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Original Article

Developmental aspects of sleep hygiene: Findings from the 2004 National Sleep Foundation *Sleep in America Poll*

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ABSTRACT

Objective: To examine the associations between sleep hygiene and sleep patterns in children ages newborn to 10 years. The relationships between key features of good sleep hygiene in childhood and recognizable outcomes have not been studied in large, nationally representative samples.
Participants and methods: A national poll of 1473 parents/caregivers of children ages newborn to 10 years was conducted in 2004. The poll included questions on sleep hygiene (poor sleep hygiene operationally defined as not having a consistent bedtime routine, bedtime after 9:00 PM, having a parent present when falling asleep at bedtime, having a television in the bedroom, and consuming caffeinated beverages daily) and sleep patterns (sleep onset latency, frequency of night wakings, and total sleep time).
Results: Across all ages, a late bedtime and having a parent present when the child falls asleep had the strongest negative association with reported sleep patterns. A late bedtime was associated with longer sleep onset latency and shorter total sleep time, whereas parental presence was associated with more night wakings. Those children (ages 3+) without a consistent bedtime routine also were reported to obtain less sleep. Furthermore, a television in the bedroom (ages 3+) and regular caffeine consumption (ages 5+) were associated with shorter total sleep time.
Conclusions: Overall, this study found that good sleep hygiene practices are associated with better sleep across several age ranges. These findings support the importance of common US based recommendations that children of all ages should fall asleep independently, go to bed before 9:00 PM, have an established bedtime routine, include reading as part of their bedtime routine, refrain from caffeine, and sleep in bedrooms without televisions.

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1. Introduction

Sleep problems in children are common, affecting 25–40% of the pediatric population [1]. Beyond physiologically-based sleep disorders, such as obstructive sleep apnea or periodic limb movement disorder, many sleep problems are behavioral, often arising at least in part from poor sleep hygiene. "Sleep hygiene" is a term that describes modifiable parent and child practices that promote good sleep quality, allow sufficient sleep duration, and prevent daytime sleepiness [2]. Sleep hygiene practices cover a number of domains, including the sleep environment, sleep routine, and daytime activities [2–4].

A common recommended sleep hygiene practice is to maintain a consistent sleep schedule for bedtimes, wake up times, and nap times (for young children). In addition, a predictable set of pre-sleep activities (bedtime routine) is associated with improved sleep onset latency and sleep consolidation in young children [5]. As part of a consistent bedtime routine, where and how a child falls asleep can affect sleep onset latency (time to fall asleep) and night wakings. Inappropriate sleep associations (e.g., rocking or nursing to sleep) that involve parental presence at bedtime can result in Behavioral Insomnia of Childhood – Sleep Onset Association type [6]. Studies have consistently found that such negative sleep associations result in disrupted sleep [7,8]. Thus, the general sleep hygiene recommendation, at least in the United States, is that children should fall asleep independently.

Other sleep hygiene recommendations involve television viewing and caffeine use. A number of studies have found that television viewing has a negative effect on sleep. In one study of 495 school-aged children, almost 25% had a television in their bedroom, with television viewing resulting in bedtime resistance,

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sleep onset delay, and anxiety around sleep, as well as shortened sleep duration [9]. In addition, Li and colleagues found that media presence in the bedroom was associated with later bedtimes, later awakening times, and shorter sleep duration in a study of almost 20,000 elementary-school children [10].

Finally, caffeine use in preschool and school-aged children, especially late in the day, may interfere with both sleep onset and sleep quality. Caffeine intake lengthens sleep latency, reduces sleep efficiency, and decreases sleep duration in adults [11]. Only one study, however, has examined caffeine use and sleep in children [12]. In this study of 191 seventh-, eighth-, and ninth-graders, caffeine intake was associated with shorter nocturnal sleep duration, increased wake time after sleep onset, and increased daytime sleep.

Few studies have investigated the impact of sleep hygiene in the pediatric population [13,14] , primarily in special populations. In one study including a community sample, sleep hygiene was found to be an important predictor of sleep quality in 776 Italian and 572 American adolescents, while controlling for several demographic variables (e.g., age, gender circadian preference) [2]. No studies, however, have examined sleep hygiene practices in a large community-based sample of children, the focus of this study.

Since 1998 the National Sleep Foundation (NSF),[1] a nonprofit organization dedicated to public education of sleep and sleep disorders, has conducted an annual national poll of sleep patterns, sleep habits, and sleep disturbances in the United States. The focus of the 2004 *Sleep in America Poll* was sleep in children from birth to 10 years. Questions included information on children's sleep practices, including sleep hygiene. The purpose of this paper is to examine the associations between sleep hygiene and children's sleep in this national sample. The three aspects of sleep included as important outcomes were (1) sleep onset latency, (2) the frequency of night wakings, and (3) total sleep time during the night (between the hours of 6 PM and 8 AM). The principal hypothesis was that in children whose caregivers reported poor sleep hygiene practices (operationally defined as not having a consistent bedtime routine, bedtime after 9 PM, having a parent present when falling asleep at bedtime, having a television in the bedroom, and consuming caffeinated beverages at least daily), longer sleep onset latencies, more frequent night wakings, and shorter total sleep time would also be reported.

2. Methods

2.1. Participants and procedure

A targeted random sample of telephone numbers was purchased from SDR (Sophisticated Data Research, Inc.) and quotas were established by region and age of child to provide equal representation. Households were polled between September 15 and October 17, 2003. To be eligible, participants had to (1) have a child living in their home aged 10 years or younger and (2) be the primary caregiver or share equally in the child's care. Approximately 80% of the interviewing was conducted on weekdays between 5 PM and 9 PM, Saturdays between 10 AM and 4 PM, and Sundays between 4 PM and 8 PM by professional interviewers. Twenty-six percent of adults who were contacted and qualified for the poll completed a short structured telephone interview (mean = 23 - min), providing a final sample of 1473 parents/caregivers. No information was collected on non-participants. Questions on sleep behaviors, bedtime routines, and sleep hygiene included in the analyses for this paper can be found in the Appendix.

Institutional review board approval was received for this study. There was no compensation for participation.

[1] *Abbreviations used:* NSF, National Sleep Foundation.

2.2. Data analyses

Descriptive analyses (means, frequencies) were used to describe demographics and sleep variables. The sleep pattern variables of interest (sleep onset latency, frequency of night wakings, and total nighttime sleep) were then compared using one-way ANOVAs for continuous variables and chi-square analyses for categorical variables across four age groups: infants (ages 0–11 months), toddlers (12–35 months), preschoolers (3–5 years old and 6-year-olds in kindergarten), and school-aged children (1st–5th grade). Because both sleep patterns and sleep hygiene change over development, it was necessary to divide the sample into age groups. However, within each age group, age was examined as a continuous variable. The reporting of night wakings were collapsed into the categories of "none" or "at least one," as no additional differences were noted in analysis of additional subcategories (e.g., twice per night, three or more times per night). Furthermore, no regional differences in any sleep pattern or sleep hygiene practice were found, thus all data presented are collapsed across region. All data presented are based on parent/caregiver report.

Within each age group, we first examined the associations among demographic and environmental variables (child age, parent age, number of people living in the home, child sex, whether the child was an only child, if the child naps, if the child has his/her own bedroom) and the three sleep pattern variables. Next, we examined the association between the presence or absence of each developmentally appropriate aspect of sleep hygiene (bedtime routine, bedtime later than 9 PM [median bedtime for all ages], child placed in the crib/bed awake or asleep, parent present when the child falls asleep at bedtime, reading at bedtime as part of the bedtime routine, presence of television in the bedroom, and daytime caffeine intake) and the three sleep pattern variables using one-way ANOVAs and chi-square analyses. Because of the multiple analyses conducted, a more conservative approach was taken and findings were considered significant if $p < .01$. Finally, hierarchical multiple regression analyses were used to examine the amount of variance in both sleep onset latency and total nighttime sleep accounted for by the sleep hygiene variables, and logistic regression analysis was used to examine factors predicting the frequency of night wakings. For all regression analyses, any demographic or environmental variable found to be significantly related to the three sleep pattern variables were entered (controlled for) in the first step, with sleep hygiene variables entered simultaneously in the second step as there were no a priori hypotheses suggesting that one variable was more important than another.

3. Results

3.1. Sample demographics

Most respondents were female (72% = mother or stepmother of child), married (91%), Caucasian (89%), college educated (at least in part, 74%), and employed (71%). Median household income was $57,500 (under $20,000 = 4.3%; $20,000 up to $40,000 = 17.4%; $40,000 up to $75,000 = 36.0%; $75,000 up to $100,000 = 18.2%; $100,000 or more=16.2%; refused = 7.2%). Children were divided equally by gender (males=51%) and represented the following four age groups: infants ($n = 210$), toddlers ($n = 239$), preschoolers ($n = 387$), and school-aged children ($n = 637$). Ninety-two percent of parents reported that their child was in excellent health.

3.2. Sleep patterns and parent-reported sleep problems

Descriptive data for the sleep pattern variables across the four age groups are presented in Table 1. The overall average reported sleep time during the night was 9.5 h (SD = 1.5 h), and differences

Table 1
Sleep patterns variables by age group.

	Sleep problem		Sleep onset latency[a]	Night wakings per night[b]		Total sleep time at night[c]
	% Yes	% No	Mean min (SD)	% None	% At least one	Mean hours (SD)
Infants (n = 210)	6.3	93.7	13.0 (9.8)	29.7	70.3	9.0 (2.1)
Toddlers (n = 239)	10.5	89.5	16.4 (16.0)	53.6	46.4	9.8 (1.7)
Preschoolers (n = 387)	10.2	89.8	17.4 (16.7)	64.4	35.6	9.6 (1.5)
School-aged (n = 637)	10.8	89.2	17.2 (14.7)	86.4	13.6	9.4 (1.1)

[a] Variable significantly different across age groups using one-way ANOVA analysis, p = .003.
[b] Variable significantly different using $X2$ analysis, p < .001.
[c] Variable significantly different across age groups using one-way ANOVA analysis, p < .001, Tukey HSD post-hoc analysis shows infants and toddlers TST significantly different compared to school-aged children.

were found across age groups [$F(3,1458) = 9.66$, $p < .001$], with post-hoc analyses indicating that infants slept less at night than school-aged children, and toddlers slept more than school-aged children. The overall average reported sleep onset latency was 16.5 min (SD = 14.9 min) with significant differences across age groups [$F(3,1422) = 4.65$, $p = .003$]. Post-hoc analyses indicated that sleep onset latency was significantly shorter for infants than for preschool and school-aged children. During the night, 32.9% of children woke at least one time requiring parental attention, with significantly fewer such night wakings reported across the developmental age span [$X^2(3) = 260.0$, $p < .001$]. Finally, almost 10% of parents/caregivers reported that they thought their child had a sleep problem (see Appendix), with no significant differences across the four age groups [$X^2(3) = 3.62$, $p = .31$].

3.3. Sleep hygiene

3.3.1. Infants

No demographic variables were significantly related to sleep onset latency. Child's age was positively correlated with reported total nighttime sleep [$r = .25$, $p < .001$], and infants with at least one night waking were younger than infants with no night wakings [$F(1,207) = 12.94$, $p < .001$]. More infants who shared a bedroom had at least one night waking compared to infants with their own bedroom (82.6% vs. 64.3%) [$X^2(1) = 7.44$, $p = .006$], and there was a trend that more infants who were breastfeeding had at least one night waking compared to infants who were not breastfeeding (78.0% vs. 63.3%) [$X^2(1) = 5.40$, $p = .02$].

Five areas of sleep hygiene were examined for infants (Table 2). Ninety percent of infants had a consistent bedtime routine, and 64% of infants had a bedtime after 9 PM. Less than half (45.8%) of infants were placed in the crib awake at bedtime. Parents reported being present when the child fell asleep at bedtime a few nights per week to every night for 68.0% of infants and never or rarely for 32.0% of infants. Reading was part of the bedtime routine for 16.7% of the infants.

Infants with a consistent bedtime routine slept on average 86 min longer per night [$F(1,205) = 8.64$, $p = .004$]. Infants with a late bedtime (after 9 PM) had a trend for a longer sleep onset latency [$F(1,202) = 6.01$, $p = .02$], were less likely to wake at night [$X^2(1) = 8.21$, $p = .004$], and slept 78 min less than infants with a bedtime before 9 PM [$F(1,205) = 20.09$, $p < .001$]. Infants placed in the crib awake at bedtime had a shorter sleep onset latency [$F(1,198) = 12.25$, $p = .001$], were significantly less likely to wake at night [$X^2(1) = 10.63$, $p = .001$], and there was a trend toward an overall longer sleep duration at night of 60 min [$F(1,194) = 4.06$, $p = .05$]. When reading was part of the bedtime routine, there was a trend for infants to be less likely to wake at night [$X^2(1) = 5.19$, $p = .02$] and to sleep 46 min more on average during the night [$F(1,205) = 3.90$, $p = .05$].

Table 3 includes multiple regression models for sleep onset latency and total nighttime sleep, as well as logistic regression models, including Wald statistics, odds ratios, and 95% confidence

Table 2
Sleep Hygiene and Sleep Patterns Variables for Infants (n = 209).

	Sleep onset latency	Night wakings per night		Night sleep amount
	Mean min (SD)	% None	% At least one	Mean hours (SD)
Bedtime routine?				
Yes (n = 188)	12.8 (9.2)	30.9	69.1	9.2 (2.0)**
No (n = 21)	15.2 (14.1)	19.0	81.0	7.7 (3.0)**
Late bedtime?				
Before 9 PM (n = 74)	10.8 (6.4)*	41.9	58.1**	9.9 (1.8)**
After 9 PM (n = 135)	14.2 (11.1)*	23.0	77.0**	8.6 (2.1)**
How placed in crib?				
Awake (n = 92)	11.6 (9.4)*	41.3	58.7***	9.6 (2.1)***
Asleep (109)	14.5 (10.2)*	20.2	79.8***	8.6 (2.0)***
Parent present at bedtime?				
Never or rarely (n = 67)	11.1 (7.8)	53.7	46.3***	10.2 (1.3)***
Few to every night (n = 142)	13.8 (10.5)	18.3	81.7***	8.5 (2.2)***
Reading to child at bedtime?				
Yes (n = 35)	10.6 (7.2)	45.7	54.3*	9.7 (1.8)*
No (n = 174)	13.5 (10.2)	26.4	73.6*	8.9 (2.2)*

Note: Significant difference with ANOVA for sleep onset latency and total sleep time and chi-square analysis for night wakings.
* p < .05 level.
** p < .01 level.
*** p < .001 level.

intervals for each of the predictors in the final model of night waking frequency for infants. While neither a late bedtime nor being put in the crib asleep were individual predictors of a longer sleep onset latency in infants, there was a trend for the full model with both variables included [$F(2,193) = 3.54$, $p = .03$], accounting for 4% of the variance. No bedtime routine, a late bedtime, and a parent present at bedtime significantly predicted less total nighttime sleep [$F(6,193) = 9.26$, $p < .001$], accounting for 22% of the variance. In terms of night waking frequency, a test of the full model with seven predictors against a constant-only model was statistically significant [$X^2(7) = 42.97$, $p < .001$], indicating that the predictors, as a set, reliably distinguished between infants who had at least one night waking per night and infants who did not wake during the night. Infants who had night wakings were 2.3 times more likely to be breastfeeding and 3.2 times more likely to have a parent present at bedtime.

3.3.2. Toddlers

Child age [$r = .19$, $p = .004$] and the number of individuals in the home [$r = .24$, $p < .001$] were positively correlated with sleep onset latency in toddlers. There was a trend for shorter sleep onset latencies for only children compared to children with siblings (13.3 vs. 18.0 min) [$F(1.231) = 4.57$, $p = .03$], children who napped compared to children who did not nap (15.6 vs. 34.8 min) [$F(1,231) = 14.72$, $p < .001$], and children with their own bedroom compared to children who shared a bedroom (14.6 vs. 21.2 min) [$F(1,231) = 7.98$, $p = .005$].

Table 3
Summary of multiple regression and logistic regression models for infants.

	B	SE	*β*	R^2	Odds ratio	Wald	95% CI Lower	95% CI Upper
Sleep onset latency				.04*				
Late bedtime	2.62	1.52	.13					
In crib asleep	2.24	1.45	.11					
Total nighttime sleep				.22***				
Child age (months)	.06	.05	.09					
No bedtime routine	−1.07	.47	−.15*					
Late bedtime	−.69	.32	−.15*					
In crib/bed asleep	−.25	.32	−.06					
Parent present at bedtime	−1.28	.25	−.28***					
No reading at bedtime	−.04	.38	−.01					
Night wakings (⩾1/night)								
Infant age categorical	−.36	.18			.70	4.07*	.49	.99
Own bedroom	−.64	.40			.53	2.50	.24	1.17
Breastfed	.84	.36			2.31	5.38*	1.14	4.70
Late bedtime	.05	.40			1.05	.02	.48	2.30
In crib asleep	.36	.42			1.43	.73	.63	3.24
Parent present at bedtime	1.15	.43			3.17	7.04**	1.35	7.42
No reading at bedtime	.81	.45			2.24	3.19	.92	5.45

Note: Sleep hygiene variables were entered into the regression using dummy coding, with the variable listed equal to 1, and the other choice equal to 0 (e.g., Late bedtime = 1, early bedtime = 0). Categorical ages were 1 = 0–3 months, 2 = 4–6 months, 3 = 7–9 months, 4 = 10–11 months.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

Six areas of sleep hygiene were examined for toddlers (Table 4). Almost 95% of toddlers had a consistent bedtime routine, with about half (48.9%) of toddlers going to bed after 9 PM. Eighty percent of toddlers were placed in their crib or bed awake, with a parent present at bedtime a few nights to every night for 43.2% of toddlers. Reading was part of the bedtime routine for 51.9% of toddlers and a television was in the bedroom of 17.3% of toddlers.

There was a trend for toddlers with a consistent bedtime routine to sleep on average almost 1 h (54 min) longer during the night [$F(1,236) = 3.86$, $p = .05$]. Toddlers with a late bedtime slept 78 min less than toddlers with an early bedtime [$F(1,236) = 50.08$, $p < .001$]. Toddlers placed in the crib awake at bedtime slept longer during the night [$F(1,234) = 9.21$, $p = .003$]. If a parent was present at bedtime at least once a week or every night, toddlers were more likely to wake at night [$X^2(1) = 6.80$, $p = .001$] and slept approximately 1 h less [$F(1,234) = 17.60$, $p < .001$], compared to toddlers who did not have a parent present at bedtime. When reading was part of the bedtime routine, there was a trend for toddlers to sleep on average 26 min longer [$F(1,236) = 3.67$, $p = .06$]. Furthermore, there was a trend for toddlers with a television in their bedroom to sleep over 30 min less than toddlers without a television in their bedroom [$F(1,236) = 13.13$, $p = .03$].

Table 4
Sleep hygiene and sleep variables for toddlers ($n = 237$).

	Sleep onset latency	Night wakings per night		Night sleep amount
	Mean min (SD)	% None	% At least one	Mean hours (SD)
Bedtime routine?				
Yes ($n = 225$)	16.3 (16.2)	54.7	45.3	9.8 (1.7)*
No ($n = 12$)	17.5 (11.8)	33.3	66.7	8.9 (1.5)*
Late bedtime?				
Before 9 PM ($n = 121$)	14.3 (12.2)*	57.9	42.1	10.4 (1.1)***
After 9 PM ($n = 116$)	18.6 (18.9)*	49.1	50.9	9.1 (1.8)***
How placed in crib?				
Awake ($n = 189$)	16.4 (16.8)	56.6	43.4	9.9 (1.6)**
Asleep ($n = 46$)	16.6 (12.5)	41.3	58.7	9.1 (1.8)**
Parent present at bedtime?				
Never or rarely ($n = 134$)	15.5 (15.8)	61.2	38.8**	10.1 (1.3)***
Few to every night ($n = 102$)	17.4 (16.2)	44.1	55.9**	9.3 (1.9)***
Reading to child at bedtime?				
Yes ($n = 123$)	17.0 (18.8)	56.1	43.9	10.0 (1.5)
No ($n = 114$)	15.8 (12.1)	50.9	49.1	9.5 (1.8)
Television in the bedroom?				
No ($n = 196$)	15.9 (14.9)	54.6	45.4	9.9 (1.5)*
Yes ($n = 41$)	18.7 (20.1)	48.8	51.2	9.3 (2.1)*

Note: Significant difference with ANOVA for sleep onset latency and total sleep time and chi-square analysis for night wakings and change of location.
* $p < .05$ level.
** $p < .01$ level.
*** $p < .001$ level.

Results of multiple and logistic regression models for toddlers are provided in Table 5. More individuals in the home, absence of a regular nap, and a late bedtime were significant predictors of longer sleep onset latency [$F(6.226) = 5.94$, $p < .001$] accounting for 14% of the variance. A late bedtime and having a parent present at bedtime were significant predictors of less total nighttime sleep [$F(6,227) = 10.84$, $p < .001$], accounting for 22% of the variance. In terms of night waking frequency, a test of the full model with one predictor against a constant-only model was statistically significant [$X^2(1) = 6.82$, $p = .009$], indicating that parental presence at bedtime reliably distinguished between toddlers who had at least one night waking per night and toddlers who did not wake during the night; toddlers who had night wakings were two times more likely to have a parent present at bedtime.

3.3.3. Preschoolers

Only one association emerged between demographic variables and sleep: preschoolers with frequent night wakings were younger (52 vs. 55 months) [$F(1, 383) = 7.47$, $p = .007$].

Six areas of sleep hygiene were examined for preschool aged children (Table 6). Almost 93% of preschoolers had a consistent bedtime routine, with 53% of preschoolers having a late bedtime. Almost half of preschoolers (45.7%) had a parent present at bedtime, and reading was part of the bedtime routine for 57.9% of preschoolers. Thirty percent of preschoolers had a television in their bedroom and 27.1% of preschoolers were reported to drink at least one caffeinated beverage per day.

Preschoolers with a late bedtime slept 48 min less at night [$F(1,383) = 33.69$, $p < .001$]. If a parent was present at bedtime, preschoolers slept over 30 min less than preschoolers who did not have

Table 5
Summary of multiple regression and logistic regression models for toddlers.

	B	SE	*β*	R^2	Odds ratio	Wald	95% CI lower	95% CI upper
Sleep onset latency				.14***				
Child age (months)	.24	.16	.10					
No. of People in Home	2.70	1.32	.18*					
Only child	1.00	2.74	.03					
Naps regularly	−15.75	5.07	−.20**					
Own bedroom	−2.61	2.50	−.07					
Late bedtime	4.30	1.99	.14*					
Total nighttime sleep				.22***				
Parent age	.02	.02	.09					
No bedtime routine	−.46	.44	−.06					
Late bedtime	−1.19	.21	−.36***					
In crib/bed asleep	−.08	.28	−.02					
Parent present at bedtime	−.49	.22	−.15*					
TV in bedroom	−.25	.26	−.06					
Night Wakings (⩾ 1/night)								
Parent present at bedtime	.69	.27			2.0	6.72**	1.18	3.37

Note: Sleep hygiene variables were entered into the regression using dummy coding, with the variable listed equal to 1, and the other choice equal to 0 (e.g., Late bedtime = 1, early bedtime = 0).
* $p < .05$.
** $p < .01$.
*** $p < .001$.

Table 6
Sleep hygiene and sleep variables for preschoolers ($n = 385$).

	Sleep onset latency	Night wakings per night		Night sleep amount
	Mean min (SD)	% None	% At least one	Mean hours (SD)
Bedtime routine?				
Yes ($n = 357$)	17.7 (17.0)	65.5	34.5	9.6 (1.6)
No ($n = 28$)	13.1 (10.5)	50.0	50.0	9.5 (1.2)
Late bedtime?				
Before 9 PM ($n = 181$)	16.5 (14.6)	68.5	31.5	10.0 (1.4)***
After 9 PM ($n = 204$)	18.1 (18.2)	60.8	39.2	9.2 (1.6)***
Parent present at bedtime?				
Never or rarely ($n = 218$)	17.5 (16.6)	66.5	33.5	9.8 (1.5)**
Few to every night ($n = 165$)	17.4 (16.8)	61.8	38.2	9.3 (1.6)**
Reading to child at bedtime?				
Yes ($n = 223$)	17.9 (15.9)	65.5	34.5	9.8 (1.4)**
No ($n = 162$)	16.6 (17.6)	63.0	37.0	9.3 (1.6)**
Television in the bedroom?				
No ($n = 271$)	17.7 (18.0)	62.4	37.6	9.7 (1.5)**
Yes ($n = 114$)	16.6 (12.8)	69.3	30.7	9.3 (1.6)**
How many caffeinated beverages per day?				
None ($n = 280$)	17.9 (17.1)	66.1	33.9	9.8 (1.4)***
At least one per day ($n = 105$)	15.9 (15.3)	60.0	40.0	9.1 (1.8)***

Note: Significant difference with ANOVA for sleep onset latency and total sleep time and chi-square analysis for night wakings and change of location.
** $p < .01$ level.
*** $p < .001$ level.

a parent present at bedtime [$F(1,380) = 5.23$, $p = .006$]. When reading was part of the bedtime routine, preschoolers slept 30 min longer during the night [$F(1,383) = 7.73$, $p = .006$]. Preschoolers with a television in their bedroom slept almost 30 min less than preschoolers without a television in their bedroom [$F(1,383) = 7.32$, $p = .007$]. Preschoolers who had at least one caffeinated beverage per day slept over 40 min less than preschoolers who did not drink caffeine daily [$F(1,383) = 17.55$, $p < .001$].

Table 7 includes both multiple regression and logistic regression models for preschoolers. Although child age, parent age, and regular napping were not independently significant predictors of sleep onset latency, the full model with these variables included reached borderline significance [$F(3,368) = 2.58$, $p = .05$] accounting for only 2% of variance. A late bedtime and having at least one caffeinated beverage per day were significant predictors of shorter total nighttime sleep for preschoolers [$F(5,377) = 10.10$, $p < .001$]. Younger age within the preschool group was associated with increased risk for regular night wakings [$X^2(2) = 13.50$, $p = .01$].

3.3.4. School-aged children

Child age was positively correlated with sleep onset latency [$r = .12$, $p = .004$]. Children with their own bedroom had a shorter sleep onset latency compared to children who shared a bedroom (16.4 vs. 20.2 min) [$F(1,611) = 6.82$, $p = .009$]. Compared to children with siblings, more only children had at least one night waking per night (24.2% vs. 12.0%) [$X^2(1) = 8.87$, $p = .003$]. Six areas of sleep hygiene were examined for school-aged children (Table 8). Ninety-six percent of school-aged children had a consistent bedtime routine, with 64% having a late bedtime. Almost 30% of school-aged children had a parent present at bedtime, and reading was part of the bedtime routine for 25% of school-aged children. Forty-three percent of school-aged children had a television in their bedroom, and 41% of school-aged children had at least one caffeinated beverage per day.

School-aged children whose caregivers reported a consistent bedtime routine slept almost 1 h longer during the night [$F(1,630) = 15.85$, $p < .001$] than those who did not. School-aged children with a late bedtime had a longer sleep onset latency [$F(1,611) = 9.27$, $p = .002$] and slept 1 h less at night [$F(1,630) = 127.57$, $p < .001$]. If a parent was present at bedtime, school-aged children were more likely to wake at night [$X^2(1) = 22.16$, $p < .001$]. When reading was part of the bedtime routine, there was a trend for school-aged children to sleep 15 min longer during the night [$F(1,630) = 5.35$, $p = .02$]. School-aged children with a television in their bedroom slept almost 20 min less than children without a television in their bedroom [$F(1,630) = 12.44$, $p < .001$]. If the caregiver reported at least one caffeinated beverage per day, children were reported on average to sleep almost 20 min less than children without daily caffeine intake [$F(1,630) = 17.55$, $p = .001$].

Multiple and logistic regression models for school-aged children are summarized in Table 9. Younger child age, not sharing a

Table 7
Summary of multiple regression and logistic regression models for preschoolers.

	B	SE	*β*	R^2	Odds ratio	Wald	95% CI lower	95% CI upper
Sleep onset latency				.02*				
Child age (months)	−.08	.09	−.05					
Parent age	−.21	.14	−.08					
Naps regularly	2.37	1.93	.07					
Total Nighttime Sleep				.12***				
Late bedtime	−.70	.16	−.23***					
Parent present at bedtime	−.14	.16	−.05					
No reading at bedtime	−.20	.16	−.06					
TV in bedroom	−.13	.17	−.04					
>1 caffeine beverage/day	−.52	.18	−.15**					
Night Wakings (⩾ 1/night)								
Child age categorical	−.40	.13			.67	9.37**	.51	.86
Only child	.50	.27			1.65	4.01	.97	1.65

Note: Sleep hygiene variables were entered into the regression using dummy coding, with the variable listed equal to 1, and the other choice equal to 0 (e.g., Late bedtime = 1, early bedtime = 0), child sex, male = 1 and female = 0. Categorical ages were 1 = 3 years, 2 = 4 years, 3 = 5–6 years.
* $p < .05$.
** $p < .01$.
*** $p < .001$.

Table 8
Sleep hygiene and sleep variables for school-aged children ($n = 627$).

	Sleep onset latency	Night wakings per night		Night sleep amount
	Mean min (SD)	% None	% At least one	Mean hours (SD)
Bedtime routine?				
Yes ($n = 600$)	17.1 (14.7)	86.7	13.3	9.5 (1.1)***
No ($n = 27$)	19.8 (16.0)	81.5	18.5	8.6 (1.5)***
Late bedtime?				
Before 9 PM ($n = 227$)	14.8 (10.7)**	87.2	12.8	10.1 (0.8)***
After 9 PM ($n = 400$)	18.6 (16.5)**	86.0	14.0	9.1 (1.2)***
Parent present at bedtime?				
Never or rarely ($n = 485$)	17.7 (15.3)	89.9	10.1***	9.5 (1.2)
Few to every night ($n = 141$)	15.6 (12.7)	74.5	25.5***	9.4 (1.0)
Reading to child at bedtime?				
Yes ($n = 157$)	16.5 (14.4)	82.2	17.8	9.6 (1.2)*
No ($n = 470$)	17.4 (14.8)	87.9	12.1	9.4 (1.1)*
Television in the bedroom?				
No ($n = 357$)	17.6 (15.6)	85.4	14.6	9.6 (1.1)***
Yes ($n = 270$)	16.6 (13.5)	87.8	12.2	9.3 (1.2)***
How many caffeinated beverages per day?				
None ($n = 370$)	17.5 (15.8)	87.6	12.4	9.6 (1.1)***
At least one per day ($n = 257$)	16.8 (13.0)	84.8	15.2	9.2 (1.2)***

Note: Significant difference with ANOVA for sleep onset latency and total sleep time and chi-square analysis for night wakings and change of location.
* $p < .05$ level.
** $p < .01$ level.
*** $p < .001$ level.

bedroom, and a late bedtime were significant predictors of shorter sleep onset latency [$F(4,603) = 5.68$, $p < .001$], accounting for 4% of variance. Older child age, no bedtime routine, and a late bedtime were significant predictors of less total nighttime sleep in school-aged children [$F(6,601) = 28.07$, $p < .001$]. A test of the full model for night waking frequency with three predictors against a constant-only model was statistically significant [$X^2(3) = 31.44$, $p < .001$], indicating that the set of predictors reliably distinguished between school-aged children who had at least one night waking per night and children who did not wake during the night. Children whose parents were present at bedtime were 2.6 times more likely to have night wakings.

4. Discussion

The results of this poll of caregivers of young children (ages newborn to 10 years) indicate that sleep hygiene is significantly associated with how well children sleep. Across all ages, a late bedtime and having a parent present when the child falls asleep had the strongest negative association with reported sleep patterns. A late bedtime was associated with longer sleep onset latencies and reduced total amounts of sleep, whereas parental presence was associated with increased night wakings.

For younger children, a key issue was whether the parent reported putting the child in the crib/bed awake versus asleep. Since early studies by Anders and Keener [15], a common recommendation in the United States is for babies to be put to bed "drowsy but awake," that is, to have a baby fall asleep independently without parental assistance [16]. More than half of infants and 20% of toddlers in this study were put in their crib already asleep, which is counter to this recommendation. Our findings suggest negative effects on sleep associated with a child not falling asleep independently. For infants, being placed in their crib/bed asleep was associated with taking longer to fall asleep, being twice as likely to wake during the night (with almost 80% reported to experience night wakings most nights of the week), and getting 1 h less sleep at night. These associations were less pronounced in the toddler group, although if placed in bed asleep, parents reported 48 min less sleep at night on average.

For all age groups, parental presence while the child fell asleep was negatively associated with reports of good sleep. As expected, a large percentage of infants and toddlers had a parent present at bedtime. What was surprising was that caregivers reported they were present at bedtime for one-third of school-aged children. Furthermore, parental presence at bedtime was associated with increased night wakings and reduced total sleep time for children of all ages. For example, parental presence at bedtime was associated with 1.7 h less sleep at night for infants, and school-age children were six times more likely to wake during the night if parents were present at bedtime than if they fell asleep independently. On the other hand, parental presence was not associated with how long it took children to fall asleep (sleep onset latency) in older children. These results are consistent with other studies, both within the United States and internationally, that have found that sleep ecology is a major determinant of sleep outcomes, with parental presence associated with increased night wakings and more sleep difficulties [17,18].

Table 9
Summary of multiple regression and logistic regression models for school-aged children.

	B	SE	*β*	R^2	Odds ratio	Wald	95% CI lower	95% CI upper
Sleep onset latency				.04***				
Child age (months)	.08	.04	.09*					
No. of individuals in home	.49	.57	.04					
Own bedroom	−3.58	1.58	−.10*					
Late bedtime	3.06	1.27	.10*					
Total nighttime sleep				.22***				
Child age (months)	−.01	.003	−.14***					
No bedtime routine	−.71	.21	−.12***					
Late bedtime	−.83	.09	−.35***					
No bedtime reading	.002	.10	.001					
TV in bedroom	−.15	.09	−.06					
⩾1 caffeine beverage/day	−.15	.09	−.06					
Night wakings (⩾1/night)								
Child age categorical	−.29	.10			.75	8.38**	.61	.91
Only child	.55	.31			1.74	3.11*	.94	3.21
Parent present at bedtime	.94	.26			2.57	13.64***	1.56	4.25

Note: Sleep hygiene variables were entered into the regression using dummy coding, with the variable listed equal to 1, and the other choice equal to 0 (e.g., Late bedtime = 1, early bedtime = 0). Categorical ages were 1 = 6 years, 2 = 7 years, 3 = 8 years, 4 = 9 years, 5 = 10 years.

* $p < .05$.
** $p < .01$.
*** $p < .001$.

As mentioned above, a late bedtime (after 9 PM) was associated with poor sleep across all ages. Infants with a late bedtime got 1.3 h less sleep at night and had longer sleep latencies. There was also an association between late bedtimes and less overall sleep and more night wakings in toddlers, preschoolers, and school-aged children. Although it is expected that a late bedtime may result in reduced or shorter overall sleep, what is counter-intuitive is that a late bedtime also was associated with children taking longer to fall asleep and experiencing more night wakings, especially for infants. This result supports the belief that going to bed too late can lead to a child being "overtired," and thus having a more difficult time falling asleep and waking more frequently at night.

As expected, caffeine and a television in the bedroom were associated with poor sleep. Caregivers reported a large amount of caffeine use in young children, with 27% of preschoolers and 41% of school-aged children reported to drink at least one caffeinated beverage daily. Interestingly, caffeine did not appear to be associated with falling asleep but rather total nighttime sleep. Preschoolers who consumed caffeine daily were reported by their parents to average 42 min less sleep per night and school-aged children 24 min less. In addition, a television in the bedroom was reported for 17% of toddlers, 30% of preschoolers, and 43% of school-aged children, with a television in the bedroom associated with 18–36 min less sleep per night. This negative association between sleep and a television in the bedroom is consistent with previous studies [9,10,19].

Our analysis of these NSF poll data also found that positive aspects of sleep hygiene were related to better sleep. For example, significant differences in sleep were found as a function of bedtime routine, even though very few families reported not having an established bedtime routine. Those children without a consistent bedtime routine were reported to sleep less, as much as nearly an hour less in school-aged children. Another positive aspect of sleep hygiene was reading as part of a bedtime routine, which was reported by about 50% of families. Those children who were read to or who read on their own as part of their bedtime routine also experienced more sleep at night. Therefore, not only does reading at bedtime contribute to the development of literacy, [20] it is also associated with more sleep. We note that reading *per se* may not necessarily have a direct effect on children's sleep. An alternative hypothesis is that those families who include reading as part of their child's bedtime routine may provide more structure and make sleep a priority, which could have a positive effect on sleep.

A number of other interesting findings emerged from these analyses. First, sleep problems were commonly reported across the ages, with a large percentage of children reported to experience waking during the night. These results are consistent with other studies that have found a similar percentage of school-aged children who wake at night [21,22]. Second, the findings support the notion that skipping a nap is associated with poorer sleep for toddlers, whereas continued napping in preschoolers is associated with disrupted nighttime sleep. Finally, several other factors were associated with poorer sleep, including sharing a bedroom and being an only child.

We note that our study has a number of limitations. First, there are methodological concerns. The description of sleep in this study relied on parental reports, which can be problematic, especially as children grow older and parents may become less attuned to their child's sleep. Previous studies have found that parents are less accurate reporters of sleep disruptions (e.g., sleep onset delays, night wakings) for school-aged children than for younger children [23]. Furthermore, those parents who are present at bedtime and/or throughout the night, including those who bed-share and/or room-share, may have reported extended sleep onset latency and increased night wakings because of increased awareness. Given the robust findings of this study, however, the associations between sleep hygiene factors and sleep disruption are impressive. Furthermore, the study design does not enable analysis of other more in-depth questions. For example, this cross-sectional poll does not allow for assessment of developmental effects versus potential cohort effects. Data were also not collected on concurrent medical/psychiatric disorders, as well as medications that may affect sleep, which may have influenced the results.

In addition, this poll did not include other sleep hygiene factors that may influence sleep, such as a consistent sleep schedule (including consistent bedtimes and wake times) and the timing and duration of naps. Future studies may benefit from assessing other aspects of sleep hygiene, such as consistency of sleep schedules (including night-to-night variability) and the bedroom environment. For example, a common recommendation is that children not shift their bedtimes and wake times by more than 1 h on weekends, and that bedrooms be cool, dark, and comfort-

able to promote sleep. None of these factors was assessed in this NSF poll. In addition, electronic devices in the bedroom other than televisions, such as computers and hand-held electronic games, may also be related to a child's sleep.

Finally, given the nature of this poll, we cannot determine whether the putative sleep hygiene risk factors preceded outcomes, caused them, arose because of sleep problems, or showed associations simply because of a confound that was not included in this poll. For example, a late bedtime was associated with less overall sleep. Rather than the reduced sleep being a direct effect of a late bedtime, it may be a result of insomnia that may delay bedtime and reduce time spent in bed. On the other hand, children who need less sleep overall may simply choose to go to bed later. In addition, parental presence at bedtime may result from children having difficulty falling asleep and parents opting to put them to bed only after they have first fallen asleep elsewhere.

Finally, the issues of room-sharing and bed-sharing are complex and complicate analyses regarding both reporting of night wakings and whether a parent is present with a child at bedtime. Without a complete assessment of the reasons for bed/room-sharing (e.g., by necessity, family lifestyle choice, response to sleep difficulties), it limits our ability to completely understand their relationships with sleep outcomes. Future studies should delve more deeply into these complex issues and attempt to elucidate these factors.

Overall, our analysis of these NSF poll data found that good sleep hygiene is closely associated with better sleep across several age ranges. Although causal relationships could not be assessed in this large cross-sectional poll, the findings support the common recommendations that children of all ages should fall asleep independently, go to bed before 9 PM, have an established bedtime routine, include reading as part of their bedtime routine, refrain from caffeine, and sleep in bedrooms without electronic devices.

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Appendix

Questions for the National Sleep Foundation Poll

Referred to in paper	Question asked
Sleep onset latency	On a typical night in the past two weeks, how many minutes did it take your child to fall asleep, from lights out to being asleep?
Total nighttime sleep	On a typical night in the past two weeks, how many hours did your child actually sleep at night between the hours of 6 PM and 8 AM?
Night wakings	During a typical night in the past two weeks, how many times did your child wake up and need your help or attention? Would you say…(once per night, twice per night, three or more times per night, did he/she not wake at night) – *first three answers combined for this paper*
Bedtime routine	Does your child have a usual bedtime routine, that is, on most nights, do the same activities occur?
Late bedtime	On a typical night in the past two weeks, what was the usual time that the child went to sleep for the night? (*divided into before 9 PM and after 9 PM. based on median split)*
Awake/asleep	When your child is put into his or her crib or bed, is he or she typically asleep or awake?
Parent present	How often is a parent or other adult present in the room when the child falls asleep? Would you say… (every night or almost every night, a few nights a week, about once a week, rarely, or never?) – *first two and last two combined for this paper*
Reading at bedtime	What are the three most common activities that occur most nights as part of this bedtime routine? (no list was read, but yes indicates parent or other adult reads to the child or the child reads to him/herself was indicated as one of the top three activities)
Sleep problem	Thinking about your child's sleep, do you think that your child has any sleep problems?
TV	Does the child have a television in his or her bedroom?
Caffeine	Thinking about caffeinated beverages such as Coke, Pepsi, Mountain Dew, coffee, iced tea, how many cups or cans of caffeinated beverages does your child typically drink each day? (*defined as at least one per day versus none for this paper).*

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