant's self-soothing skills are highly associated with night wakings and difficulties falling asleep [6–8]. A recent study of 5004 infants and toddlers from the United States/Canada [2] found that parenting behaviors that encouraged independence and self-soothing (e.g., having the child fall asleep independently) were associated with extended and more consolidated sleep,

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compared to more active interactions (e.g., nursing or rocking to sleep) that were associated with shorter and more fragmented sleep.

One area that has been the focus of limited research is the impact of parenting behaviors within the context of cosleeping. For example, studies of the Sadeh and Anders model have been primarily done in solitary sleeping infants. Burnham et al. [5] found that less time out of the crib, high levels of quiet sleep, and longer parental response times to infant wakings at 3 months were the most predictive of self-soothing and resulting sleep disruptions; however, this was solely focused on solitary sleeping infants. Looking at cosleeping in general, studies have primarily found cosleeping to be associated with increased night wakings and sleep problems [9,10]. But these studies have not evaluated cosleeping within the larger context of parenting behaviors, which may be more salient. Finally, studies on the relationship between cosleeping and sleep outcomes have been conducted primarily in western countries, where these practices are typically not the norm.

As stated, the majority of studies to date that have evaluated different aspects of a transactional model have focused on young children from a narrow region of the world, primarily western countries. Furthermore, the majority of studies have not evaluated sleep-related parenting practices as well as these behaviors within the context of cosleeping (i.e., bed sharing and room sharing), which is the predominant sleep practice in many parts of the world [11] Thus, this large scale study includes more diverse geographic regions, specifically Asian countries/regions where there is a preponderance of cosleeping and where parenting behaviors related to sleep are not well documented.

Thus, the aims of the present study were (a) to assess the prevalence of sleep-related parenting behaviors in a large sample of infants and toddlers from predominantly-Caucasian and predominantly-Asian countries/regions, (b) to evaluate the links between parenting behaviors and other aspects of sleep ecology and sleep outcomes (i.e., nocturnal sleep duration, night wakings, longest sleep episode, and daytime sleep duration) and (c) to assess these relationships within the context of cosleeping.

2. Methods

2.1. Participants

Parents/caregivers (from hereon referred to as "parents") of 29,287 infants and toddlers (1073 Australia, 501 Canada, 7505 China, 1049 Hong Kong, 3982 India, 967 Indonesia, 1036 South Korea, 872 Japan, 997 Malaysia, 1081 New Zealand, 1034 Philippines, 1001 Singapore, 896 Taiwan, 988 Thailand, 4505 United States, 800 United Kingdom, and 1000 Vietnam) participated in this study. Countries/regions were grouped as either predominantly-Caucasian (P-C; Australia, Canada, New Zealand, United Kingdom, and United States) or predominantly-Asian (P-A; China, Hong Kong, India, Indonesia, Japan, Korea, Singapore, Malaysia, Philippines, Taiwan, Thailand, and Vietnam).

Children's ages ranged from birth to 36 months. Sample sizes within each country/region were evenly distributed across age groups according to the following: 0–2 month olds, 3–5 month olds, 6–8 month olds, 9–11 month olds, 12–17 month olds, 18–23 month olds, and 24–36 month olds. There were equal boys (48.1%) and girls (51.9%) across the entire sample, $\chi^2 = .53$, $p = .82$. Demographic information of the complete sample can be found in Table 1.

Table 1
Demographic characteristics.

		N	%
Child's age	0–2 months	2503	8.6
	3–5 months	3769	12.9
	6–8 months	3799	13.0
	9–11 months	3580	12.2
	12–17 months	5312	18.1
	18–23 months	4005	13.7
	24–36 months	6319	21.6
Child's sex	Girl	14,076	48.1
	Boy	15,211	51.9
Child's birth order	Only child	14,770	50.4
	Youngest child	5798	19.8
	Oldest child	7740	26.4
	Middle or a multiple child	979	3.3
Respondent	Mother	26,282	89.7
	Other	3005	10.3
Respondent's education	Post-graduate degree	4947	17.2
	College education or a college degree	11,950	41.5
	High-school degree	11,564	40.2
	Less than high-school degree	331	1.2
Respondent's employment	Full time	15,260	52.1
	Part-time	2260	7.7
	At-home parent, student status, unemployment, or other	11,767	40.2
Respondent's age range	21–24 years	1846	6.3
	25–29 years	10,873	37.1
	30–34 years	11,289	38.6
	35–39 years	4080	13.9
	Age <21 or >39	1185	4.0

2.2. Procedure

All participants completed the Brief Infant Sleep Questionnaire (BISQ) [8,11]. The BISQ includes specific questions about infant daytime and nighttime sleep patterns, as well as sleep-related behaviors. Sleeping arrangements (bed sharing and room sharing) and bedtime routines were also assessed. The respondents were asked to describe their child's behavior during the last two weeks. The BISQ is well-validated with high (>.82) test–retest reliability. Sleep quality measures derived from the BISQ significantly differentiate between referred sleep-disturbed infants and controls. Furthermore, there are significant correlations between BISQ measures and measures derived from actigraphy and daily logs [8]. In addition to the BISQ, demographic information was collected, including parental age, education, employment status, and child's birth order. The complete questionnaire was translated into each respective language and back-translated to ensure appropriate translation.

All data were collected online, except for Thailand and Vietnam, where a paper-based version was completed face-to-face with a researcher. In eight countries/regions (Australia, China, India, Malaysia, Singapore, Philippines, United Kingdom, United States), the questionnaire was set as a pop-up screen at a popular parenting website (BabyCenter) and invited parents to complete a sleep survey for children ages birth to 36 months. All other countries/regions utilized a free-standing website for the survey. Recruitment in these areas was conducted via email, utilizing mailing lists obtained from local marketing firms and online advertising at other parenting sites. The online version used pull-down menus with optional responses for each presented question. Those who completed paper copies of the questionnaire were able to skip questions. Completion of the questionnaire was voluntary and parents were not offered any feedback. All participants were invited to complete a survey about their child's sleep. A few areas offered incentives for completion (e.g., free samples or gift voucher). The complete sample was collected between May and June 2006 (CA, UK, and US), September–December 2007 (AU, NZ, CN, HK, IN, ID, JP, KR, SG, MY, PH, TH, TW), and April 2008 (VN).

2.3. Statistical analyses

Means and frequencies were used for demographic information. Data analysis for continuous variables was based on ANOVA with Cohen's *d* utilized for effect sizes. Duncan post hoc analyses were used to test for specific age group differences. Categorical variables were analyzed utilizing chi-square. Effect sizes reported for chi-square analyses are phi (ϕ). Because of the large cohort size and the multiple analyses, findings were considered significant if $p < .001$. Stepwise regression analyses were conducted using parenting behaviors/sleep ecology and demographic variables as predictors of sleep outcomes (including daytime sleep duration, nocturnal sleep duration, night wakings, and longest sleep episode). Additional details about regression analyses are provided below.

3. Results

3.1. Parental behaviors

All parents provided information on parental sleep-related behaviors. The overall and age-dependent frequencies of parental sleep-related behaviors are presented in Table 2. Table 3 presents these behaviors for those living in predominantly-Asian (P-A) and predominantly-Caucasian (P-C) countries/regions. Overall, for all families, the most common parental behaviors at sleep initiation are falling asleep in parents' bed with a parent present (31%) and feeding to sleep, including bottle feeding (31%) and nursing (26%). Also common are holding (26%) and rocking (23%) to sleep. Less frequent are falling asleep independently (18%) or in a crib/bed with a parent present (12%). Rarely do children fall asleep while watching television (6%) or in another room of the house other than a bedroom (3%). Across all parenting behaviors, overall only 23% of parents reported that their child fell asleep independently, i.e., alone in his/her crib or bed.

Table 3
Percentages of children in each age group using specific method by cultural group.

	P-A $N = 20069$	P-C $N = 9218$	χ^2	ϕ
Sleep initiation method				
Bottle-feeding	37.25	16.01	1212.85**	.20
Nursing	28.07	19.74	210.38**	.08
Rocking	23.50	20.69	26.33**	.03
Holding	26.11	26.63	.83	.01
Watching TV	6.85	4.41	59.30	.05
In crib/bed alone in the room	3.58	56.98	11156.58**	.62
In parents' bed alone	5.50	2.00	164.13**	.07
In crib/bed with parent present	11.91	12.45	1.62	.01
In parents' bed with parent	38.41	10.99	2038.80**	.26
In another room of the house	2.30	5.01	144.51**	.07
Resuming sleep				
Holding or rocking to sleep	28.77	21.09	174.47**	.08
Picking up - returning awake	5.18	18.47	1277.29**	.21
Rub or pat in crib/bed	31.89	28.51	31.05**	.03
Giving a bottle	33.61	21.07	432.85**	.12
Nurse back to sleep	29.30	25.00	53.03**	.04
Verbal comfort in crib	13.06	15.95	40.62**	.04
Bring child to parents' bed	7.46	19.37	860.95**	.17
Let cry to fall asleep	1.97	15.65	2023.14**	.26
Wait a few minutes	21.30	45.53	1692.49**	.24
Play until ready for sleep	5.58	1.22	262.79**	.09
Watch TV or video	1.03	1.39	6.83	.02
Sing to child	11.98	8.74	61.69**	.05

P-A: predominantly-Asian.
P-C: predominantly-Caucasian.
** $p < .0001$.

During the night, parents are also highly likely to interact with their child following night wakings. The most common behaviors include bottle feeding (30%) or nursing (28%) back to sleep, as well as rubbing/patting in crib/bed (31%) or holding/rocking back to sleep (27%). Interestingly, an equal percentage of parents wait a

Table 2
Percentages of children in each age group using specific method.

	Age group (months)								
	Total	0–2 $N = 2503$	3–5 $N = 3769$	6–8 $N = 3799$	9–11 $N = 3580$	12–17 $N = 5312$	18–23 $N = 4005$	24–36 $N = 6319$	χ^2
Sleep initiation method									
Bottle-feeding	31.47	28.09[a]	28.07[a]	30.80[a]	34.25[a]	37.05[a]	33.71[b]	27.58[c]	177**
Nursing	25.81	55.85[a]	47.23[b]	41.35[c]	31.01[d]	18.90[e]	9.44[f]	5.02 [g]	4733**
Rocking	22.73	39.07[a]	39.82[a]	33.22[b]	27.82[c]	19.86[d]	11.41[e]	6.47[f]	2566**
Holding	26.25	51.74[a]	42.64[b]	36.06[c]	27.93[d]	22.01[e]	14.38[f]	10.62 [g]	2695**
Watching TV	6.18	2.64[a]	2.71[a]	2.40[a]	2.88[a]	4.78[b]	8.19[c]	13.72[d]	959**
In crib/bed alone in the room	18.09	13.06[a]	18.73[b]	20.58[b]	20.75[b]	17.58[c]	22.02[d]	14.64[e]	170**
In parents' bed alone	4.55	4.23[a]	4.72[a]	3.79[a]	3.72[a]	4.05[a]	4.09[a]	6.22[b]	57**
In crib/bed with parent present	12.05	15.90[a]	13.74[a]	10.92[b]	10.61[b]	10.43[b]	11.34[b]	12.83[b]	75**
In parents' bed with parent	30.96	18.34[a]	20.56[a]	23.85[b]	25.45[b]	32.7[c]	27.13[d]	44.17[e]	1113**
In another room of the house	3.04	5.63[a]	3.53[b]	2.58[b]	2.29[b]	2.64[b]	2.62[b]	3.02[b]	75**
Resuming sleep									
Holding or rocking to sleep	26.68	38.79[a]	29.50[b]	31.17[b]	31.70[b]	27.16[c]	21.87[d]	17.30[e]	621**
Picking up – returning awake	8.79	8.23[a]	5.86[b]	7.50[a]	9.27[a]	9.43[a]	10.66[c]	9.53[a]	75**
Rub or pat in crib/bed	30.97	17.90[a]	21.73[b]	27.01[c]	29.22[c]	34.34[d]	36.83[d]	38.49[d]	643**
Giving a bottle	30.20	34.76[a]	30.54[b]	31.80[b]	35.22[a]	35.45[a]	29.49[b]	20.45[c]	428**
Nurse back to sleep	28.13	62.01[a]	54.52[b]	45.88[c]	33.18[d]	19.60[e]	8.91[f]	4.80 [g]	5981**
Verbal comfort in crib	13.85	8.15[a]	7.40[a]	9.24[a]	10.39[a]	12.80[b]	18.33[c]	22.73[d]	792**
Bring child to parents' bed	10.70	11.47[a]	11.09[a]	11.74[a]	12.01[a]	11.35[a]	10.16[a]	8.58[a]	46**
Let cry to fall asleep	5.69	2.44[a]	3.16[a]	6.08[b]	7.26[b]	6.74[b]	9.01[c]	4.37[d]	226**
Wait a few minutes	27.88	25.01[a]	25.44[a]	28.90[b]	29.33[b]	27.90[b]	30.39[b]	27.44[b]	40**
Play until ready for sleep	4.40	6.83[a]	5.57[a]	4.03[a]	4.13[a]	4.25[a]	3.52[a]	3.78[a]	63**
Watch TV or video	1.13	1.40[a]	0.66[a]	0.68[a]	0.61[a]	1.02[a]	1.57[a]	1.68[a]	49**
Sing to child	11.10	14.98[a]	9.39[b]	10.53[b]	10.67[b]	12.10[b]	11.06[b]	10.37[b]	60**

Column means with different letters are significantly different (chi-square post hoc analysis).
** $p < .0001$.

few minutes to respond to their child (28%). Rarely did parents indicate that they let their child cry to fall back to sleep (6%), play until ready for sleep (4%), or watch television or a video (1%).

Significant differences were found in parenting behaviors comparing across cultural groups. For P-C, the most common behavior occurring at bedtime is falling asleep independently in own crib/bed (57%), compared to just 4% of P-A children. The other two most common behaviors in this cultural group are holding (27%), rocking (21%), and nursing (20%). In P–A children, parents are most likely to have the child fall asleep with them in their bed (38%), feed to sleep (37% bottle feeding, 28% nursing), as well as hold to sleep (26%). Among all parenting behaviors, overall 59% of P-C compared to just 9% of P-A parents reported that their child fell asleep independently. During the night, there were similar differences, with almost half of all parents of P-C children reporting waiting a few minutes (46%) compared to 21% of P-A parents who employed this strategy. P-C parents are also likely to rub/pat in crib/bed (29%), feed back to sleep (25% nursing, 21% bottle feeding), and hold/rock back to sleep (21%). Similarly, P-A parents are most likely to feed (29% nursing, 34% bottle feeding) and hold/rock back to sleep (29%).

Significant age-related changes occurred in the sleep setting as far as parental interventions are involved, both in the sleep initiation process and in response to nocturnal awakenings (see Table 2). There is a sharp decrease with age in the percentage of parents reporting bottle feeding, nursing, rocking, and holding the infant during sleep initiation. For resuming sleep following night waking, similar significant age-related changes are also evident, especially nursing back to sleep. There is much less of a decline in holding, rocking, and giving a bottle back to sleep. Interventions like verbal comfort in crib increase with age, whereas other interventions (e.g., bring child to parents' bed, watch TV) do not show any age-related tendency.

3.2. Predictors of sleep

To assess the relationships between parenting behaviors/sleep ecology and sleep patterns we used stepwise regression analysis using sleep ecology and demographic variables as predictors of the most prominent sleep variables: nighttime sleep duration, daytime sleep duration, longest sleep episode, and the number of night wakings. The potential predictors in each regression analysis included child variables (child's age, sex, birth order), parent variables (age, education level, employment status), and sleep ecology measures (sleeping arrangement, sleep location, sleep position, and method of falling asleep and resuming sleep, including all parental behaviors). Given the large cohort size, we limited the analysis to highly significant measures and set the level for entry into the regression model to $p < .0001$ and to variables with at least 1.0% contribution to the explained variance. All measures reported here meet these criteria.

As seen in Table 4, daytime sleep duration was mostly explained by the age of the child. Bedtime provided additional limited contribution to the explained variance. Together, these variables explained 25.7% of the variance. In contrast, nocturnal sleep duration was mostly explained by bedtime, with added limited contributions of age, falling asleep alone at bedtime, and having a bedtime routine. The total explained variance of these measures was 23.5%. The number of night wakings was explained by a somewhat overlapping set of variables. Higher number of night wakings was predominantly associated with breast-feeding back to sleep. Falling asleep independently at bedtime, bottle-feeding back to sleep, and age also provided limited contributions. These variables explained 22.7% of the variance in night wakings. Finally, longest continuous sleep episode was explained (26.8% of the variance) by a similar set of variables to number of night wakings. Longest continuous sleep period (consolidated sleep) was associated primarily with nursing back to sleep, followed by bottle-feeding back to sleep, bedtime, age, and falling asleep independently at bedtime.

Table 4
Stepwise regression analyses explaining sleep measures using sleep ecology and demographic variables.[a]

Explained variable	Predictors	Beta	% Explained variance	*F*
Daytime sleep duration	1. Age	−.41	23.0	5219
	2. Bedtime	.14	1.7	356
Nocturnal sleep duration	1. Bedtime	−.37	16.6	5595
	2. Age	.10	2.1	941
	3. Fall asleep independently at bedtime	.28	2.0	140
	4. Consistent bedtime routine	.13	1.0	571
Night wakings	1. Breast-feeding back to sleep	.71	12.9	717
	2. Fall asleep independently at bedtime	−.37	3.9	238
	3. Bottle-feeding back to sleep	.29	1.9	308
	4. Age	−.07	1.1	251
Longest sleep episode	1. Breast-feeding back to sleep	−1.50	12.8	4405
	2. Bottle-feeding back to sleep	−.91	3.9	3635
	3. Bedtime	−.22	2.9	1981
	4. Age	.27	2.7	186
	5. Fall asleep independently at bedtime	.32	1.6	535

[a] All entered variables met the criteria of $p < .0001$ and contribution to explained variability of at least 1.0%. On all variables, high scores reflect higher levels (or approval) of the items as described. Beta values are derived from the final regression model with all predictors. Percentages of explained variability refer to the unique contribution of each variable.

Similar results for the sleep outcomes were found for young children in P-A and P-C countries/regions, although sleep ecology is more highly predictive of nighttime sleep outcomes in P-C regions. In P-C countries/regions daytime sleep duration was primarily explained by the age of the child (38.6%), as well as bedtime (2.2%). Together, these variables explained 42.3% of the variance. Nocturnal sleep duration was predominantly explained by bedtime (23.8%), with added limited contributions of falling asleep alone at bedtime (3.2%), age (2.1%), and having a bedtime routine (1.1%), with 31.9% of the total variance explained. The number of night wakings was mostly explained by breast-feeding back to sleep (11.6%) and falling asleep independently at bedtime (6.2%), with limited contributions of bottle-feeding back to sleep (2.0%) and being taken to the parents' bed to return to sleep (1.1%). These variables explained 22.6% of the variance in night wakings. Longest continuous sleep episode was explained (39.0% of the variance) by a similar set of variables, with falling asleep independently at bedtime (17.7%) accounting for most of the variance, followed by nursing back to sleep (7.2%), bottle-feeding back to sleep (3.3%), and having a bedtime routine (2.3%).

In P-A countries/regions daytime sleep duration was exclusively explained by the age of the child (19.1%), with 20.2% of the total variance explained by the total model. Nocturnal sleep duration was mostly explained by bedtime (9.5%), with added limited contributions of age (2.1%) and having a bedtime routine (1.1%). The total explained variance of these measures was 14.0%. Higher number of night wakings was predominantly explained by breast-feeding back to sleep (13.3%), with limited contributions of age (2.6%) and bottle-feeding back to sleep (1.1%) accounting for 20.0% of

Table 5
Percent overlap of sleep initiation and sleep resumption techniques.

	Hold/rock back to sleep	Pick up – return awake	Rub-pat back to sleep	Bottle-feed back to sleep	Nurse back to sleep
Bottle-feed to sleep at bedtime (%)	49.02	6.39	34.13	60.53	12.31
Nurse to sleep at bedtime	45.36	5.45	19.48	13.02	88.33
Hold/rock to sleep at bedtime	44.63	7.11	30.84	36.41	39.09

the total variance. Finally, longest continuous sleep episode (consolidated sleep) was explained (22.0% of the variance) by a similar set of variables to number of night wakings; nursing back to sleep (11.5%) accounted for the largest percent of variance, followed by age (4.1%), bottle-feeding back to sleep (1.6%), and bedtime (1.4%).

In assessing these predictors, it is important to realize there is high overlap amongst parenting behaviors that occur at sleep initiation and sleep resumption (Table 5). Of primary interest is that 88% of children who are nursed to sleep at bedtime are nursed back to sleep during the night. Similarly, bottle feeding to sleep at night is associated with initially bottle feeding to sleep (61%).

3.3. Cosleeping and the role of parental presence at bedtime

In addition, we further analyzed the contributions of bed sharing and room sharing to parental report of sleep patterns and sleep problems. As previously reported [1], in predominantly P-A countries/regions 64.7% of children bed share and 87.5% room share, compared to just 11.8% bed sharing and 22.0% room sharing in P-C regions. Initial analyses (see Table 6) indicate significant differences in sleep outcomes between those who do and do not cosleep. Overall, children who sleep in a separate room obtain more sleep, wake less at night, have less difficulty at bedtime, fall asleep faster, and are perceived as having fewer sleep problems. These differences across sleep location, however, are primarily observed in P-C children and not in P-A children. A closer look at the data indicates that it may not be room sharing per se accounting for these differences, but rather whether a parent is present at the time of sleep onset (e.g., holding, rocking, feeding to sleep). That is, a possible mechanism for these differences is whether a parent is present at bedtime when the child falls asleep (see Fig. 1). In children from P-A countries/regions, parents are present whether there is cosleeping or not, which is not the case in P-C countries. Children who fall asleep in a crib/bed in a separate room are much less likely to have a parent present (41.9%) at sleep onset time than those who bed share (97.4%) or room share (83.9%). Furthermore, as noted in the predictors above, it was not cosleeping per se that was a significant predictor of nighttime sleep, but rather falling asleep independently.

As noted in the predictors above, in comparison to cosleeping in parents bed or room sharing, parental presence in the room at bedtime was the most potent predictor in explaining (in combination with age) the number of night wakings (11.8% of the variance), longest sleep episode (15.8%), and total sleep time (10.8%). In these analyses, cosleeping in parents' bed or room sharing had significant but negligible (<1%) independent contribution to the explained variance.

Table 6
Sleep variables by sleep location.

Total sample	Bed-share $N = 15{,}029$	Room-share $N = 7027$	Separate room $N = 6234$	F	Effect size Cohen's d
Bedtime	21.45[a] (1.23)	21.34[b] (1.30)	20.33[c] (1.24)	928.59**	.09
Number of wakings	1.73[a] (1.38)	1.65[b] (1.26)	.99[c] (1.11)	610.91**	.06
Duration of wakings (h)	.49[a] (.77)	.61[b] (.83)	.33[c] (.55)	95.86**	.01
Longest sleep	7.12[a] (3.00)	7.04[a] (2.87)	8.63[b] (2.75)	451.76**	.04
Nighttime sleep	9.20[a] (1.47)	9.21[a] (1.59)	10.12[b] (1.49)	453.38**	.04
Risetime	7.14[a] (1.25)	7.02[b] (1.26)	6.80[c] (1.05)	44.88**	.01
Number of naps	1.97[a] (1.19)	2.43[b] (1.25)	1.87[c] (1.02)	112.48**	.01
Daytime sleep	3.03[a] (1.73)	3.51[b] (1.99)	2.78[c] (1.51)	57.11**	.01
Total sleep time	12.24[a] (2.12)	12.72[b] (2.34)	12.91[c] (1.89)	101.23**	.01
Predominantly-Asian	Bed-share $N = 13{,}787$	Room-share $N = 5426$	Separate room $N = 2114$		
Bedtime	21.46 (1.22)	21.42 (1.28)	21.40 (1.30)	3.69	.00
Number of wakings	1.72[a] (1.38)	1.69[a] (1.29)	1.52[b] (1.39)	21.09**	.00
Duration of wakings (h)	.49[a] (.76)	.58[b] (.82)	.55[b] (.80)	27.10**	.00
Longest sleep	7.20[a] (3.01)	7.22[a] (2.92)	7.47[b] (2.86)	7.62*	.00
Nighttime sleep	9.21[a] (1.44)	9.18[a] (1.56)	9.07[b] (1.67)	187.96**	.02
Risetime	7.15[a] (1.25)	7.05[b] (1.27)	7.01[b] (1.25)	20.53**	.00
Number of naps	1.95[a] (1.17)	2.32[b] (1.25)	2.12[c] (1.23)	187.96**	.02
Daytime sleep	3.02[a] (1.71)	3.35[b] (1.87)	3.14[c] (1.86)	67.31**	.01
Total sleep time	12.23[a] (2.20)	12.53[b] (2.24)	12.21[a] (2.31)	39.90**	.00
Predominantly-Caucasian	Bed-share $N = 939$	Room-share $N = 1601$	Separate room $N = 5420$		
Bedtime	21.28[a] (1.23)	21.06[b] (1.33)	20.09[c] (1.09)	691.79**	.15
Number of wakings	1.82[a] (1.41)	1.52[b] (1.12)	.90[c] (1.02)	411.05**	.09
Duration of wakings (h)	.51[a] (.80)	.73[b] (.83)	.29[c] (.49)	327.52**	.08
Longest sleep	6.13[a] (2.65)	6.43[b] (2.59)	8.82[c] (2.70)	761.60**	.16
Nighttime sleep	9.33[a] (1.75)	9.30 [a] (1.68)	10.33[b] (1.38)	402.41**	.09
Risetime	6.92[a] (1.07)	6.66[b] (1.13)	6.59[b] (.78)	11.03**	.01
Number of naps	2.12[a] (1.27)	2.80[b] (1.20)	1.81[c] (.97)	549.09**	.12
Daytime sleep	3.00[a] (1.82)	4.07[b] (2.26)	2.70[c] (1.44)	407.03**	.09
Total sleep time	12.33[a] (2.23)	13.37[b] (2.52)	13.04[c] (1.76)	81.76 **	.02

Column means with different letters are significantly different (Duncan's post hoc analysis).
** $p < .0001$.

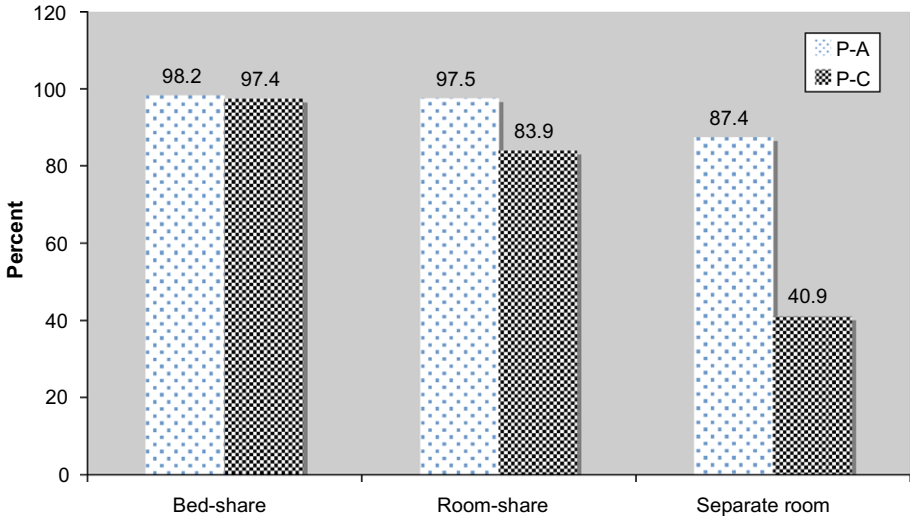

Fig. 1. Percent of children with a parent present at bedtime across sleep location.

4. Discussion

To the best of our knowledge, this is the first survey on infant and toddler sleep to date utilizing a large sample from differing geographic regions that allows for analyses of parenting behaviors and sleep ecology, and how these factors predict sleep patterns and sleep problems.

4.1. Parenting behaviors and sleep ecology

This study provides a broad picture of parenting behaviors and sleep ecology across a large global sample from P-A and P-C countries/regions. Overall, less than 25% of young children fell asleep alone. In contrast, parents were very likely to engage in holding, rocking, and feeding to sleep at bedtime. Similarly, during the night, parents were likely to be involved in their child returning to sleep, whether that involved rubbing/patting their child back to sleep, holding or rocking, or feeding to sleep. Approximately 25% of parents waited a few minutes before responding to their child. But these results are based on the sample as a whole. As would be expected, there are cultural differences in parental behaviors, with parents from P-A countries/regions much more likely to be engaged with their child at bedtime and following night wakings, compared to parents from P-C countries. The most striking difference is that just over half of children in P-C areas fall asleep independently, compared to fewer than 5% of children in P-A countries/regions. This decreased likelihood of parents in P-A countries/regions to have their child fall asleep independently may reflect differences in broader and important cultural differences in parenting styles and parent–child interactions.

4.2. Predictors of sleep patterns

Similar to past studies conducted in almost exclusively Caucasian children, the results of the regression analyses indicate that nocturnal sleep quality and sleep duration are associated with a similar set of measures mostly related to parental behaviors. Nighttime sleep duration is primarily influenced by bedtime, with minimal contributions of age, falling asleep independently, and having a consistent bedtime routine. Nighttime awakenings are predicted by breastfeeding, with smaller contributions of falling asleep independently, bottle feeding, and age. Similarly, sleep consolidation is primarily predicted by nursing, with bottle feeding, bedtime, age, and falling asleep independently less influential. Thus, these results provide evidence that sleep ecology, particularly surrounding parental behaviors at bedtime, especially feeding associated with sleep onset, are strongly associated with sleep consolidation in young children. These associations exist even after controlling for other important factors such as the child's age. These results also support the common recommendations made to parents for an early bedtime, consistent bedtime routine, and encouraging children to fall asleep independently to learn self-soothing skills [12–15]. Interestingly, in contrast, daytime sleep is almost exclusively determined by age, with parenting behaviors and sleep ecology making a minor contribution.

Overall, parenting behaviors and sleep ecology, including culture, were predictive of sleep outcomes, consistent with Sadeh et al.'s transactional model [3,4]. This study primarily considered factors within the sleep context domain, including caregiver interventions, crib/sleep location, and sleep onset state. Other factors in this model need to be further assessed in future studies, including caregiver variables (e.g., parenting stress, parental cognitions), infant variables (e.g., temperament), and other cultural/environmental/social factors. Given that, we found that the variables evaluated in this study were much more highly predictive in children from P-C countries; these other factors may be more salient in other cultures.

As with any descriptive research, it is important to note that the associations found in this study do not necessarily imply causality. Rather, these are simply associations. Many of these parenting behaviors may result from a child having difficulty falling asleep or returning to sleep throughout the night independently. As discussed by Sadeh and colleagues [4], parenting behaviors and infant sleep are bi-directional in nature, with both parenting behaviors determining infant sleep and infants with more difficult sleep patterns requiring more parental involvement [16].

4.3. Cosleeping and the role of parental presence at bedtime

Similar to previous studies [9,10], cosleeping was found to be associated with poorer sleep, including going to bed over an hour later, waking almost twice as much at night, and obtaining less sleep at night and overall. These differences, however, were much more prominent for those children from P-C regions compared to P-A regions, where there were minimally significant differences in sleep outcomes across sleep location. Further investigation of

this interesting difference revealed that the mechanism of action is likely parental presence at bedtime. Children in P-C areas who sleep in a separate room are significantly more likely to fall asleep independently (41% compared to over 80%), whereas this difference in parenting behavior across sleep location does not exist in P-A areas, where almost all children have a parent present with them at bedtime irrespective of location. Thus, it does not seem that cosleeping per se accounts for the differences in sleep outcomes but rather that this relationship is mediated by parental involvement in sleep onset.

4.4. Limitations

As noted previously [1,2], there are a number of limitations to this study, with the cohort skewed toward higher education and higher socioeconomic status. We further expect that this sample represents more urban-based populations, especially in Asia, given the need for internet access. The results from this sample, however, do compare with other studies conducted in similar countries [17–19]. The results are also based on parental report, which may influence the results. For example, parents of children who sleep in a separate room may be less aware of their child's wakings and nighttime behaviors. Thus, future studies should include more objective measures of sleep, although parental behaviors during the night are inherently likely to continue to be based on parental report, unless videotaping is used in the home.

5. Conclusions

Overall, results from a large cohort drawn from varied geographical regions of the world note strong relationships between parental behaviors at bedtime and during the night and sleep outcomes in young children. The best predictors of nighttime sleep, explaining a substantial portion of the variability, were those related to bedtime interaction. Interestingly, although sleep location is significantly related to sleep outcomes, this relationship is predominantly mediated by parental behavior. These findings support the role of bedtime interactions and parental behaviors in sleep outcomes and provide additional support for addressing parental behaviors in behavioral interventions for infant and toddler sleep problems, although it remains important to consider specific cultural beliefs in making such recommendations.

Conflict of Interests

Jodi Mindell has served as a consultant and speaker for Johnson & Johnson. Avi Sadeh has served as a consultant for Johnson & Johnson. Jun Kohyama served as a consultant and speaker for Johnson & Johnson. Ti Hwei How is an employee of Johnson & Johnson Asia Pacific, a division of Johnson & Johnson Pte., Ltd., Singapore.

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