

Johnson's<sup>®</sup>  
Science  
of Baby Sleep

# A Good Night's Sleep

A SCIENTIFIC REVIEW



## A Good Night's Sleep

Sleep is a basic need, yet studies indicate that many infants, toddlers, and preschoolers around the world are not getting the sleep they need. In addition to the support by Johnson and Johnson Consumer Inc. of instrumental studies on sleep in young children, publicly-available empirically-based resources have been developed to help families obtain anticipatory guidance about sleep and access online interventions to alleviate sleep issues. A compilation of a number of these studies and their findings can be found in this booklet.

As pediatric providers, we can help give the gift of a good night's sleep to all young children and their families by ensuring that (1) we ask about sleep at every well child visit, (2) we educate families about healthy sleep habits, prevention of sleep problems, and signs and symptoms of sleep disorders, and (3) every child has a safe and comfortable place to sleep. I hope you find this to be a valuable educational resource, for every child, and their families, deserve a good night's sleep.

Pleasant dreams,

Jodi A. Mindell, Ph.D.

*Author of *Clinical Guide to Pediatric Sleep Disorders: Diagnosis and Management of Sleep Problems* (Wolters Kluwer, 2015)*



## Table of Contents

Infant Sleep Safety Recommendations in Parenting Books:The Past 100 Years .....	5
Predictors of Sleep Outcomes in Infants and Toddlers .....	7
Sleep, Mood, and Development in Infants .....	9
Parental Perceptions of Sleep Problems in Preschoolers: A Cross-Cultural Perspective ....	11
Physical Growth and Sleep in Young Children .....	13
Bedtime Routines for Young Children: A Dose-Dependent Association With Sleep .....	15
Sleep in School-Aged Children:Predictors of Sleep Seven Years Later .....	17
An iPhone Application for Young Children’s Sleep: Concerns of Users .....	19
Efficacy of an Internet-Based Intervention for Infant and Toddler Sleep .....	21
Long-Term Efficacy of an Internet-Based Intervention For Infant And Toddler Sleep Disturbances: One Year Follow-Up .....	23
Dr. Jodi A. Mindell.....	25

# Infant Sleep Safety Recommendations in Parenting Books: The Past 100 Years

Elizabeth Culnan,<sup>1</sup> Jodi A. Mindell,<sup>2,3</sup> Russel Walters,<sup>4</sup> Deanna Day,<sup>5</sup> Lorena Telofski<sup>4</sup>

<sup>1</sup>Department of Psychology, Drexel University, Philadelphia, PA, USA; <sup>2</sup>The Children's Hospital of Philadelphia, Philadelphia, PA, USA; <sup>3</sup>Department of Psychology, Saint Joseph's University, Philadelphia, PA, USA; <sup>4</sup>Johnson & Johnson Consumer Inc., Skillman, NJ, USA; <sup>5</sup>Department of History and Sociology of Science, University of Pennsylvania, Philadelphia, PA, USA

## Objectives

- Investigate how recommendations regarding infant sleep safety (sleep position, bed-sharing, and use of pillows and crib bumpers) have changed over the past 100 years.
- Investigate whether the recommendations provided in baby guidebooks are based on empirical evidence/practice guidelines, or are influenced by current trends or opinion.

## Sample

- Sixty parenting books published between 1911 and 2014.
- Books were selected by:
  - 2010–2012, best-selling parent guide books were selected from Amazon.com.
  - 1989–2009, parent guide books were randomly selected.
  - 1911–1989, every available parent guide book was acquired.

## Data Collection

- Direct excerpts on the following topics were collected from each book:
  - Sleep position
  - Crib bumpers
  - Pillow use
  - Bed-sharing
- Excerpts were then categorized. For instance, recommendations regarding bed-sharing were coded as either for bed-sharing (“yes”), against (“no”), neither for or against (“neutral”), or not mentioned (“silent”).

## Results

### Sleep position:

- Before 1992, when the American Academy of Pediatrics (AAP) recommended the supine sleep position, books recommended that babies sleep prone (29%), or on their side (9%), or were neutral/silent (63%). Since 1992, no books were silent; the majority recommended the supine position (88%), with a few indicating the supine/side position (12%).

### Crib bumpers:

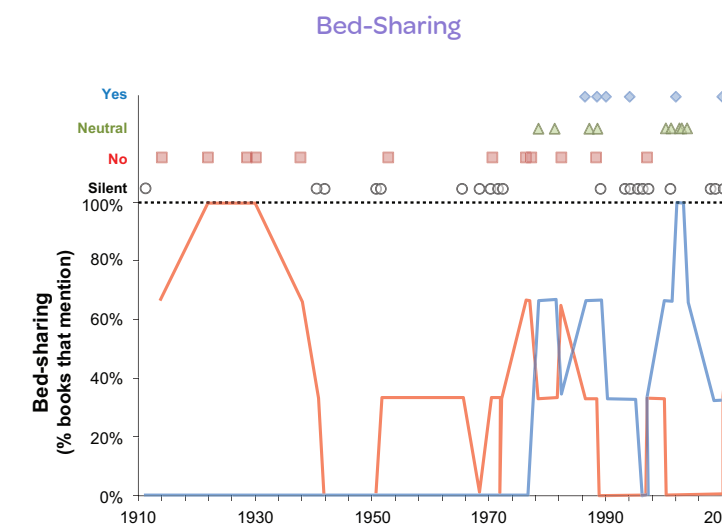
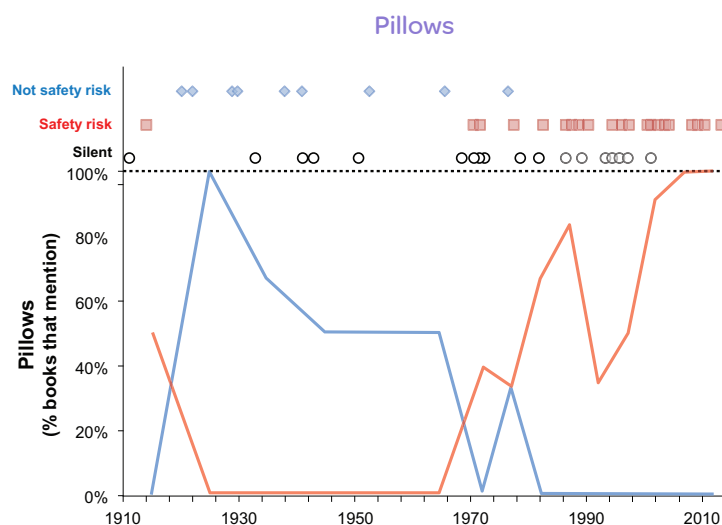
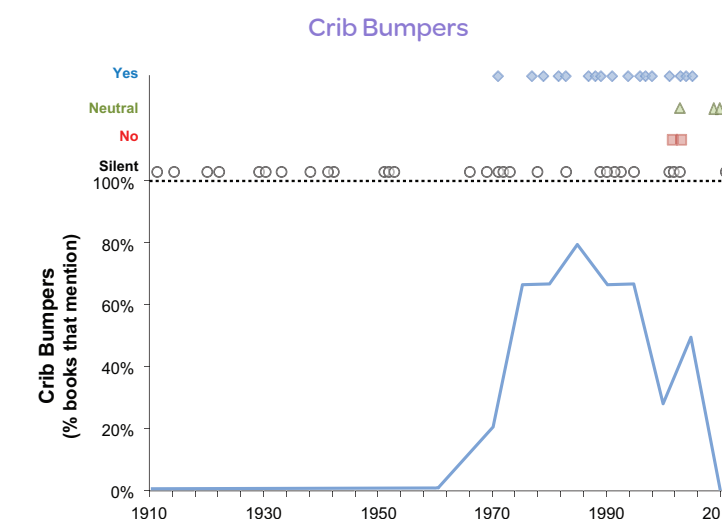
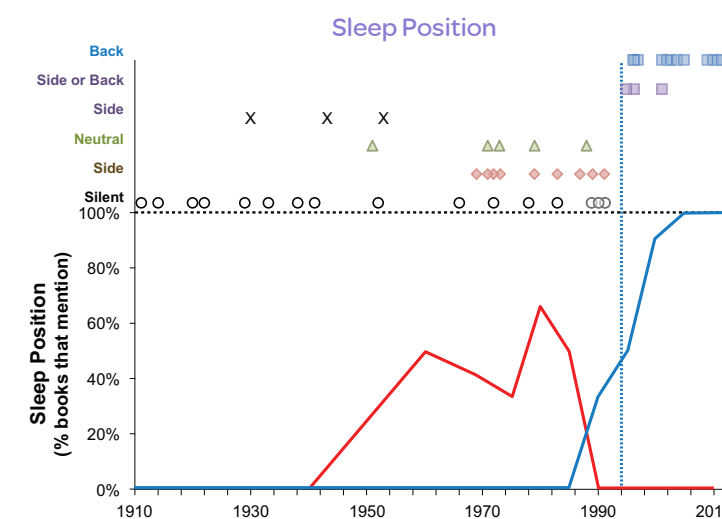
- All books (100%) were silent regarding crib bumpers until the 1970s, after which books were silent (37%), in support (44%), against (9%), or neutral (9%). Following the AAP's 2011 recommendation against crib bumpers, two books recommended against bumpers.

### Pillows:

- After 1970, the majority (71%) of books stated that pillows were a safety issue, which is in concert with the AAP's recommendation. A small minority stated pillows were not a safety concern (2%), whereas the rest were silent (27%).

### Bed-sharing:

- Until 1987, books were mostly silent (42%) or recommended against (50%), with a few neutral (7%) and none in support (0%). After 1987, recommendations were silent (31%), neutral (34%), in support (19%), and fewer against (19%). AAP (2011) has recommended room-sharing, but not bed-sharing.



## Conclusions

- Many recommendations were based on best-practice guidelines and, as empirical evidence changed, so did the recommendations. However, this was not always the case.
- Only 10% of books published after 1990 discuss all topics integral to infant sleep safety.

# Predictors of Sleep Outcomes in Infants and Toddlers

Jodi Mindell, Ph.D.<sup>1,2</sup>; Avi Sadeh, D.Sc.<sup>3</sup>; Jun Kohyama, M.D., Ph.D.<sup>4</sup>; Ti Hwei How, MBA<sup>5†</sup>

<sup>1</sup>The Children's Hospital of Philadelphia, Philadelphia, PA, USA; <sup>2</sup>Saint Joseph's University, Philadelphia, PA, USA; <sup>3</sup>Department of Psychology, Gershon H. Gordon Faculty of Social Sciences, Tel Aviv, Israel; <sup>4</sup>Tokyo Bay Urayasu/Ichikawa Medical Center, Tokyo, Japan; <sup>5</sup>Johnson & Johnson Consumer Inc., Singapore City, Singapore

## Aims

- Assess the prevalence of sleep-related parenting behaviors in infants and toddlers.
- Evaluate the links between sleep ecology and sleep outcomes.
- Assess these relationships within the context of co-sleeping.

## Methods

### Participants:

- 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 an online survey.

### Measure:

- Brief Infant Sleep Questionnaire (BISQ)

## Sleep-Related Parenting Behaviors

- *Predominantly Caucasian:* The majority are falling asleep independently in own crib/bed (57%)
- *Predominantly Asian:* Only 9% fall asleep independently, with most children falling asleep in their parents' bed (38%) and/or feeding to sleep (37% bottle-feeding; 28% nursing).

## Sleep Ecology and Sleep Outcomes

- Sleep ecology significantly predicts sleep outcomes, including nocturnal sleep duration, night wakings, and sleep consolidation.
- Those with a bedtime prior to 9:00 PM slept 60 more minutes at night,  $P < 0.05$ .
- Those with a consistent bedtime routine obtained 32 minutes more sleep and were awake 13 minutes less during the night,  $P < 0.05$ .
- Those who fell asleep independently slept 78 more minutes at night and woke 1.0 times less often,  $P < 0.05$ .

## Co-Sleeping and Sleep Outcomes

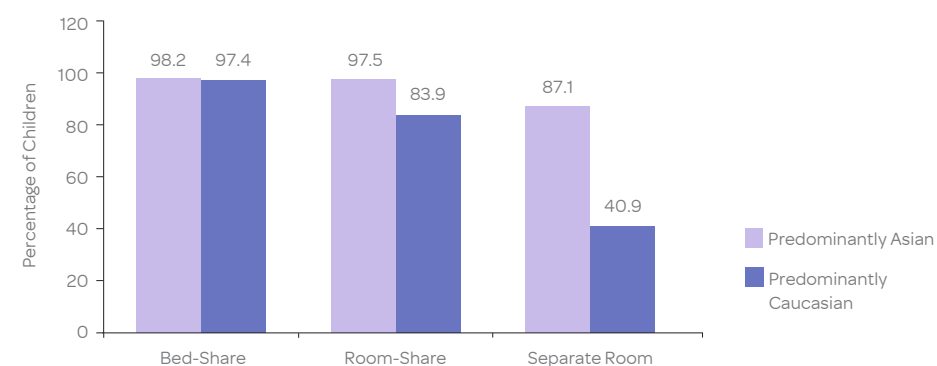
- Children who sleep in a separate room obtain more sleep, wake less at night, have less difficulty at bedtime, fall asleep faster, and are perceived as having fewer sleep problems.\* However, a possible mechanism for these differences is whether a parent is present at bedtime when the child falls asleep.

\* Since parents whose child is sleeping in a separate room might be unaware of some night wakings, this result should be carefully interpreted.

Table 1: Sleep ecology and predictors of sleep outcomes.

Explained Variable	Predictors	Beta	% Explained Variance	F
Daytime sleep duration	1. Age	-0.41	23.0	5219
	2. Bedtime	0.14	1.7	356
Nocturnal sleep duration	1. Bedtime	-0.37	16.6	5595
	2. Age	0.10	2.1	941
	3. Fall asleep independently at bedtime	0.28	2.0	140
	4. Consistent bedtime routine	0.13	1.0	571
Night wakings	1. Breast-feeding back to sleep	0.71	12.9	717
	2. Fall asleep independently at bedtime	-0.37	3.9	238
	3. Bottle-feeding back to sleep	0.29	1.9	308
	4. Age	-0.07	1.1	251
Longest sleep episode	1. Breast-feeding back to sleep	-1.50	12.8	4405
	2. Bottle-feeding back to sleep	-0.91	3.9	3635
	3. Bedtime	-0.22	2.9	1981
	4. Age	0.27	2.7	186
	5. Fall asleep independently at bedtime	0.32	1.6	535

Percentage of children with a parent present at bedtime (by sleeping arrangements)



## Conclusions

- Sleep ecology and parental behaviors, including parental presence at sleep onset, bedtime, and bedtime routine, significantly explain a portion of the variance in sleep patterns.
- Parental involvement in sleep onset mediates the relationship between co-sleeping and sleep outcomes.
- Primary care practitioners should consider educating parents about positive sleep practices starting from a young age.

## Objective

- To assess the relationship of sleep with mood and development in infancy.

## Methods

### Participants

- Mothers of 1351 infants (aged 3–13 months; mean 7.4 months) completed an Internet-based survey.

### Measures

- Sleep
  - Brief Infant Sleep Questionnaire
- Development
  - Mood
 

Mothers were asked about their perception of their child’s mood at bedtime, in the morning, and throughout the day on a 5-point scale (“very fussy” to “very happy”) regarding the past 2 weeks. The questions were phrased as follows: “How would you rate your child’s mood at...”
  - Ages & Stages Questionnaires® (ASQ, 5 developmental domains) (Brookes Publishing Co., Baltimore, MD, USA)
    - Communication
    - Gross motor
    - Fine motor
    - Problem-solving
    - Personal–social skills

## Statistics

Multivariate analyses of covariance, controlling for child age in months, gender, and maternal education, were conducted to analyze the relationships between sleep outcomes and developmental scores for each domain of the ASQ.

## Results

### Sleep and Mood

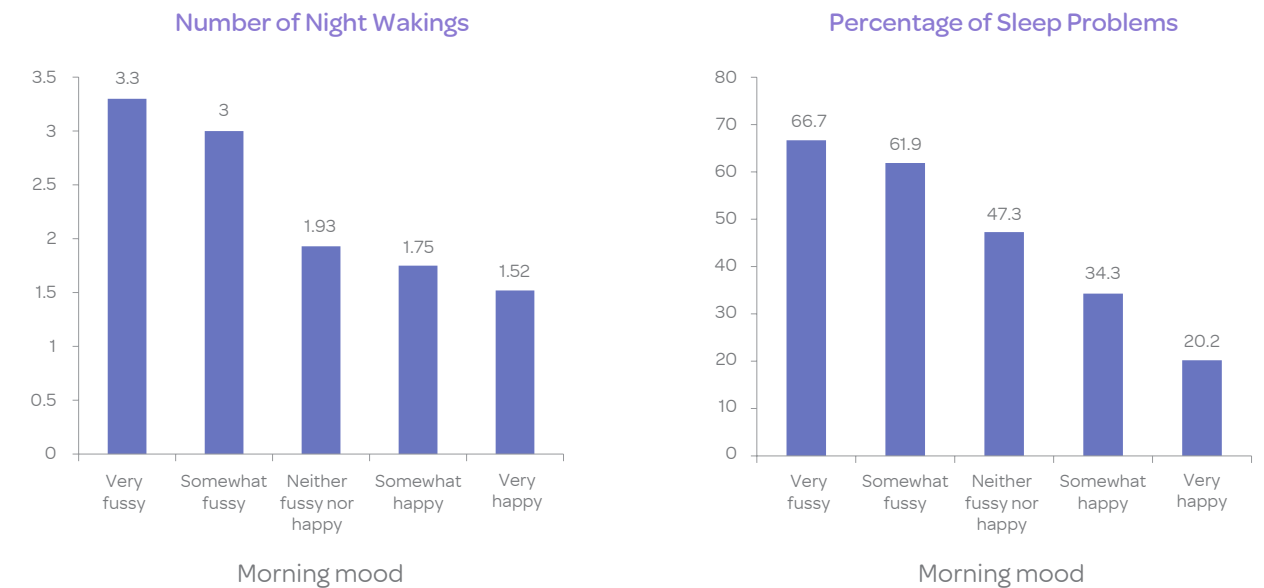
- Only 20.1% of infants were considered “very happy” at bedtime, whereas 77.3% were “very happy” in the morning, and 61.1% “very happy” during the day.
- Pearson correlations indicated modest significant relationships in parent-perceived mood ratings across the 3 time points: bedtime–morning ( $r = 0.14, P < 0.001$ ), bedtime–daytime ( $r = 0.25, P < 0.001$ ), and morning–daytime ( $r = 0.25, P < 0.001$ ).
- Differences were found across morning mood ratings for number of night wakings and parental perception of sleep problems.

	Bedtime mood	Morning mood	Daytime mood
Bedtime	-0.01	0.02	-0.07**
Sleep onset latency	-0.13	-0.05	-0.05
Number of night wakings	-0.13***	-0.13***	-0.08**
Duration of night wakings	-0.10***	-0.09**	-0.06*
Wake time	0.02	0.12***	0.01
Nighttime sleep	0.04	0.16***	0.06*
Nap duration	0.08**	0.06*	0.08**
Sleep problems (1–5 scale)	-0.28***	-0.23***	-0.18***

\* $P < 0.05$ , \*\* $P < 0.01$ , \*\*\* $P < 0.001$ .

### Sleep and Development

- Multivariate analysis of covariance results were not significant ( $P > 0.05$ ) for any sleep outcomes for any of the domains comparing those below and above the cutoff point for developmental concerns (based on standardized cutoff scores for each domain on the ASQ).



## Conclusions

- Overall, these results indicate that sleep patterns and sleep problems during infancy are associated with parental ratings of mood, but not more global developmental outcomes.

# Parental Perceptions of Sleep Problems in Preschoolers: A Cross-Cultural Perspective

Jodi A. Mindell, PhD<sup>1,2</sup>; Daniel Y. T. Goh, MD, FRCPC<sup>3</sup>; Avi Sadeh, DSc<sup>4</sup>; Robert Kwon<sup>5</sup>

<sup>1</sup>The Children's Hospital of Philadelphia, Philadelphia, PA, USA; <sup>2</sup>Saint Joseph's University, Philadelphia, PA, USA; <sup>3</sup>National University of Singapore, Singapore; <sup>4</sup>Tel Aviv University, Tel Aviv, Israel; <sup>5</sup>Johnson & Johnson Consumer Inc., Asia Pacific, Singapore

## Objective

- The aim of this study was to assess the prevalence and predictors of parent-reported sleep problems in a large cross-cultural sample of Asian and Caucasian preschool-aged children (3 to 6 years).

## Methods

### Participants:

- Parents of 2,590 preschool-aged children, ages 3 to 6 years
- Predominantly Caucasian countries (P-C)
  - Australia/New Zealand (AU/NZ)
  - Canada (CA)
  - United States (US)
  - United Kingdom (UK)
- Predominantly Asian countries (P-A)
  - China (CH)
  - Hong Kong (HK)
  - India (IN)
  - Korea (KR)
  - Japan (JP)
  - Malaysia (MY)
  - Philippines (PH)
  - Singapore (SG)
  - Thailand (TH)

### Measure:

- Brief Child Sleep Questionnaire (modified)
  - Assesses daytime and nighttime sleep patterns, sleep-related behaviors, and maternal perceptions.

## Results

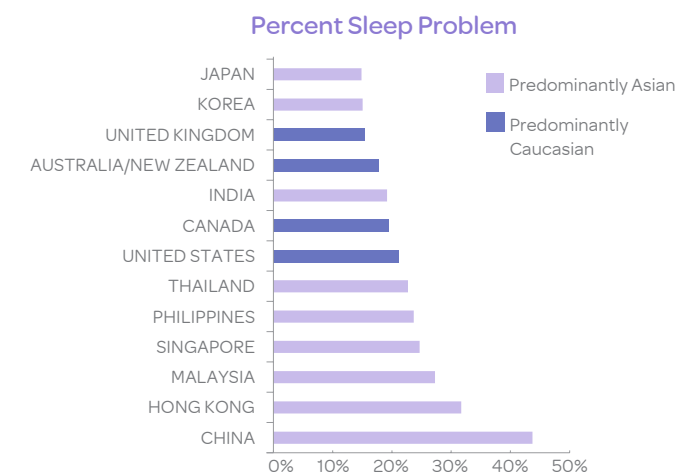
### Parental perception of sleep-specific problems

Country	Sleep terrors	Nightmares	Bruxism	Daytime sleepiness
Australia/NZ	6.6	8.4	10.8	12.6
Canada	5.1	6.6	13.2	7.4
China	2.0	1.6	8.9	2.4
Hong Kong	0.0	0.0	8.5	0.0
India	1.7	0.7	6.6	11.7
Japan	0.0	0.7	13.5	10.1
Korea	3.5	6.4	11.2	12.5
Malaysia	6.6	3.3	15.7	15.7
Philippines	3.9	1.3	19.7	14.5
Singapore	6.2	3.7	9.9	9.9
Thailand	1.1	0.0	10.2	6.8
United Kingdom	3.7	5.0	10.4	15.1
United States	4.6	8.1	12.7	14.8
Total	3.7	4.4	11.1	10.9
$\chi^2$	29.30*	54.98**	19.34	49.26**
Effect size ( $\phi$ )	0.11	0.15	--	0.14

\*  $P < 0.001$ ; \*\*  $P < 0.0001$ .  
Note: Prevalence includes "<3 times a week" and "3 times a week or more".

### Parental perception of sleep problems

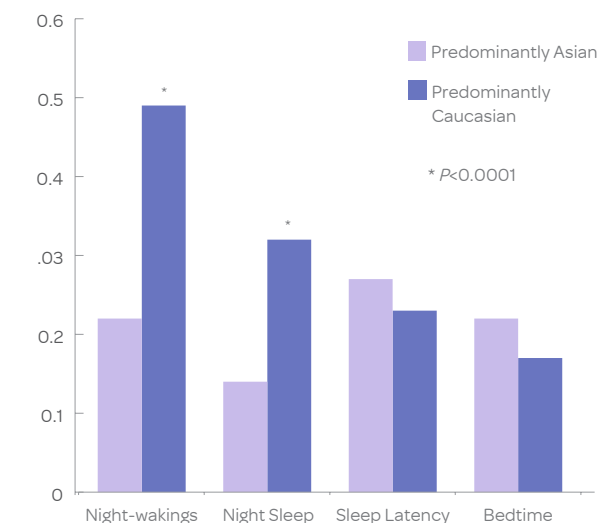
- There were significant country/region-based differences in parental perceptions of sleep problems, ranging from 14.9% (Japan) to 43.7% (China). Overall, parents from P-A countries/regions were more likely to view their child as having a sleep problem (24.2% vs. 18.4%).



### Predictors of parent-reported sleep problems

- Based on stepwise logistic regressions, the following variables were significant predictors of parentally perceived sleep problems ( $P < 0.001$ ): (1) increased number of night-wakings (Wald  $\chi^2 = 194.4$ ); (2) increased sleep-onset latency (Wald  $\chi^2 = 88.6$ ); (3) later bedtime (Wald  $\chi^2 = 50.7$ ); and (4) decreased nighttime sleep (Wald  $\chi^2 = 11.6$ ). These variables explained 31.34% of the variance in P-C and only 15.02% in P-A.

### Correlation with Sleep Problem Rating



## Conclusions

- Overall, there are significant cultural differences in the prevalence of parent-perceived sleep problems in preschoolers, similar to our previous findings in infants and toddlers. Interestingly, sleep patterns were much more likely to predict parental indication of sleep problems in P-C countries than in P-A countries. Further studies are needed to understand the basis for these differences, as well as what additional factors may be contributing to parental perceptions, particularly in P-A countries. For healthcare providers, these results suggest the importance of having parents articulate their individual concerns about their child's sleep.

# Physical Growth and Sleep in Young Children

Jodi A. Mindell,<sup>1,2</sup> Dayna Kahl,<sup>1</sup> Alexandria DiGiuseppe,<sup>1</sup> Avi Sadeh,<sup>3</sup> Robert Kwon,<sup>4</sup> Daniel Y. T. Goh<sup>5</sup>

<sup>1</sup>The Children's Hospital of Philadelphia, Philadelphia, PA, USA; <sup>2</sup>Saint Joseph's University, Philadelphia, PA, USA; <sup>3</sup>National University of Singapore, Singapore; <sup>4</sup>Tel Aviv University, Tel Aviv, Israel; <sup>5</sup>Johnson & Johnson Consumer Inc., Asia Pacific, Singapore

## Objective

- The aim of this study was to assess the relationship between growth and sleep in a large cross-cultural sample of Asian and Caucasian young children (aged birth to 6 years).

## Methods

### Participants

- Parents of 10,085 young children, aged birth to 6 years.
- Countries:
  - Australia/New Zealand
  - Canada
  - China
  - Hong Kong
  - India
  - Korea
  - Japan
  - Malaysia
  - Philippines
  - Singapore
  - Thailand
  - United States
  - United Kingdom

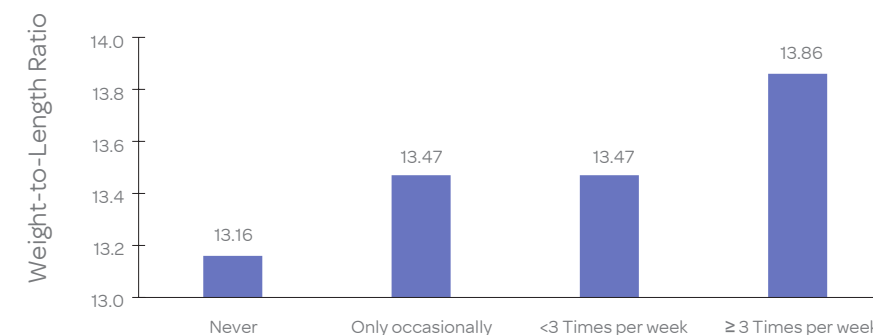
### Measures

- The Brief Infant/Child Sleep Questionnaire (modified).
  - Assesses daytime and nighttime sleep patterns, sleep-related behaviors, and maternal perceptions.
- The child's current height and weight were recorded, and their weight-to-length ratio was calculated.

## Results

### Snoring and Weight-to-Length Ratio

- Children who snore 3 or more times per week had a significantly higher weight-to-length ratio than children who never snored ( $P = 0.001$ ).



### Sleep Patterns and Weight-to-Length Ratio

- After controlling for age and snoring, higher weight-to-length ratio was associated with earlier bedtimes, decreased number and duration of night wakings, later wake time, increased total nighttime sleep, decreased daytime sleep, and increased total sleep time ( $P < 0.001$ ).
- These relationships were stronger in 0- to 35-month-olds than in 3- to 6-year-olds.
- These relationships were stronger in children in predominantly Caucasian countries compared to those in predominantly Asian countries.
- No differences were found in these relationships for girls versus boys.

### Correlation Coefficient

	All	<3 Years	≥3-6 Years	Predominantly Caucasian	Predominantly Asian
Bedtime	-0.11***	-0.12***	-0.07**	-0.32***	0.01
Number of night wakings	-0.38***	-0.31***	-0.01	-0.41***	-0.37***
Duration of night wakings	-0.44***	-0.45***	0.01	-0.54***	-0.34***
Wake time	0.09***	0.09***	-0.08**	0.02	0.13
Nighttime sleep	0.33***	0.36***	0.03	0.48***	0.20***
Daytime sleep	-0.59***	-0.54***	-0.10***	-0.69***	-0.50***
Total sleep time	-0.35***	-0.22***	-0.07***	-0.36***	-0.34***

\*\* $P < 0.01$ , \*\*\* $P < 0.001$ .

## Conclusions

- As expected, an increased weight-to-length ratio was associated with increased snoring. Unexpectedly, it was also associated with "better" nighttime sleep, including earlier bedtimes and increased sleep consolidation. These relationships were stronger in young children and those from predominantly Caucasian countries. These findings were different from earlier studies, including one of 6-month-olds (Tikotzky & Sadeh, 2009), and thus require further study to understand these relationships.



# Bedtime Routines for Young Children: A Dose-Dependent Association with Sleep

Jodi A. Mindell, PhD<sup>1</sup>; Albert M. Li, M.D.<sup>2</sup>; Avi Sadeh, DSc<sup>3</sup>; Robert Kwon<sup>4</sup>; Daniel Y. T. Goh, MD, FRCPC<sup>5</sup>

<sup>1</sup>The Children's Hospital of Philadelphia, Philadelphia, PA, USA, and Saint Joseph's University, Philadelphia, PA, USA; <sup>2</sup>Chinese University of Hong Kong; <sup>3</sup>Tel Aviv University, Tel Aviv, Israel; <sup>4</sup>Johnson & Johnson Consumer Inc., Asia Pacific, Singapore; <sup>5</sup>National University of Singapore, Singapore

## Objective

- To examine the associations of a consistent bedtime routine with sleep outcomes in young children (ages birth to 6 years) in a large global sample and assess whether there is a dose-dependent relationship between the frequency of a bedtime routine both concurrently and retrospectively with sleep outcomes.

## Methods

### Participants:

- Mothers of 10,085 young children, ages birth to 6 years.
- Countries
  - Australia/New Zealand
  - Canada
  - China
  - Hong Kong
  - India
  - Korea
  - Japan
  - Malaysia
  - Philippines
  - Singapore
  - Thailand
  - United States
  - United Kingdom

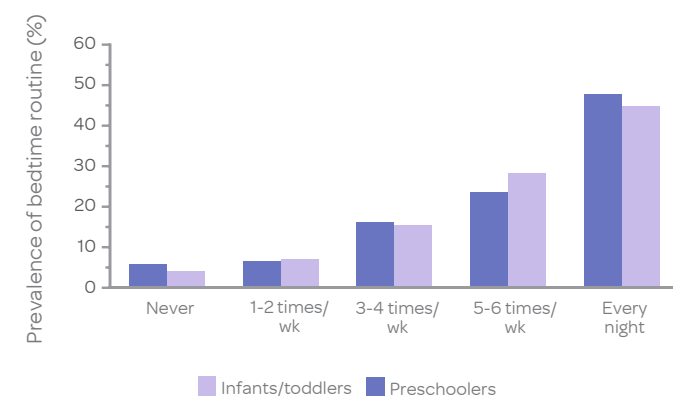
### Measure:

- Brief Infant/Child Sleep Questionnaire (modified)
  - Assesses daytime and nighttime sleep patterns, sleep-related behaviors, and maternal perceptions.

## Results

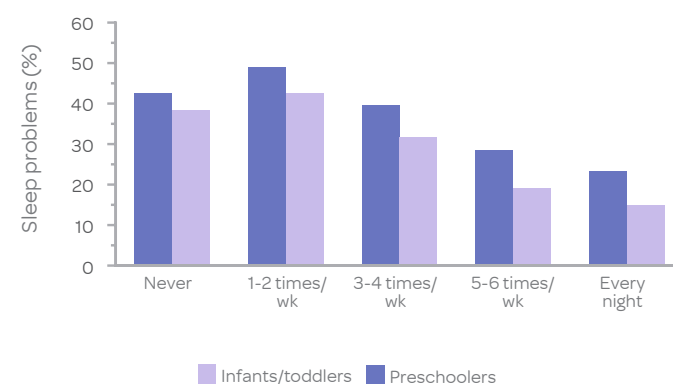
### Prevalence of bedtime routines

- Approximately half of all mothers reported a bedtime routine occurring less than every night.



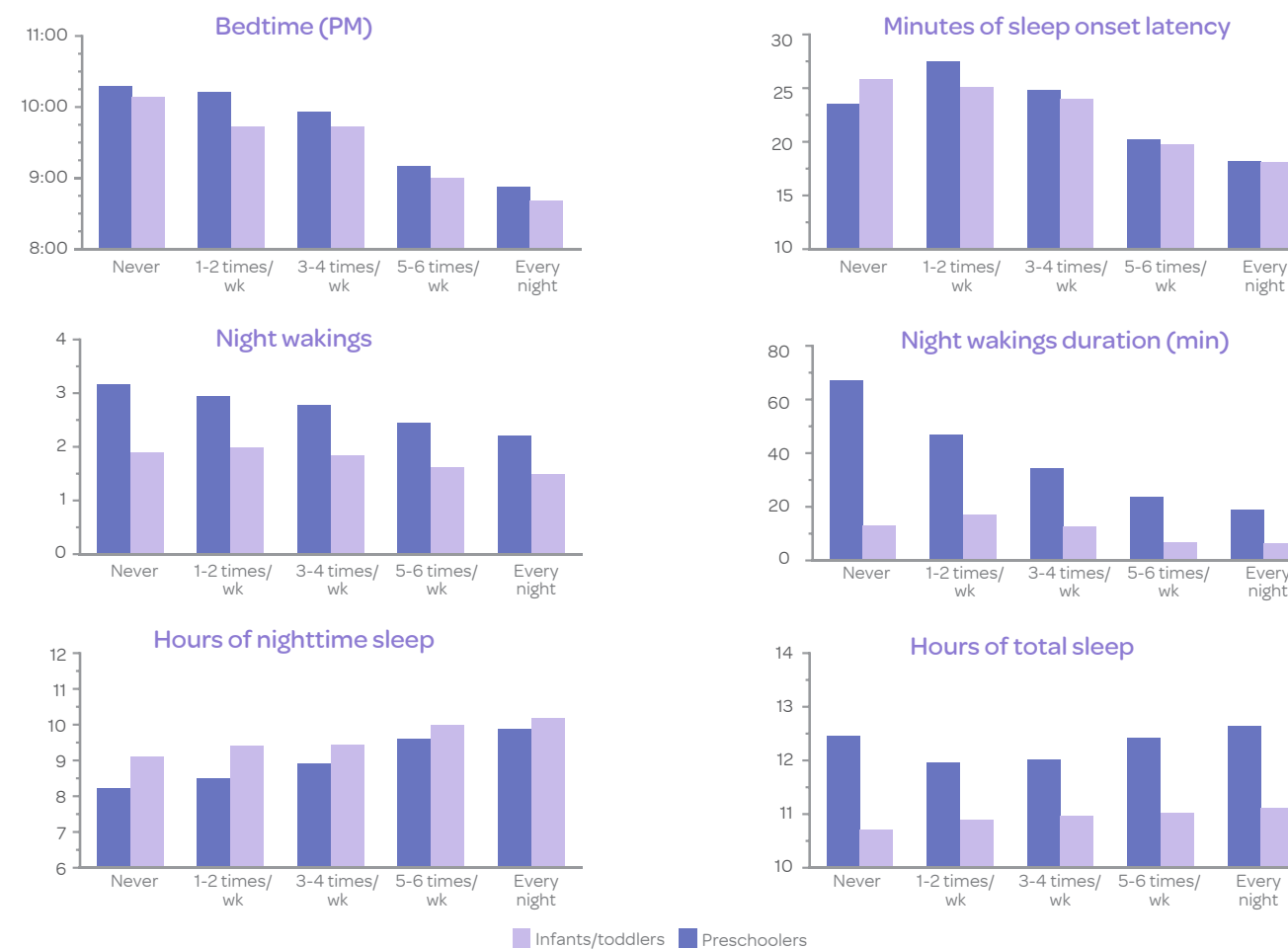
### Sleep problems by frequency of current bedtime routine

- Sleep problems decreased in a linear progression with increases in bedtime routine frequency per week.



### Sleep patterns by frequency of current bedtime routine

- Better sleep outcomes, including earlier bedtimes, shorter sleep onset latency, fewer number and duration of night wakings, more nighttime sleep, and more total sleep, were associated with frequency of a current bedtime routine in a dose-dependent relationship.



## Conclusions

- A consistent bedtime routine was associated with better sleep outcomes, including earlier bedtimes, shorter sleep onset latency, reduced night wakings, and increased sleep duration. Decreased parent-perceived sleep problems and daytime behavior problems were also related to institution of a regular bedtime routine. Furthermore, there was a dose-dependent relationship, with better outcomes associated with increased "doses" of having a bedtime routine, both currently and retrospectively, and was found within both predominantly-Asian and predominantly-Caucasian cultural regions.

# Sleep in School-Aged Children: Predictors of Sleep Seven Years Later

Jodi A. Mindell,<sup>1,2</sup> Avi Sadeh,<sup>3</sup> Arthur Teng,<sup>4</sup> Alex Bartle,<sup>5</sup> Robert Kwon,<sup>6</sup> Daniel Y. T. Goh<sup>7</sup>

<sup>1</sup>The Children's Hospital of Philadelphia, Philadelphia, PA, USA; <sup>2</sup>Saint Joseph's University, Philadelphia, PA, USA; <sup>3</sup>Tel Aviv University, Tel Aviv, Israel; <sup>4</sup>Sydney Children's Hospital, Randwick, Australia; <sup>5</sup>Sleep Well Clinics, Christchurch, New Zealand; <sup>6</sup>Johnson & Johnson Consumer Inc., Asia Pacific, Singapore; <sup>7</sup>National University of Singapore, Singapore

## Objective

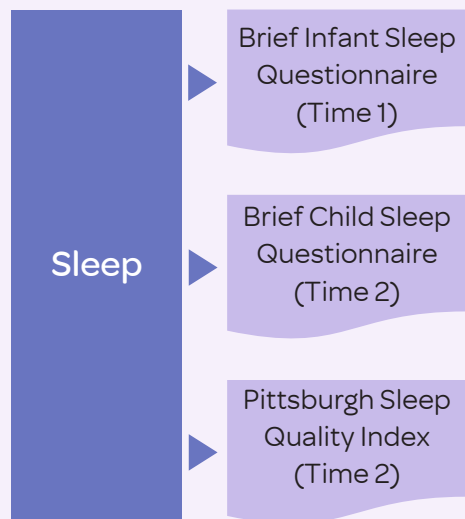
- The aim of this longitudinal study was to assess sleep in school-aged children and their mothers, as well as assess predictors of sleep outcomes.

## Methods

### Participants

- Mothers of 221 children (46% boys; aged 7 to 10 years, mean 8.2) from Australia and New Zealand participated in this study.
- All participants who had participated in a previous study 7 years earlier were contacted.
- Response rate = 28.9%; no differences in sleep patterns or sleep problems at the original time point were found between completers and noncompleters ( $P > 0.05$ ).

### Measures



## Results

### Sleep Patterns

- As expected, sleep quality improved over age, as manifested by reductions in night wakings and wake after sleep onset (WASO).

	Time 1		Time 2		<i>r</i>	<i>F</i>
	Mean	SD	Mean	SD		
Bedtime	7:23	0.89	8:02	0.64	0.22**	99.38***
Number of wakings	1.11	1.33	0.29	0.63	0.18*	79.52***
Duration of wakings	0.37	0.56	0.06	0.28	-0.03	55.30***
Nighttime sleep	10.67	1.20	10.29	0.85	0.12	16.76***

\* $P < 0.01$ , \*\* $P < 0.001$ , \*\*\* $P < 0.0001$ .

### Sleep Stability and Gender

- Low stability was found for sleep measures from Time 1 to Time 2. After controlling for age, significant correlations were found only for bedtime ( $r = 0.23$ ,  $P < 0.001$ ), total sleep time ( $r = 0.22$ ,  $P < 0.005$ ), and number of night wakings ( $r = 0.20$ ,  $P < 0.005$ ).
- Significantly higher correlations for night wakings were found in boys ( $r = 0.39$ ,  $P < 0.0001$ ) in comparison with girls ( $r = -0.12$ , NS). Similarly, the relationship between Time 1 and Time 2 for total sleep time was stronger in boys ( $r = 0.26$ ,  $P < 0.05$ ) than in girls ( $r = 0.16$ , NS).

### Child Sleep and Maternal Sleep

- Child sleep at Time 1 was much more highly associated with later maternal sleep.

Time 1 (Child)	Maternal sleep (Time 2)			Time 2 (Child)	Maternal sleep (Time 2)		
	Bedtime	Sleep latency	Total sleep		Bedtime	Sleep latency	Total sleep
Bedtime	0.18**	0.02	-0.09	Bedtime	0.25***	-0.03	-0.08
Nighttime sleep	-0.25***	-0.22**	0.21**	Nighttime sleep	-0.08	0.22	0.09
Night wakings	0.19**	0.16*	-0.22**	Night wakings	0.02	-0.13	0.00
WASO	0.24***	0.16*	-0.25***	WASO	0.00	-0.1	-0.04
Total sleep	-0.24***	-0.07	0.20**	Total sleep	-0.07	0.12	-0.14

\* $P < 0.05$ , \*\* $P < 0.01$ , \*\*\* $P < 0.001$ .

### Parental Behaviors and Sleep

- Although measures of parental early soothing techniques and bedtime interactions were significant predictors of early sleep quality, they failed to significantly predict sleep quality at the follow-up assessment.

## Conclusions

- Overall, sleep quality significantly improved with age. However, these results suggest differential trajectories in boys and girls. Lower sleep quality in early childhood may be a better predictor of later lower sleep quality in boys than in girls. Furthermore, infant sleep is more predictive of later maternal sleep than concomitant child sleep, which may reflect prolonged influences on maternal sleep established during the first few years.

# An iPhone Application for Young Children's Sleep: Concerns of Users

Jodi A. Mindell,<sup>1</sup> Erin S. Leichman,<sup>2</sup> Kristina Puzino,<sup>2</sup> Russel Walters,<sup>3</sup> Bula Bhullar<sup>4</sup>

<sup>1</sup>The Children's Hospital of Philadelphia and Saint Joseph's University, Philadelphia, PA, USA; <sup>2</sup>Lehigh University, Bethlehem, PA, USA; <sup>3</sup>Johnson & Johnson Consumer Inc., Skillman, NJ, USA; <sup>4</sup>GiantSky, Philadelphia, PA, USA

## Objective

- The aim of this study was to investigate the types of concerns submitted to an Ask the Expert feature of an iPhone-based application for sleep in young children.

## Methods

- Data were collected from 49,396 consecutive users of a free publicly available iPhone app over a 10-month period.
- A total of 1,287 sleep-related questions were analyzed from submissions over a 10-month period to an Ask the Expert section of a publicly available iPhone-based application for sleep in young children.
- All questions were coded using nVivo software (QSR International, Burlington, MA, USA) for analysis of qualitative data. Emerging themes were identified and a standardized codebook was developed.
- This study was IRB-approved and all users provided consent.

## Submissions

- Questions were primarily submitted by mothers (78.4%).
- Questions regarding infants (3–11 months) were most frequently submitted (53.9%), followed by newborns (23.8%) and toddlers (17.8%), with an average age of 10.94 months (SD=23.67).
- There were an almost equal number of questions submitted regarding boys (49%) as girls (51%).

## Representative quotes

Theme	Quote
Night wakings	"How can I get her to sleep through the night? She wakes up every 2 hours or so. Even if I sleep next to her. I tried the CIO method but then she cries in her sleep and still wakes up from time to time. What should I try next?"
Schedule	"How much sleep does a 2 month old require? My son seems to want frequent naps during the day. At least 3 to 4 naps, sometimes 1 to 2 hours long. Is this normal?"
Bedtime problems	"My 4 year old is afraid, wants the light on, wants us to come back in the room etc. He will yell for us or be really loud so we'll know he is still awake."
Sleep environment	"She will nap in her crib most of the time but at night she loves her swing and won't either go down in the crib or back in her crib after the middle of the night feeding."
Sleep training	"I would like to know how to put my daughter to bed after her routine that does not involve her crying it out. I am not comfortable doing this and if I put her to bed after her routine she just cries. Admittedly, I have never let her cry for more than 2 or 3 minutes, but by then she is screaming (hands balled into fists, face bright red, and tears)!"
Parasomnias	"My son often wakes up through the night crying frantically as if he was having a bad dream, is there anything I can do to stop this from happening?"
Health-related sleep issues	"How can I help my baby sleep better when she has a cough with phlegm?"
Sleep-disordered breathing	"My daughter is 7 months old now, she breathes really hard when she naps or sleeps throughout the night, is this normal?"

## Results

### Prevalence of themes

Theme	Total Sample	Newborn	Infant	Toddler	Older Child
Night wakings	29.53%	19.96%	33.51%	31.35%	17.63%
Schedule	27.89%	27.44%	18.98%	15.92%	4.61%
Bedtime problems	26.65%	29.51%	20.28%	22.32%	28.17%
Sleep environment	11.42%	7.99%	8.86%	9.97%	23.45%
Sleep training	9.40%	4.45%	10.83%	10.27%	4.12%
Parasomnias	7.69%	1.52%	1.35%	4.18%	13.67%
Health-related sleep issues	4.51%	5.41%	3.97%	2.15%	4.39%
Sleep-disordered breathing	0.54%	0.33%	0.22%	3.86%	0.77%

## Conclusions

- Parents of young children are most concerned about night wakings, schedule issues, and bedtime problems, accounting for almost 85% of all questions submitted. These results align with the most common concerns noted in epidemiological studies. An understanding of the specific types of concerns for which parents seek advice is beneficial in the continued development of resources for caregivers. Technologically based or traditional, these resources can provide concentrated information on the most common concerns, as well as cover the broad array of issues that parents face.

# Efficacy of an Internet-Based Intervention for Infant and Toddler Sleep

<sup>1</sup>The Children's Hospital of Philadelphia, Philadelphia, PA, USA; <sup>2</sup>Saint Joseph's University, Philadelphia, PA, USA; <sup>3</sup>Tel Aviv University, Israel; <sup>4</sup>Johnson & Johnson Consumer Inc., Skillman, NJ, USA

Jodi A. Mindell, Ph.D.<sup>1,2</sup>; Courtney Johnson<sup>1</sup>; Avi Sadeh, D.Sc.<sup>3</sup>; Lorena S. Telofski<sup>4</sup>; Neema Kulkarni<sup>4</sup>; Euen Gunn<sup>4</sup>

## Background

- Sleep problems occur in 20% to 30% of young children. Although behaviorally based interventions are highly efficacious, most existing interventions require personal contact with a trained professional; therefore, many children remain untreated. However, the use of an Internet-based intervention provides widespread access.

## Objective

- The objective of this 3-week study was to examine the efficacy of an Internet-based intervention, the Customized Sleep Profile (CSP), for infant and toddler sleep disturbances, as well as indirect benefits to maternal sleep, mood, and confidence.

## Methods

- 264 mothers and their child (6-36 months; mean = 19.4 months; 50.2% males) participated in a 3-week study.
- Families were randomly assigned to either a control or 1 of 2 intervention groups (CSP or CSP + routine).
  - Control group: 3 weeks of usual practices.
  - CSP: 1-week baseline followed by completion of an online intervention (CSP) in which customized behavioral recommendations (eg, have child fall asleep independently) were provided.
  - CSP + routine: 1-week baseline followed by completion of an online intervention (CSP) and instructions provided to conduct a specific bedtime routine (bath, lotion, and quiet activities).

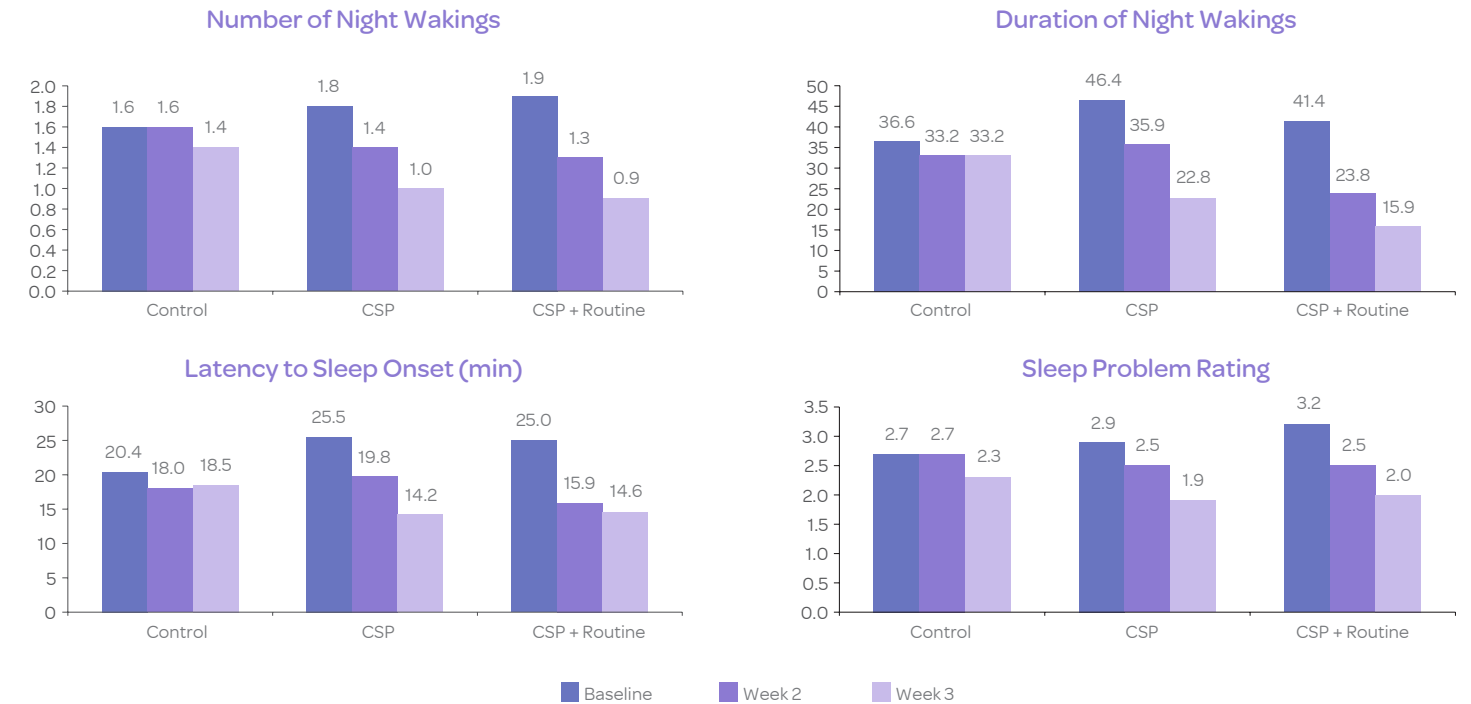
## Measures

- Mothers completed weekly:
  - Brief Infant Sleep Questionnaire (BISQ)
  - Pittsburgh Sleep Quality Index (PSQI)
  - Profile of Moods Scale (POMS).

## Results

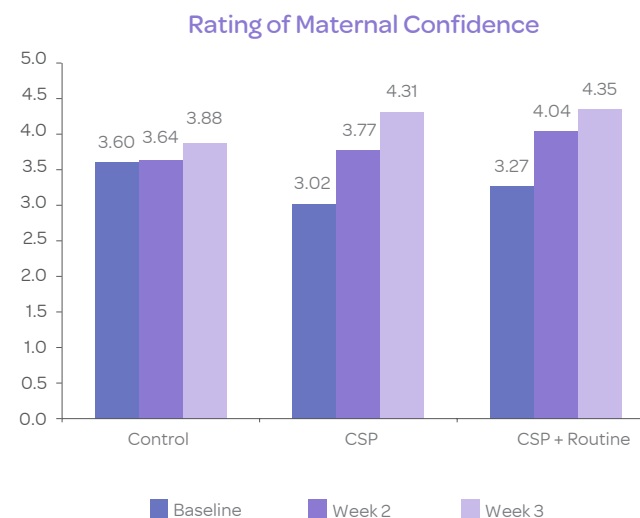
### Infant and toddler sleep

- The Internet-based intervention resulted in significant improvements in both intervention groups for number/duration of night wakings, latency to sleep onset, and maternal ratings of sleep problems ( $P < 0.001$ ).



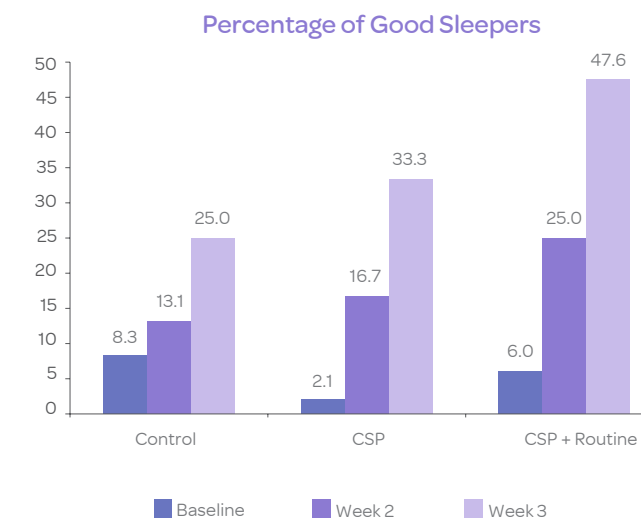
### Maternal confidence

- Significant improvements were seen in mothers' confidence in managing their child's sleep ( $P < 0.001$ ) following intervention.



### Maternal sleep quality

- There was a significant increase in mothers being classified as good sleepers compared with poor sleepers ( $P < 0.001$ ).



## Conclusions

- These results suggest that educating parents about sleep and providing customized recommendations are beneficial in improving multiple aspects of infants'/toddlers' sleep, especially bedtime problems, wakefulness after sleep onset, and longest consolidated sleep period, as well as maternal sleep and mood. Furthermore, there were significant improvements by the end of the first week of intervention, with additional improvements by the end of the second week.

# Long-Term Efficacy of an Internet-Based Intervention For Infant And Toddler Sleep Disturbances: One Year Follow-Up

Jodi A. Mindell, Ph.D.<sup>1,2</sup>; Courtney Du Mond, Ph.D.<sup>3</sup>; Avi Sadeh, D.Sc.<sup>4</sup>; Lorena S. Telofski<sup>5</sup>; Neema Kulkarni<sup>5</sup>; Euen Gunn<sup>5</sup>

<sup>1</sup>The Children's Hospital of Philadelphia, Philadelphia, PA, USA; <sup>2</sup>Saint Joseph's University, Philadelphia, PA, USA; <sup>3</sup>Upstate Golisano Children's Hospital, Syracuse, NY USA; <sup>4</sup>Tel Aviv University, Tel Aviv, Israel; <sup>5</sup>Johnson & Johnson Consumer Inc., Skillman, NJ, USA

## Background

- Sleep problems occur in 20% to 30% of young children. Although behaviorally based interventions are highly efficacious, most existing interventions require personal contact with a trained professional; therefore, many children remain untreated. The use of an Internet-based intervention, however, provides widespread access.

## Objective

- The objective of this study was to assess the long-term efficacy of an Internet-based intervention for infant/toddler sleep disturbances that was previously found to be beneficial.

## Methods

- 171 mothers of children aged 18 to 48 months participated in the 1-year follow-up (65% of the initial sample of 264 mothers).
- Families were previously randomly assigned to either a control or 1 of 2 intervention groups (CSP [customized sleep profile] or CSP + routine).
  - Control group: 3 weeks of usual practices
  - CSP: 1-week baseline followed by completion of an online intervention (CSP) in which customized behavioral recommendations (eg, have child fall asleep independently) were provided
  - CSP + routine: 1-week baseline followed by completion of an online intervention (CSP) and instructions provided to conduct a specific bedtime routine (bath, lotion, and quiet activities)

## Measures

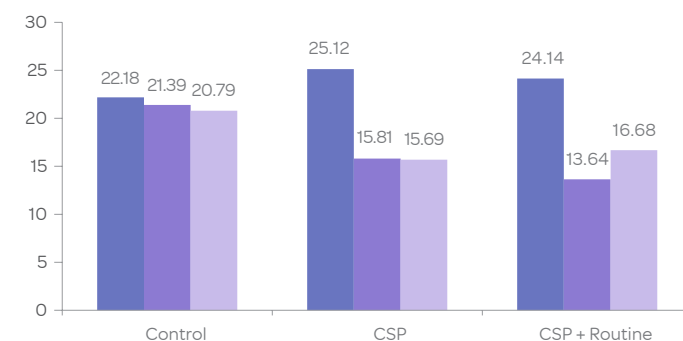
- Mothers completed a brief 10-item survey that included questions from the Brief Infant Sleep Questionnaire.

## Results

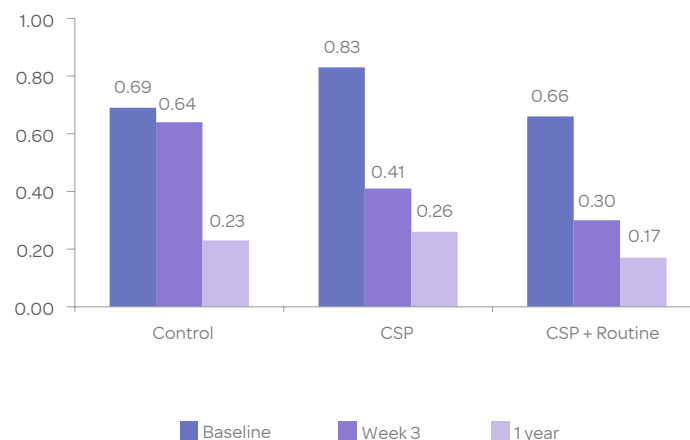
### Infant and toddler sleep

- The Internet-based intervention demonstrated maintenance of improvements in sleep latency, difficulty falling asleep, number/duration of night wakings, and longest continuous sleep period at 1-year follow-up,  $P < 0.001$ .

Latency to sleep onset (minutes)

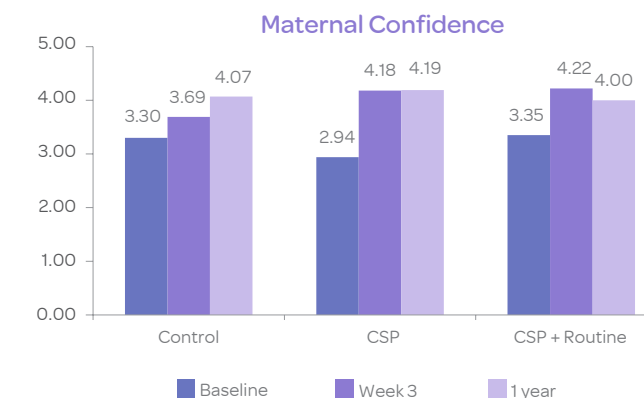


Duration of night wakings (hours)



### Maternal confidence

- Significant improvements were seen in mothers' confidence in managing their child's sleep and were maintained in the intervention groups at 1-year follow-up,  $P < 0.001$ .




### Sleep recommendations

- Parents were positive about the Internet-based intervention at 1-year follow-up:
  - 67.5% reported that they found the individualized recommendations "helpful."
  - 57.2% continued to follow the individualized recommendations at least half of the time.
  - 87.3% continued to use the prescribed routine at least half of the time one year later.

## Conclusions

- The Internet-based intervention resulted in significant improvements in infant/toddler and maternal sleep. One year later, all improvements were maintained.
- Improvements were also seen in the control group compared with baseline for some indices, likely indicative of normal developmental changes. It appears that the intervention advances improvement and provides additional benefits.
- These results suggest that brief Internet-interventions for early childhood sleep problems are effective in improving child and maternal sleep with improvements maintained one year later.



Dr. Jodi A. Mindell is a professor of psychology at Saint Joseph's University and of pediatrics at the University of Pennsylvania School of Medicine. She is also the author of *Sleeping Through the Night: How Infants, Toddlers, and Their Parents Can Get a Good Night's Sleep* and *Take Charge of Your Child's Sleep: The All-in-One Resource for Solving Sleep Problems in Kids and Teens*.

# FPO-INSIDE BACK COVER (blank)



Johnson's<sup>®</sup>  
Science  
of Baby Sleep<sup>™</sup>