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Implementation of a nightly bedtime routine: How quickly do things improve?

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Abstract

Background: Institution of a consistent bedtime routine has been demonstrated to improve sleep in young children within two weeks. However, no studies have investigated the rate of this change and when most change occurs. The purpose of this study was to examine the nightly change in infant sleep and maternal perceptions after implementing a bedtime routine.

Methods: Mothers ($n=134$) and their infant (8–18 months) were randomly assigned to implementation of a bedtime routine intervention for a two-week period.

Results: Two-level piecewise linear growth models showed that the intervention resulted in the most rapid change in the first three nights of the intervention across sleep outcomes, including sleep onset latency, the frequency and duration of nighttime awakenings, sleep consolidation, and maternal perceptions of bedtime ease, sleep quality, and infant mood. No significant additional improvement in sleep onset latency emerged after these first three nights, whereas small additional improvements occurred for all other outcomes throughout the remainder of the intervention period.

Conclusions: These results indicate that sleep disturbances in infants and toddlers can be quickly ameliorated within just a few nights after implementation of a consistent bedtime routine, including a bath, massage, and quiet activities. Future research should consider the potential mechanisms behind these relatively fast improvements in sleep, such as reduced household chaos or physiological changes (e.g. core body temperature, cortisol).

Keywords

Sleep; Infant; Toddler; Bedtime routine; Bedtime disturbances; Night wakings; Behavioral intervention

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Conflicts of interest

Dr. Mindell and Dr. Leichman serve as research consultants for Johnson & Johnson Consumer Inc.

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1. Introduction

A bedtime routine is considered a key component of healthy sleep and is typically integrated into behavioral interventions for sleep problems in young children (Mindell et al., 2006). A bedtime routine involves a consistent set of activities (e.g., bath, pajamas, stories) that occur in the same order on a nightly basis before lights out. A recent review of pediatric sleep practice recommendations found evidence across multiple studies for the efficacy of inclusion of a bedtime routine to promote positive sleep outcomes (Allen, Howlett, Coulombe, & Corkum, 2016).

As indicated, a number of studies, both cross-sectional and longitudinal, have found that the presence of a bedtime routine is associated with positive sleep outcomes (e.g., Hale, Berger, LeBourgeois, & Brooks-Gunn, 2011; Henderson & Sytsma, 2010; Mindell, Telofski, Wiegand, & Kurtz, 2009). A recent study of over 10,000 young children (ages birth to 6 years) found a dose-dependent relationship between integration of a bedtime routine and sleep outcomes (Mindell, Li, Sadeh, Kwon, & Goh, 2015). That is, the more regularly a family implemented a bedtime routine, the more improvement was observed in child sleep. In one study of over 3000 preschool aged children, the use of a language-based bedtime routine at 3 years of age was associated with greater overnight sleep duration and stronger verbal scores at 5 years of age (Hale et al., 2011). In another study examining the role of bedtime routine adherence in toddlers and preschool aged children, Staples, Bates, and Petersen (2015) evaluated bedtime routine regularity in a non-clinical sample of 87 youth. In this study, the number of parent-reported awakenings, as well as actigraphy-based nighttime and total sleep time, were examined in terms of adherence to a bedtime routine and self-reported parenting consistency. Overall, they found that adherence to a bedtime routine was associated with nighttime sleep at 36 and 42 months but not at 30 months; no associations were found among routine adherence, parenting, and signaled night wakings. Further, controlling for longitudinal stability, nighttime and total sleep at 36 months were predicted by an interaction between parenting consistency and adherence to a bedtime routine.

Bedtime routines are commonly recommended for infant and toddler sleep disturbances and are often included as a component in the efficacious treatment of sleep disturbances in young children (Allen et al., 2016; Mindell et al., 2006). Furthermore, prior studies assessing the efficacy of the daily implementation of the bedtime routine prescribed in this study were found to be efficacious on its own and in conjunction with a broader intervention at two-weeks (Mindell et al., 2011a, 2009) and one year follow-up (Mindell et al., 2011b). Our previous study (Mindell et al., 2009) found improvement in sleep onset latency, longest stretch asleep, and number/duration of night wakings for infants and toddlers following implementation of a standardized bedtime routine over two weeks of intervention. No significant changes were observed in a comparison control group. In addition, bedtime routine implementation was associated with improvement in parent perceived ease of bedtime, perception of how well the baby slept, as well as rating of baby morning mood as tested after two weeks of intervention implementation. However, how quickly those changes occurred were not examined within the two-week intervention period. In a second study (2011a; 2011b), we found that implementing an internet-based behavioral intervention that incorporated the same bedtime routine for bedtime problems and night wakings in young

children resulted in improvements in child (e.g., sleep onset latency, night wakings, sleep consolidation, morning mood) and parent (e.g., parent efficacy, maternal sleep) variables.

Although there is ample support for use of a bedtime routine within a treatment package and emerging support for use of a bedtime routine alone to improve sleep in young children, little is known about how quickly changes in sleep can be observed once a bedtime routine is implemented. The rate of improvement of the child's sleep and equally the parent's perception is likely an important factor in the parent's adherence to behavioral sleep interventions. Similarly, no large-scale studies of behavioral interventions for infant and toddler sleep disturbances have analyzed change on a night-to-night basis. Instead, all studies assess change across a longer time period, such as one week or one month post-implementation. Thus, using data from the aforementioned study (Mindell et al., 2009), the objective of the current investigation was to examine the change in child sleep and maternal perception on a nightly basis after implementing a prescribed bedtime routine. Specifically, we examined the overall nightly rate of change in sleep outcomes over the two-week prescribed bedtime routine period, and whether there was a greater rate of change at the start of bedtime routine implementation relative to the rest of the intervention period.

2. Methods

2.1. Participants

Data from 134 mothers and their young child (ages 8–18 months; 44.8% boys) were analyzed. Infant ages were distributed across the age range, with 17.3% ages 7.0–9.9 months, 33.1% ages 10–12.9 months, 25.5% ages 13.0–15.9 months, and 21.8% ages 16.0–18.5 months. Participants were recruited through an independent market research firm and were screened by telephone. Table 1 presents complete demographic information. Inclusion criteria for the study included that all children must have an identified sleep problem as noted by the mother, with all mothers endorsing that their child had a sleep problem that ranged from “small” to “severe.” However, families were excluded if the child's sleep issues were extreme and thus may be indicative of an underlying medical or developmental concern, as defined as (1) more than 3 night wakings per night, (2) awake more than 60 minutes per night, or (3) total daily sleep duration of less than 9 hours.

2.2. Procedure

This study was approved by the Institutional Review Boards at Allendale and Saint Joseph's University. Informed consent was obtained from all participants. Complete information on the sample and behavioral intervention has been previously published (Mindell et al., 2009). Of the total 206 families in the original study, 134 (65%) families were assigned to the intervention (i.e., routine) group. Following a one-week baseline period in which the mothers followed their child's usual bedtime practices, the mothers were verbally instructed in-person by a research assistant at a site visit, as well as provided with written documentation, to institute a nightly three-step bedtime routine for a two-week period that included a bath (minimum duration of 5 min, using a provided wash product), a massage (minimum duration of 3 min with suggested massage techniques, using a provided massage product), and quiet activities (e.g., cuddling, singing lullaby) with lights out within 30 min

of the end of the bath. All mothers were provided with the same products in unmarked containers. Following the bedtime routine, mothers continued to put their child to bed as they normally did, whether they put their child to bed awake or stayed with their child until asleep (e.g., rocked to sleep). Thus, the only recommended change was the institution of the prescribed bedtime routine.

All mothers completed a daily sleep diary that included information about their child's sleep patterns and their perceptions of their child's sleep. Note that all sleep variables and patterns reported were collected via parent-report daily diary. All information referred to as *parent or maternal perception* was the result of Likert scale ratings. Only those variables that were found to improve in the original study were included in the night-to-night analyses ($p < 0.001$). This included the following daily diary reported sleep pattern variables: sleep onset latency (SOL), number of night wakings (NW), duration of night wakings (DNW), and longest stretch asleep (LSA). For the parental perception variables, mothers were asked to respond on a 5-point Likert scale regarding bedtime difficulty (BD; 1 = very easy to 5 = very difficult), how well their child slept the previous night (HW; 1 = very well to 5 = very badly), and their child's mood when s/he first woke up in the morning (MM; 1 = very happy to 5 = very fussy). Note that no changes were noted in the original study for the other sleep diary variables, including the time parents started their bedtime routine, lights out, wake time, or nap duration ($p > 0.05$).

2.3. Data analytic strategy

All analyses were conducted using *IBM SPSS Statistics Version 23* software (SPSS 23; IBM Corp., 2013). As part of our preliminary analyses, we generated descriptive statistics for nightly raw sleep outcomes. Visual inspection indicated an increased rate of change over the first three nights of bedtime routine implementation relative to the rest of the two-week implementation period. We then constructed a series of linear mixed effects models using restricted maximum likelihood estimation (Raudenbush & Bryk, 2002). First, we constructed two-level fully unconditional models for each sleep outcome to generate intraclass correlation coefficients (ICCs), which identified the proportion of individual-level (level 1; within-person) versus between-person (level 2) variance in each sleep outcome. Consistent with standard procedures, ICCs for the individual and between-person levels were calculated by dividing the variance at each level by the total (between-person plus within-person) variance (Raudenbush & Bryk, 2002). We calculated three sets of ICCs to reflect the individual variance and between-person variance (1) over the baseline period, (2) over the intervention period, and (3) overall, from the baseline through intervention period.

Next, we constructed two-level unconditional linear growth models to examine the overall rate of change in each sleep outcome from baseline (indexed as the average of the one-week baseline period) through the intervention period (nights 1 through 14). In these models, the baseline average was coded as night 0, with each intervention night coded sequentially from 1 through 14, such that the resulting slope represented the average rate of change per night for each sleep outcome from baseline through intervention night 14. These fully unconditional models included only time as a predictor variable, with random effects at the intercept and slope.

Finally, we constructed piecewise linear growth models (Flora, 2008; Raudenbush & Bryk, 2002) to examine whether there was an increased rate of change during the first three nights of bedtime routine implementation following the baseline period as compared to the remainder of the intervention period. We created two separate dummy-coded piecewise variables to represent the different rates of change over the bedtime routine implementation. The first piece (hereafter referred to as Piece I) was for the rate of change from baseline through the first 3 nights, which was hypothesized to demonstrate the most rapid change. The second piece (Piece II) reflected the rate of change over the remaining nights through night 14, which was hypothesized to show a smaller rate of change. To test growth over each piece, we entered the dummy-coded intervention pieces as simultaneous individual-level predictors of sleep outcomes. The resulting individual-level model was as follows:

$$Outcome_{it} = \beta_{0j} + \beta_{1j}(Piece\ I_{ij}) + \beta_{2j}(Piece\ II_{ij}) + r_{ij}$$

The overall intercept represented average scores in the parent-reported sleep outcome over the course of the baseline period, while the slope variable for Piece 1 represented the rate of change from baseline through night 3 and the slope variable for Piece 2 represented the rate of change for the remaining nights. All coefficients are unstandardized. As such, for each outcome the slope variables represent the rate of change per night expressed in each outcome's raw units. Each model included child age in months as a covariate, given that infants and toddlers may differ in their sleep outcomes, such as night waking frequency and duration (Sadeh, Mindell, Luedtke, & Wiegand, 2009). Age was mean-centered to facilitate interpretation of the intercept.

3. Results

3.1. Preliminary analyses

Table 2 presents descriptive statistics for each sleep outcome averaged over the baseline period and intervention nights 3 and 14. Table 2 also presents ICCs for each outcome, across the baseline period, the intervention period, and overall, from baseline through the intervention period. Across sleep outcomes and across the three sets of ICC calculations, there was a greater proportion of variance attributable to within-person (level 1; 56.68–81.75%) as opposed to between-person (level 2; 18.25–43.16%) differences.

Table 3 shows the results of the unconditional linear growth models used to identify the average rate of change per night in each sleep outcome from the baseline average through intervention night 14. Consistent with published data showing positive changes across sleep outcomes from baseline to post-bedtime routine implementation (Mindell et al., 2009), rates of change were significant across sleep outcomes. There were significant improvements in SOL, NW, NWD, LSA, bedtime ease, sleep quality, and morning mood. All models demonstrated significant random effects ($p < 0.01$) for both the intercept and slope, indicating significant variation across infants and toddlers in both their level of the sleep outcome at baseline and in their rates of change over the intervention period (Table 3).

3.2. Piecewise linear growth models

Results of the piecewise linear growth models covarying for child age at baseline are shown in Table 4 and in Fig. 1a–g. Across models, there were no significant age effects, and the rate of change from baseline through the first three nights of intervention were more rapid than the rate of change observed during the remainder of the intervention.

3.2.1. Sleep onset latency—SOL (Fig. 1a) showed a significant decrease by -1.29 min (95% CI $-1.86, -0.72$) for each night from the average at baseline through intervention night 3 (Piece I, $t = -4.46, p < 0.001$). Although SOL reduced by an average of -0.11 min (95% CI $-0.23, 0.02$) each remaining night through night 14 (Piece II), reductions were not statistically significant ($t = -1.63, p = 0.10$). The larger and statistically significant beta coefficient for Piece I indicated that the most change in SOL occurred during the first 3 nights of bedtime routine implementation.

3.2.2. Night wakings—The frequency and duration of night wakings (Fig. 1b and c), showed a similar pattern, with larger beta coefficients and statistically significant reductions over the first 3 nights of bedtime routine implementation (Piece I for night waking frequency $b = -0.12$ [95% CI $-0.17, -0.07$], $t = -4.87, p < 0.001$; Piece I for night waking duration $b = -3.00$ [95% CI $-4.14, -1.86$], $t = -5.12, p < 0.001$). However, both outcomes continued to show smaller, statistically significant reductions over the remainder of the intervention period, through night 14 (Piece II for night waking frequency $b = -0.01$ [95% CI $-0.03, -0.002$], $t = -2.27, p < 0.05$; Piece II for night waking duration $b = -0.33$ [95% CI $-0.59, -0.06$], $t = -2.43, p < 0.05$).

3.2.3. Longest sleep period—For each night from the baseline average through night 3, there was a statistically significant increase in sleep consolidation (Fig. 1d), with an improvement of 0.29 (95% CI $0.18, 0.41$), which is approximately 17.4 min per night (Piece I $t = 5.00, p < 0.001$). The longest stretch asleep continued to significantly improve through night 14 at a slower rate of 0.06 (95% CI $0.03, 0.08$), or approximately 3.6 min per night (Piece II $t = 4.01, p < 0.001$), on average.

3.2.4. Maternal perceptions—Maternal perceptions of bedtime ease, sleep quality, and child's morning mood also showed a more rapid, statistically significant improvement over the first 3 nights of intervention, with smaller, continued improvements over the remaining nights (Fig. 1e–g). For these outcomes, decreasing values indicate improvement. The rate of bedtime ease improvement (Fig. 1e) was -0.14 (95% CI $-0.19, -0.09$) over the first 3 nights (Piece I $t = -5.33, p < 0.001$), with a smaller rate of improvement at -0.02 (95% CI $-0.03, -0.008$) through night 14 (Piece II $t = -3.28, p < 0.01$). Maternal perceptions of baby sleep quality (Fig. 1f) improved at a nightly rate of -0.19 (95% CI $-0.25, -0.12$) over baseline through night 3 (Piece I $t = -5.74, p < 0.001$), and at a rate of -0.02 (95% CI $-0.04, -0.006$) per night through night 14 (Piece II $t = -2.83, p < 0.01$). Finally, for morning mood (Fig. 1g) there was a nightly improvement rate of -0.12 (95% CI $-0.16, -0.07$) through night 3 (Piece I $t = -5.03, p < 0.001$), with a smaller nightly improvement rate of -0.02 (95% CI $-0.02, -0.007$) through night 14 (Piece II $t = -3.28, p < 0.01$).

4. Discussion

Results of this study enhance the results previously reported (Mindell et al., 2009), indicating that not only does a simple, consistent bedtime routine lead to improvements across the majority of infant sleep-related variables (sleep onset latency, night waking frequency and duration, longest stretch asleep, parent perception of how well a child slept, bedtime ease, and infant morning mood), but also that these changes in sleep variables and parent perception of bedtime issues happen quickly. These rapid and statistically significant changes were observed within the first three nights of intervention. For all sleep outcomes, except sleep onset latency, significant improvements continued throughout the two-week intervention period, although at a slower rate of nightly change. The lack of statistically significant change in sleep onset latency after the first three nights could be due to the large magnitude of initial change in this outcome, perhaps leaving little room for significant improvement over the remainder of the intervention period. However, it should be noted that while not statistically significant, the sleep onset latency outcome did continue to reduce through the end of the intervention period.

It appears that this specific bedtime routine, consisting of a warm bath, massage and quiet time activities, resulted in improvements in sleep beyond the benefits of just establishing a nightly routine. If the improvements were just due to implementing a routine, then we hypothesize that it would take more than three nights before change was observed, as it requires an associated learning process. One possible mechanism is that the institution of a routine reduces household chaos and caregiver stress (Boles et al., 2017). Another possible, albeit speculative, reason for observing this fast change, particularly in sleep onset latency and sleep consolidation, may be that a bath and/or massage may impact elements of physiology, such as core body temperature or cortisol. Studies in adults have found that a bath improves sleep (Kanda, Tochihara, & Ohnaka, 1999; Liao, 2002) and similar effects may have been found in this study. Furthermore, one recent study investigating the development of circadian rhythms in newborns found that changes in cortisol and core body temperature occur prior to sleep consolidation (Joseph et al., 2015) and another noted an association between cortisol and sleep regulation (Saridjan et al., 2017), thus supporting the role of core body temperature and cortisol as part of the sleep process. Additional improvements following the first few nights and occurring across the two-week span are likely additive effects of the associate learning process that a routine provides.

It should be noted that the improvements reported here are based on statistically significant changes. These changes, though, also are clinically significant. Following two weeks of conducting the prescribed bedtime routine, sleep onset latency decreased by over 6 min and the longest consolidated sleep period increased by over an hour. The number of night wakings shifted from an average of over one per night to less than one per night during that time. Further, results indicate that changes occurred quickly. For a parent, these are palpable changes.

Interestingly, this intervention did not directly prescribe independent sleep onset, although studies have found that this factor is most highly predictive of sleep outcomes (e.g., Sadeh et al., 2009). In one way, this is relevant when working with families as a practitioner in that

some families may not be comfortable allowing babies to fall asleep independently. Communicating to families that rapid change is possible with simple implementation of a three-step bedtime routine, even without formal sleep training, can be a highly useful clinical tool. It will be important for future research to address the rate and amount of change with a variation to the routine that targets self-soothing and falling asleep independently.

There are several limitations inherent to this study. First, elements of family bedtime routines at baseline were not explicitly known and recorded. If families had a before-bed sequence of activities that approximated a bedtime routine, the resulting contrast between baseline and intervention parent behavior may have been reduced. Staples et al. (2015) reported that families of toddlers have an average of five steps in a routine, with the most common activities being reading a story, taking a bath/shower, putting on pajamas, and brushing teeth. Thus, some of the families in this study likely had some type of bedtime routine. Another limitation is that data were collected exclusively via parent-report. Similarly, there was no intervention fidelity or interrater reliability data available for any of the sleep-specific variables. Level of adherence may have had an effect on intervention results or speed of attaining desired outcome. Future research should include more objective measurement, such as actigraphy, as caregivers may inaccurately report specific aspects of their infant's sleep. Finally, although our growth modeling approach allowed for individual variation in infants' initial level of each sleep outcome and in their rate of nightly change over time, we did not examine individual patterns of infant responsiveness to intervention. Future research should use other advanced modeling procedures, such as latent profile analysis, to identify whether there are different trajectories of intervention responsiveness, such as initial gains without subsequent change, a steady pattern or improvement, or a pattern of overall non-responsiveness.

Overall, a simple, consistent bedtime routine, consisting of a bath, massage and quiet activities, resulted in rapid change for both child-level sleep variables as well as maternal perception of her child's bedtime ease, sleep quality, and mood. These statistically significant changes occurred within approximately three nights, and not only resulted in improvements in child sleep, but also provided relief at a family level by improving the maternal experience of bedtime, which is often a stressful period. These findings not only support implementation of a bedtime routine but also provide additional information for a clinician in terms of obtaining caregiver buy-in. Although all families are different, clinical ability to inform caregivers that they will likely experience change, and even relief, within a matter of a few nights may increase family likelihood to implement a nightly bedtime routine as an intervention. Future studies should address caregiver buy-in and treatment adherence in relation to the knowledge that change is possible within a mere few nights.

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Fig. 1.

(a) – Sleep onset latency. (b) – Night waking frequency. (c) – Night waking duration. (d) – Longest stretch asleep. (e) – Maternal perception of bedtime ease. (f) – Maternal perception of how well child slept. (g) – Maternal perception of child morning mood.

Table 1

Demographic Variables.

Variable	Percent (n)
Age of Child (months)	
Average = 13.18 (SD = 3.04)	
8.0–11.9	40.3 (54)
12.0–18.5	59.7 (80)
Child's Gender	
Boy	44.8 (60)
Girl	55.2 (74)
Age of Mother (years)	
18–29	42.5 (57)
30–39	51.5 (69)
40–49	6.0 (8)
Married	96.3 (129)
School	
Graduated high school	19.4 (26)
Some college	35.8 (48)
College degree or more	44.8 (60)
Employed	
Full-Time	22.4 (30)
Part-Time	19.4 (26)
Not Employed	58.2 (78)
Income	
< \$30,000	8.2 (11)
\$30,000–\$39,999	19.4 (26)
\$40,000–\$49,999	14.9 (20)
\$50,000–\$74,999	30.6 (41)
\$75,000 or more	26.9 (36)

Table 2

Descriptive information and intraclass correlation coefficients for sleep outcomes.

	Baseline	Baseline period		Night 3	Night 14	Intervention period		Overall	
	M (SD)	ICC ₁	ICC ₂	M (SD)	M (SD)	ICC ₁	ICC ₂	ICC ₁	ICC ₂
SOL (min)	18.90 (15.45)	60.89	39.22	14.03 (12.96)	12.36 (11.64)	60.00	40.00	60.80	39.20
NW (number)	1.37 (1.07)	64.10	35.90	0.97 (1.08)	0.81 (1.04)	65.00	35.00	65.66	34.34
NWD (min)	23.78 (23.49)	77.47	22.53	14.60 (19.27)	11.31 (20.54)	77.51	22.49	77.78	22.22
LSA (hour)	6.99 (2.39)	60.68	39.32	8.25 (2.35)	8.88 (2.40)	55.61	44.39	56.75	43.25
Bedtime ease	2.45 (1.17)	81.75	18.25	1.96 (1.05)	1.61 (0.82)	77.38	22.62	78.57	21.43
How well slept	2.73 (1.23)	80.00	20.00	2.05 (1.18)	1.77 (1.10)	75.71	24.29	77.37	22.63
Morning mood	2.34 (1.11)	68.80	31.20	1.98 (1.00)	1.63 (0.96)	55.67	44.33	56.68	43.16

Note: Baseline refers to average over one-week baseline period. Final three variables rated on a 1–5 scale, lower numbers indicating better scores. ICC₁ = intraclass correlation coefficient for level 1 from fully unconditional model; ICC₂ = intraclass correlation coefficient for level 2 from fully unconditional model. Overall refers to intraclass correlation coefficients for baseline through end of intervention period. Min = min; SOL = Sleep Onset Latency; NW = night waking frequency; NWD = night waking duration; LSA = longest stretch asleep.

Table 3

Unconditional linear growth models.

	<u>Sleep onset latency</u>			<u>Night waking frequency</u>			<u>Night waking duration</u>		
	<i>b</i>	<i>SE</i>	<i>t-ratio</i>	<i>b</i>	<i>SE</i>	<i>t-ratio</i>	<i>b</i>	<i>SE</i>	<i>t-ratio</i>
Intercept (baseline), γ_{00}	15.23	0.75	20.36***	1.14	0.06	18.37***	19.31	1.22	15.87***
Time (baseline – night 14) γ_{10}	-0.27	0.06	-4.51***	-0.03	0.01	-5.66***	-0.68	0.10	-6.72***
	<u>Longest stretch asleep</u>			<u>Bedtime ease</u>			<u>How well baby slept</u>		
	<i>b</i>	<i>SE</i>	<i>t-ratio</i>	<i>b</i>	<i>SE</i>	<i>t-ratio</i>	<i>b</i>	<i>SE</i>	<i>t-ratio</i>
Intercept (baseline), γ_{00}	7.68	0.16	46.78***	2.06	0.05	40.75***	2.33	0.06	36.10***
Time (baseline – night 14) γ_{10}	0.09	0.01	6.54***	-0.04	0.005	-7.45***	-0.04	0.01	-6.76***
<u>Morning mood</u>									
			<i>b</i>			<i>SE</i>			
Intercept (baseline), γ_{00}			2.11			0.06	34.16***		
Time (baseline – night 14) γ_{10}			-0.03			0.005	-6.92***		

Note. Coefficients are unstandardized.

*
p < 0.05.**
p < 0.01.***
p < 0.001.

Table 4

Piecewise linear growth models.

	<u>Sleep onset latency</u>			<u>Night waking frequency</u>			<u>Night waking duration</u>		
	<i>b</i>	<i>SE</i>	<i>t-ratio</i>	<i>b</i>	<i>SE</i>	<i>t-ratio</i>	<i>b</i>	<i>SE</i>	<i>t-ratio</i>
Intercept (baseline), γ_{00}	17.28	0.90	19.16***	1.33	0.08	16.84***	23.78	1.61	14.75***
Piece I (baseline – night 3), γ_{10}	–1.29	0.29	–4.46***	–0.12	0.03	–4.87***	–3.00	0.58	–5.12***
Piece II (nights 4–14), γ_{20}	–0.11	0.07	–1.64	–0.01	0.01	–2.27*	–0.33	0.13	–2.43*
Age covariate, γ_{30}	0.20	0.22	0.89	–0.01	0.02	–0.69	–0.10	0.31	–0.32
	<u>Longest stretch asleep</u>			<u>Bedtime ease</u>			<u>How well baby slept</u>		
	<i>b</i>	<i>SE</i>	<i>t-ratio</i>	<i>b</i>	<i>SE</i>	<i>t-ratio</i>	<i>b</i>	<i>SE</i>	<i>t-ratio</i>
Intercept (baseline), γ_{00}	7.26	0.20	36.62***	2.26	0.07	32.12***	2.61	0.09	28.91***
Piece I (baseline – night 3), γ_{10}	0.29	0.06	5.00***	–0.14	0.03	–5.33***	–0.19	0.03	–5.74***
Piece II (nights 4–14), γ_{20}	0.06	0.01	4.01***	–0.02	0.01	–3.28**	–0.02	0.01	–2.83**
Age covariate, γ_{30}	0.05	0.05	1.00	0.001	0.01	0.10	0.02	0.02	0.96
	<u>Morning mood</u>								
	<i>b</i>	<i>SE</i>	<i>t-ratio</i>						
Intercept (baseline), γ_{00}			2.27			0.08			29.47***
Piece I (baseline – night 3), γ_{10}			–0.12			0.02			–5.03***
Piece II (nights 4–14), γ_{20}			–0.02			0.01			–3.28**
Age covariate, γ_{30}			0.03			0.02			1.42

Note. Coefficients are unstandardized.

* $p < 0.05$.

** $p < 0.01$.

*** $p < 0.001$.