INSIGHT Responsive Parenting Intervention and Infant Sleep

Ian M. Paul, MD, MSc,[a] Jennifer S. Savage, PhD,[b] Stephanie Anzman-Frasca, PhD,[c] Michele E. Marini, MS,[b] Jodi A. Mindell, PhD,[d] Leann L. Birch, PhD[e]

abstract

OBJECTIVES: Inadequate sleep during infancy is associated with adverse outcomes for infants and families. We sought to improve sleep behaviors and duration through a responsive parenting (RP) intervention designed for obesity prevention.

METHODS: The Intervention Nurses Start Infants Growing on Healthy Trajectories (INSIGHT) study is a randomized trial comparing a RP intervention with a safety control. Primiparous mother-newborn dyads were randomized after childbirth, and research nurses delivered intervention content at home visits at infant ages 3, 16, 28, and 40 weeks and at a research center visit at 1 year. The RP sleep component included developmentally appropriate messages about bedtime routines, sleep location and behaviors, and responses to wakings. Portions of the Brief Infant Sleep Questionnaire were administered 2, 8, and 52 weeks after birth with expanded sleep-related data collection at 16 and 40 weeks.

RESULTS: Two hundred and seventy-nine dyads completed the first home visit; 90.7% completed the 1-year visit. Compared with controls, RP group infants were less likely to have prolonged bedtime routines >45 minutes and more likely to have earlier bedtimes at 16 and 40 weeks. They were less likely to be fed immediately before bed and more likely to self-soothe to sleep. At 8, 16, and 40 weeks, RP group nocturnal sleep duration was longer by 35, 25, and 22 minutes, respectively ($P < .05$ for all). Sleep duration at 1 year was similar between groups.

CONCLUSIONS: The INSIGHT RP intervention positively influenced developmentally appropriate bedtime routines, sleep-related behaviors, and sleep duration for infants.

[a]Pediatrics and Public Health Sciences, Penn State College of Medicine, Hershey, Pennsylvania; [b]Center for Childhood Obesity Research, Penn State College of Health and Human Development, University Park, Pennsylvania; [c]Department of Pediatrics, Jacobs School of Medicine and Biomedical Sciences, University at Buffalo, Buffalo, New York; [d]Psychology, Saint Joseph's University; Sleep Center, Children's Hospital of Philadelphia, Philadelphia, Pennsylvania; and [e]Department of Foods and Nutrition, University of Georgia, Athens, Georgia

WHAT'S KNOWN ON THIS SUBJECT: Short sleep duration during infancy has been associated with numerous adverse outcomes for infants and their families. Inadequate sleep affects infant cognitive, psychomotor, physical, and socioemotional development, as well as parental emotional health and parenting practices.

WHAT THIS STUDY ADDS: A responsive parenting intervention delivered at home nurse visits positively influenced developmentally appropriate bedtime routines, sleep-related behaviors, and nighttime sleep duration in the first year after birth.

Many young children get less sleep than they require,[1] and today's children sleep less than those in previous generations.[2] Inadequate sleep is problematic because sleep is associated with cognitive, psychomotor, physical, and socioemotional development, including emotional regulation, mood, and behavior in infancy and childhood.[3–6] Furthermore, infant sleep-related behaviors are associated with maternal sensitivity, relationship quality, parental emotional health, and parenting practices.[7,8] Inadequate sleep has also emerged as an important risk factor for obesity[9,10] with links between sleep and weight beginning in infancy.[11–16] Short sleep duration during infancy is also associated with inadequate sleep later in childhood,[17] and therefore improving sleep-related behaviors and extending infant sleep duration has the potential to influence the long-term well-being of children and families.

During the first year, infants spend much of their time asleep but experience substantial changes in sleep/wake cycles. For the first few weeks, infants wake every few hours, typically to feed, and normal circadian rhythms are developed.[18–23] After this period, how parents put their infant to bed (eg, bedtime routines, falling asleep independently) and respond to night wakings represent sources of variability in infants' developing sleep patterns[24,25] and also affects the frequency and timing of feedings. Previously, we demonstrated that early in infancy, nocturnal sleep duration can be extended by teaching parents caregiving procedures to address non–hunger-related fussiness.[26,27] Combined with education on hunger and satiety cues, this reduced nighttime feeds and awakenings. Another recent report describing an Internet-based intervention designed to improve infant and toddler sleep revealed that participants took less time to fall asleep, had less time awake overnight, and had longer sleep durations between awakenings.[28] Maternal sleep and mood improved, and positive benefits on infants' sleep were seen 1 year later.[29]

Given evidence of sleep's malleability and its links to weight outcomes, we included sleep-related components within a responsive parenting (RP) intervention designed for the primary prevention of obesity. On the basis of previous research,[26–28] the sleep components focused on consolidating sleep and extending night sleep duration by providing guidance on sleep-related parenting behaviors, particularly establishing consistent bedtime routines, encouraging self-soothing and early bedtimes, and strategies to address night waking.[30] In this ongoing randomized, controlled trial, the RP intervention is compared with a home safety control intervention that includes a safe sleep component. We assessed intervention effects on infant sleep in the first year with the hypothesis that sleep duration would be longer and positive sleep-related behaviors would be more prevalent compared with controls.

METHODS

Participants and Design

Mothers and their newborns were recruited after delivery from 1 maternity ward (Penn State Milton S. Hershey Medical Center, Hershey, PA) into the Intervention Nurses Start Infants Growing on Healthy Trajectories (INSIGHT) study from January 2013 to March 2014 (see Supplemental Information). The study design and inclusion/exclusion criteria have been published previously.[30] Major eligibility criteria included term singletons weighing ≥2500 g delivered to English-speaking, primiparous mothers ≥20 years old. Using a computer-generated algorithm, 291 dyads were randomized 2 weeks after delivery to the RP or control groups, stratified on birth weight for gestational age (<50th percentile or ≥50th percentile) and intended feeding mode (breastfeeding or formula). A baseline survey was administered to mothers electronically. Two hundred and seventy-nine mother-infant dyads completed the first home visit and are considered the study cohort for outcomes as specified before study initiation in the protocol.

As described previously, research nurses were trained in administering both the RP and control interventions[30] at home visits conducted at infant age 3–4, 16, 28, and 40 weeks, and a research center visit occurred at age 1 year. This study was approved by the Penn State College of Medicine's Human Subjects Protection Office and registered at http://www.clinicaltrials.gov without sleep noted as an a priori outcome.

RP Intervention Sleep-Related Components

INSIGHT's RP intervention contained messages addressing infant behavioral states: Drowsy, Sleeping, Fussy, and Alert.[30] Lessons include instructing parents to (1) recognize infant hunger and satiety cues; (2) use alternatives to feeding to soothe a fussy, but nonhungry, infant; (3) provide appropriate portions of healthy foods and allow children to determine the amount consumed; (4) improve acceptance of developmentally appropriate foods such as vegetables through repeated exposure and positive role modeling, while discouraging controlling feeding practices; and (5) actively engage infants in playtime to reduce sedentary behaviors.

Developmentally appropriate sleep guidance was delivered at visits within 3 categories: Bedtime Routine, Sleep Location and Behaviors, and Night Waking (Table 1). This guidance was consistent with recommendations for age-appropriate sleep durations,[31] helped parents recognize whether fussiness was due to fatigue versus hunger, provided strategies to transition infants from a fussy or drowsy state to sleep without feeding, and included detailed information on bedtimes and routines before bed, particularly the importance of consistent, short bedtime routines that do not finish with feeding to sleep, early bedtimes, and the importance of self-soothing to sleep and after night wakings. Before the 3-week visit, participants received materials by mail; for RP parents, materials included a video[32] describing alternative soothing strategies and instructions to view it, practice soothing strategies before the home visit, and use these strategies, particularly at night. At the 16- and 40-week visits, nurses used the Brief Infant Sleep Questionnaire (BISQ)[33] to provide each mother with a personalized infant sleep profile,[28] including information regarding how much her infant slept relative to recommendations and customized sleep-related feedback.

Control Group Sleep-Related Components

Briefly, INSIGHT's home safety control intervention contained crib safety and prevention of sudden infant death syndrome components in a 2-week mailing and at the 3–4-week home visit.[30] At the 3–4- and 16-week visits, the infant's sleep surface was examined by the nurse to tailor safety guidance. At the 16- and 28-week visits, sleep safety recommendations addressed developmental changes, such as rolling over and pulling to stand. At 40 weeks, information on prevention of carbon monoxide poisoning was provided.

Measures

Data were collected and managed using REDCap.[35] Paper surveys were mailed to those lacking Internet connectivity ($n = 20$). A detailed listing of measures has been published.[30]

Background Characteristics

Demographic information collected at enrollment included parent and child race/ethnicity, annual income, and marital status. Data extracted from medical charts included maternal age, prepregnancy weight, gestational weight gain, infant gestational age, and birth anthropometrics.

Sleep

The validated BISQ was used to assess sleep.[33] This survey assesses infant sleep location, before-bedtime activities, and sleep patterns. Sleep duration is divided into nighttime (7 PM–7 AM) and daytime (7 AM–7 PM) and is reported in hours and minutes. Selected questions

TABLE 1 RP Intervention: Sleep Components During First Year

Intervention Component	3–4 Weeks	16 Weeks	28 Weeks	40 Weeks
Bedtime routine				
Consistent routine beginning 30–45 min before bedtime	x	x	x	x
Choose age-appropriate, calm bedtime activity	x	x	x	x
Feeding not the last step before bed	x	x	x	x
Cereal in the bottle does not improve sleep	x	x		x
Offer child choices with routine (eg, choice between 2 books)				
Sleep location and behaviors				
Age-appropriate sleep duration guidance	x	x	x	x
Best bedtime is 7–8 PM	x	x		
Avoid stimulating environment at bedtime (low light, no TV, etc)	x	x		
Use white noise	x	x		
Use swaddle blanket	x			
Pacifier use	x			
Transition to own room by 3 mo	x	x	x	x
Consistently put to bed drowsy but still awake by 4 mo	x	x		
Avoid rocking, feeding to sleep		x	x	
Allow infant some time to self-soothe when put down for night		x	x	x
Nap frequency, duration, and routines		x		x
Strategies for separation anxiety affecting sleep				x
Night waking				
Respond differently night vs day	x			
Stop waking infant routinely to feed	x			
Caretaking behaviors other than feeding: 5 S's[34]	x			
Feed before parent's bedtime: "dream feed"	x			
Avoid "dream feeds" after age 4 mo		x		
Allow infant some time to self-soothe when waking at night		x	x	x
Possible increased frequency around developmental advances		x	x	x
Do not reinforce waking; keep night interactions with child boring		x	x	x
Avoid overnight feeds; infants can sleep 8–12 h without eating			x	
Personalized sleep profile		x		x

5 S's, swaddling, side (or stomach) position, shhhhing, swinging, sucking.

TABLE 2 Demographic Characteristics of Mothers and Infants Who Were Randomized and Received First Nurse Home Visit (n = 279)

	RP (n = 140)	Control (n = 139)
Infant		
Male sex, n (%)	75 (54)	69 (50)
Gestational age (wk), mean (SD)	39.6 (1.2)	39.5 (1.1)
Birth wt (kg), mean (SD)	3.40 (0.43)	3.46 (0.43)
Birth length (cm), mean (SD)	50.9 (2.4)	50.7 (4.5)
Mother		
Age, y, mean (SD)	28.7 (4.6)	28.7 (4.9)
Prepregnancy BMI, mean (SD)	25.5 (5.0)	25.3 (5.6)
Gestational wt gain (kg), mean (SD)	15.6 (6.4)	15.0 (6.0)
Diabetes during pregnancy, n (%)	6 (4.3)	13 (9.4)
Smoked during pregnancy, n (%)	12 (8.6)	9 (6.5)
Race, n (%)		
Black	10 (7.1)	7 (5.0)
White	122 (87.1)	127 (91.4)
Native Hawaiian or Pacific Islander	1 (0.7)	0 (0)
Asian	5 (3.6)	4 (2.9)
Other	2 (1.4)	1 (0.7)
Marital status, n (%)		
Married	102 (72.9)	108 (77.7)
Not married, living with partner	25 (17.9)	19 (13.7)
Single	12 (8.6)	12 (8.6)
Divorced/separated	1 (0.7)	0 (0)
Annual household income, n (%)		
<$10 000	6 (4.3)	5 (3.6)
$10 000–$24 999	10 (7.1)	10 (7.2)
$25 000–$49 999	5 (3.6)	23 (16.6)
$50 000–$74 999	46 (32.9)	26 (18.7)
$75 000–$99 999	32 (22.9)	23 (16.6)
≥$100 000	32 (22.9)	43 (30.9)
Do not know or refuse to answer	9 (6.4)	9 (6.4)
Education, n (%)		
High school graduate or less	16 (11.4)	16 (11.5)
Some college	37 (26.4)	36 (25.9)
College graduate	48 (34.3)	52 (37.4)
Graduate degree or higher	39 (27.9)	35 (25.2)

capturing sleep duration (day and night), location, and night feedings were administered at infant age 2 (baseline), 8, and 52 weeks. An expanded version was completed at 16 and 40 weeks that also included questions on bedtime routine components and duration, infant sleep behaviors and environment, and parenting responses to night wakings. Further questions assessed specific behaviors related to the RP intervention's sleep guidance. A Bedtime Routines Questionnaire[36] was completed at age 52 weeks, with questions about consistency of parenting behaviors before bedtime and consistency of the bedtime environment.

Statistical Analysis

Data were analyzed by using SAS version 9.4 (SAS Institute, Cary, NC). Descriptive statistics were generated for sleep duration, bedtime routine components, sleep location and behaviors, and night wakings. Each outcome variable was assessed for normality. Statistical significance was defined as $P \leq .05$. Bedtime routine data were analyzed by χ^2 and Mantel-Haenszel tests. Effects of study group on sleep duration were analyzed by t tests; effects of sleep behaviors were analyzed as nested effects, along with study group, in analyses of variance, with Tukey's honest significant difference post hoc comparisons used to compare

sleep behavior effects on sleep duration, wakings, and feedings.

RESULTS

Among 279 participants, there were no differences between RP and control groups on demographic or baseline characteristics including feeding mode (Table 2). Mothers were predominantly white, non-Hispanic, married, employed, well-educated, and privately insured at enrollment. At 1 year, 90.7% remained in the study with no significant difference in attrition by study group.

Bedtime Routine and Sleep Behaviors

At baseline 2 weeks after delivery, there were no significant group differences in bedtime routines, sleep location, or sleep behaviors. By the next assessment (8 weeks), differences began to emerge. Reflecting RP intervention content, more RP infants were usually or always allowed to self-soothe to sleep (put to bed for the night while still awake: 35% vs 16%, $P < .001$), as opposed to sometimes, rarely, or never.

The more detailed bedtime routine and sleep behavior data collection at ages 16 and 40 weeks revealed many differences between groups (Table 3). As instructed by the nurses, RP infants were more likely to have shorter bedtime routines beginning ≤45 minutes before bed at 16 (51% vs 37%; $P = .03$) and 40 weeks (57% vs 44%; $P = .04$). Although there were many similar components of bedtime routines between groups including calm activities, RP infants were more likely to be read to at 16 (47% vs 28%; $P = .002$) and 40 weeks (61% vs 49%; $P = .05$). Although nearly all infants were fed as part of their bedtime routine at both 16 and 40 weeks, RP infants were less likely

TABLE 3 Comparison of RP Versus Control on Bedtime Routine and Sleep Behaviors at Ages 16 and 40 Weeks

	16 wk			40 wk		
	RP (n = 134)	Control (n = 128)	P	RP (n = 127)	Control (n = 124)	P
Bedtime routine, %						
Duration ≤45 min	51	37	.03	57	44	.04
Components						
Read book	47	28	.002	61	49	.05
Rocking	67	59	.23	54	54	.89
Bath	61	55	.34	66	69	.65
Music	24	26	.57	24	21	.59
Watch television	13	12	.93	7	12	.13
Bottle feed/breastfeed	94	90	.16	91	92	.85
Fed as last activity before bed	20	40	<.001	22	33	.05
Cereal in bottle	13	18	.37	15	14	.86
Sleep location and behaviors, %						
Bedtime 8 PM or earlier	46	24	<.001	66	47	.002
Sleeps in own room	59	55	.65	80	83	.37
Falls asleep swaddled	33	20	.01	2	1	.57
Falls asleep with pacifier	36	31	.46	35	32	.66
Falls asleep with white noise	30	25	.42	34	21	.02
Falls asleep being held	36	48	.06	21	38	.004
Falls asleep alone in room, in crib (self-soothes)	44	28	.009	59	46	.04
Falls asleep in ≤15 min	66	55	.07	75	64	.06
Night waking, %						
≥2 per night	37	33	.53	28	32	.50
≥2 night feedings	34	30	.50	14	15	.70
Parenting strategies						
Give few minutes to fall back to sleep	56	45	.09	57	56	.93
Pick up and hold/rock back to sleep	35	36	.76	33	48	.02
Rub/pat but do not pick up	24	19	.29	48	27	<.001
Feed back to sleep	54	72	.002	24	41	.005
Give pacifier	41	38	.50	40	35	.42
Change diaper	65	64	.86	35	37	.82
Dream feeds	39	19	<.001	25	10	.001

All analyses used χ^2 or Fisher exact tests as appropriate.

to be fed as the last activity of their bedtime routine at 16 (20% vs 40%; P < .001) and 40 weeks (22% vs 33%; P = .05).

Again reflecting intervention content, RP infants had earlier bedtimes (Fig 1). At 16 weeks, 46% of RP infants went to bed by 8 PM versus 24% of controls (P < .001); the disparity was 66% vs 47% at 40 weeks (P = .002). RP infants were less likely to fall asleep being held at either time point (16 weeks: 36% vs 48%; P = .06; 40 weeks: 21% vs 38%; P = .004) and more likely to self-soothe so sleep (16 weeks: 44% vs 28%; P = .009; 40 weeks: 59% vs 46%; P = .04). RP infants were more likely to be swaddled at 16 weeks (33% vs 20%; P = .01) and listen to white noise at 40 weeks (34% vs 21%; P = .02), whereas pacifier

use was similar between groups at both assessment points. RP mothers were also marginally more likely to report that their infants fell asleep within 15 minutes of being put to bed (16 weeks: P = .07; 40 weeks: P = .06).

Data from the abbreviated BISQ at age 1 year indicated that 61% of RP infants were in bed by 8 PM versus 52% for controls (P = .11). Although this did not reach statistical significance, RP mothers reported using the same bedtime routine every night (55% vs 34%; P = .001), a finding supported by the Bedtime Routines Questionnaire, which demonstrated more consistency for the RP group overall (P = .02) and on Routine Behaviors (P = .05) and Routine Environment (P = .03) subscales.

Sleep Duration

At baseline 2 weeks after birth, mean (SD) nighttime, daytime, and total sleep durations in minutes for the entire study cohort were 485.4 (98.4), 464.9 (99.8), and 951.4 (151.0), respectively, with no study group differences (Fig 2). After interventions were initiated, however, there were significant group differences in reported sleep duration. At 8 weeks, total daily sleep duration was marginally longer in RP infants versus control infants (866.3 ± 130.3 vs 839.2 ± 146.6; P = .10). The intervention affected nighttime sleep specifically; RP group infants slept an average of 532.3 (76.0) minutes overnight compared with 497.2 (90.5) minutes in the control group (P < .001). At 16 weeks, a marginally significant disparity for
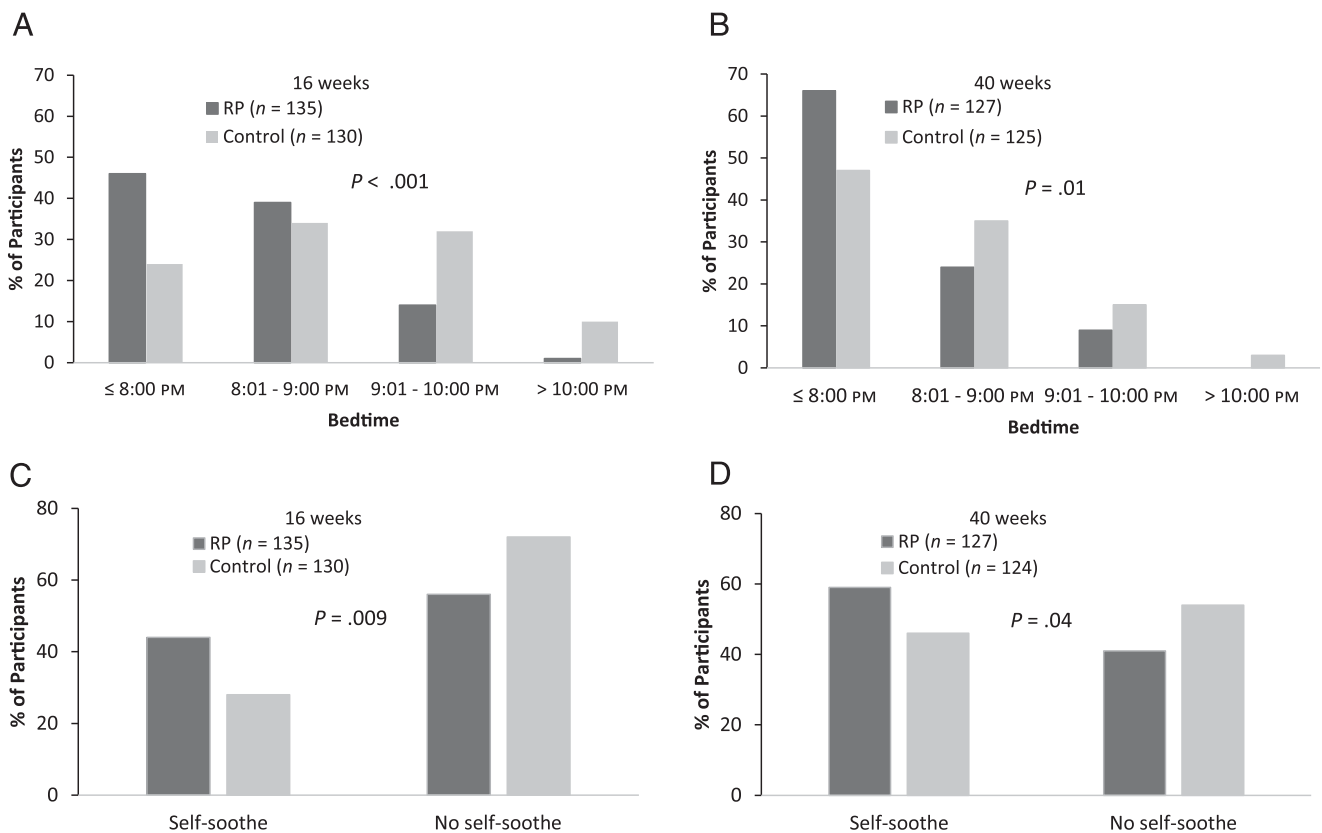
FIGURE 1
Intervention effects on bedtime and infant self-soothing to sleep at 16 and 40 weeks.

total 24-hour sleep duration favored the RP group (808.8 ± 109.3 minutes vs 785.3 ± 110.2 minutes; *P* = .08) with differences explained by the significantly longer nighttime sleep duration (582.1 ± 79.5 minutes vs 557.2 ± 78.6 minutes; *P* = .01). By age 40 weeks, nighttime sleep remained longer for the RP group (624.6 ± 67.6 minutes vs 602.9 ± 76.1 minutes; *P* = .01), but no differences were detected in total 24-hour sleep between groups. There were no intervention effects on daytime sleep at any time point. At age 1 year, daytime and nighttime sleep durations were similar between study groups, although RP infants were marginally more likely to sleep the recommended 12 to 14 hours per day (odds ratio: 1.89, 95% confidence interval: 0.95–3.78). There was no interaction between feeding mode (breastfeeding vs formula feeding) and study group on sleep duration at any study assessment point.

Sleep-related parenting behaviors that were a focus of the RP intervention were associated with increased nighttime sleep duration among the total sample (Fig 3). In particular, 16-week nighttime sleep duration was longest for infants put to bed by 8 PM, regardless of intervention group (607.1 vs 550.0 minutes, *P* < .001). At 40 weeks, infants self-soothing to sleep and who had a bedtime at 8 PM or earlier slept on average 78 minutes longer at night than those who did not self-soothe and had a bedtime later than 8 PM (*P* < .001).

Night Waking and Feeding

At the 2-week baseline and 8-week assessments, no differences existed in parental response to night wakings or number of nighttime feedings. Although night waking and feeding at night were also similar

between groups at 16 and 40 weeks, those in the RP group were more likely to "dream feed" (*P* < .001 and *P* = .001, respectively), a nighttime feed initiated by the parent before the parent's bedtime (RP intervention suggestion for infants <4 months). Parenting behaviors in response to night awakenings also differed; consistent with intervention content, RP mothers were less likely to report feeding their infant back to sleep at 16 (54% vs 72%; *P* = .002) and 40 weeks (24% vs 41%; *P* = .005). Finally, at 40 weeks, these parents were more likely to report soothing their child with methods other than picking up and holding/rocking their infant to sleep.

Across study groups, self-soothing to sleep and earlier bedtimes predicted fewer night waking, fewer nighttime
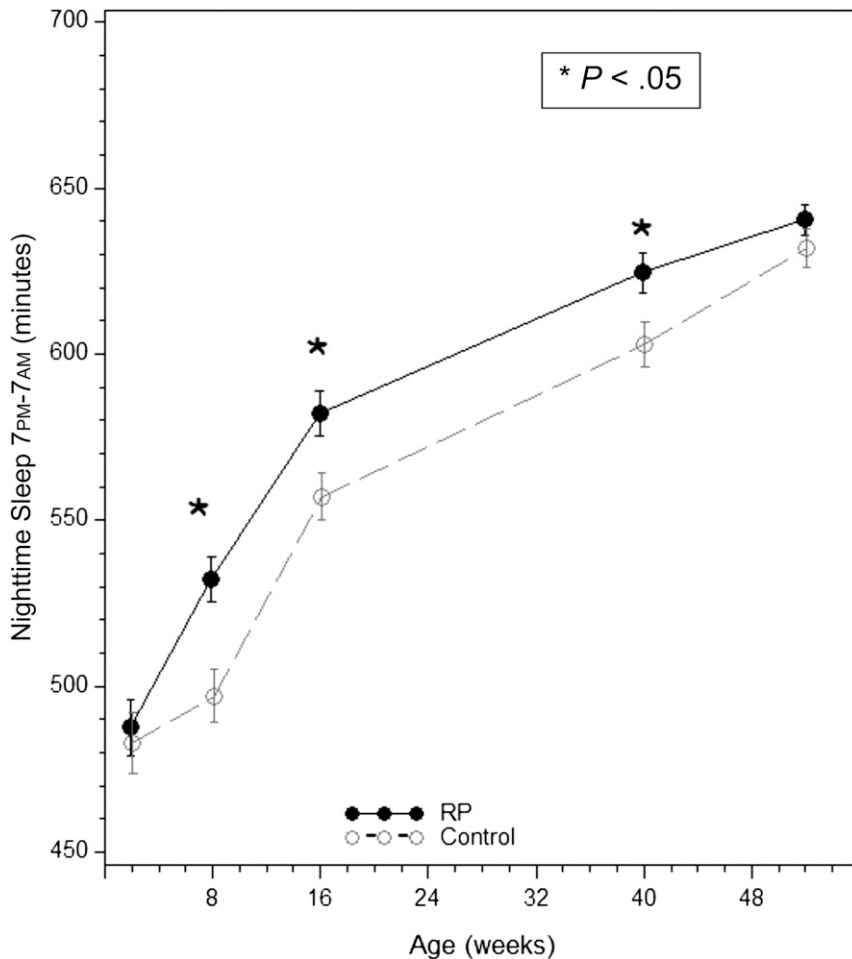
FIGURE 2
Total nighttime sleep duration (7 PM–7 AM) by study group.

feeds, and less time awake at night. At 16 weeks, those with bedtimes after 8 PM who did not self-soothe to sleep woke and fed nearly twice as often as those with earlier bedtimes who self-soothed to sleep (1.85 vs 0.95 wakings, 1.70 vs 0.81 feeds; $P < .001$ for both). At 40 weeks, bedtime was not associated with nighttime feedings or wakings, but self-soothing to sleep was associated with reduced wakings (1.38 vs 0.88; $P < .001$) and feeds (0.89 vs 0.49; $P = .001$) compared with those not self-soothing to sleep. Alternatively, those who had bedtime by 8 PM and self-soothed to sleep had less time awake at night compared with those who did not engage in these behaviors (38 vs 85 minutes; $P < .001$).

DISCUSSION

The INSIGHT RP intervention promoted developmentally appropriate bedtime routines, sleep-related behaviors, and sleep duration, particularly nighttime sleep duration for infants in the first year. In addition to longer reported sleep durations at several time points, RP mothers were more likely to report consistent bedtime routines and earlier bedtimes. Their infants were more likely to self-soothe to sleep without being fed and were less likely to be fed back to sleep after night wakings. These findings are consistent with sleep-related content of the RP intervention, which was designed to promote healthy developmental and behavioral

outcomes, including the protective effect on rapid infant weight gain and overweight at age 1 year that we recently reported.[37]

Improving sleep duration and sleep-related behaviors during infancy can affect infant and family well-being in both the short- and long-term. Infant sleep duration has been associated with toddler sleep duration and numerous other health outcomes.[17,29] For example, Mindell and Lee reported that longer nighttime sleep duration for infants is associated with improved parental perception of infant mood,[38] and difficult bedtimes and short sleep duration affect socioemotional development during the first 2 years and beyond.[3,39] Parental mental health is also adversely affected among infants who have difficult bedtimes or do not sleep well.[7,8]

We included a sleep component in our RP intervention designed for the primary prevention of obesity because previous studies have shown inverse relationships between sleep duration and both dietary intake and weight among infants and young children.[10–13,26,40] In an experiment designed to promote longer nighttime sleep among breastfed infants, treatment group participants slept longer at night and had fewer nocturnal feedings than controls.[26] Data from the Gemini study also supported the inverse relationship between sleep duration and energy intake by demonstrating that 16-month-old children with short sleep durations consumed more calories at night, mostly from milk, versus their peers who slept longer.[40] Recent experimental evidence showed that within individual children, increasing sleep duration resulted in lower energy intake, lower levels of leptin, and lower weight.[15] Although the RP intervention increased nighttime sleep duration, it did not reduce nighttime feedings. However, RP group infants were less likely to be picked up, held, and/or fed back to sleep, which is consistent with
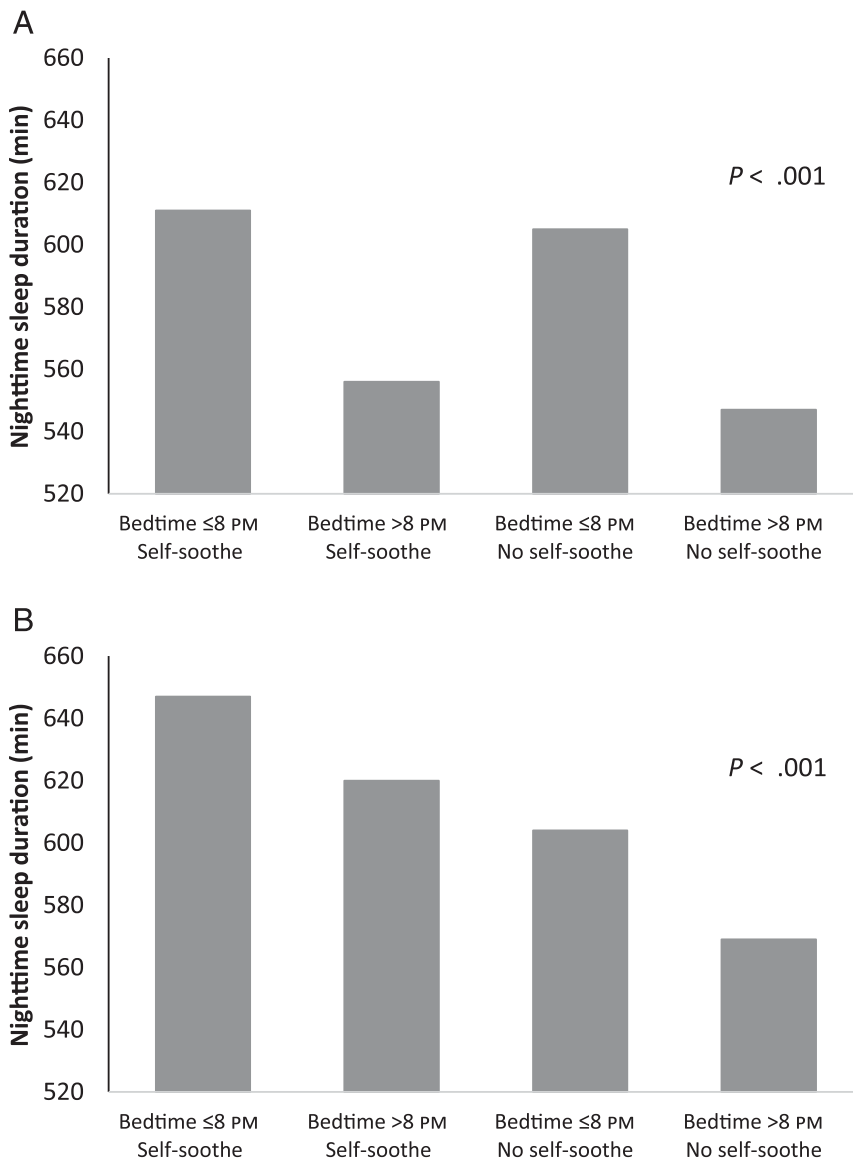
FIGURE 3
Independent and combined effects of bedtime and self-soothing to sleep on nighttime sleep duration among total sample at ages (A) 16 weeks and (B) 40 weeks.

address whether key components of the RP sleep intervention could be delivered as anticipatory guidance in a variety of health care settings and whether findings generalize to sociodemographic groups at increased risk for sleep problems and health disparities.

CONCLUSIONS

These findings reveal that sleep-related behaviors are modifiable during infancy and that those in the RP intervention had longer nighttime sleep duration. Clinicians can inform parents that simple strategies, including a consistent bedtime by 8 PM and allowing infants to self-soothe to sleep without being held, rocked, or fed, are associated with significantly longer nighttime sleep durations, fewer nighttime wakings and feeds, and less time awake at night. RP, which has been associated with other positive developmental outcomes,[42] shows promise for promoting good sleep hygiene and the primary prevention of sleep problems, which could affect related health and wellness outcomes for infants and families.

ABBREVIATIONS

BISQ: Brief Infant Sleep Questionnaire
INSIGHT: Intervention Nurses Start Infants Growing on Healthy Trajectories
RP: responsive parenting

our objective to reduce feeding as the default response to night waking or other infant distress.

Limitations of this study include maternal self-report of all sleep outcome data.[33] However, the BISQ and other sleep questionnaires have shown strong agreement with actigraphy-derived sleep duration.[33,41] Next, social desirability may have influenced some of the findings, given that some survey questions mapped directly onto intervention content. Lastly, the population in central Pennsylvania is relatively homogeneous with all participants coming from 1 center.

Even in this relatively homogeneous sample, findings reveal that although a greater proportion of RP mothers were implementing sleep guidance relative to control, a substantial proportion of RP mothers were not, and future research is needed to identify factors associated with uptake as well as barriers to implementing the RP guidance. Future research could

REFERENCES

1. National Sleep Foundation. *"Sleep in America" Poll*. Washington, DC: National Sleep Foundation; 2004

2. Matricciani LA, Olds TS, Blunden S, Rigney G, Williams MT. Never enough sleep: a brief history of sleep recommendations for children. *Pediatrics*. 2012;129(3):548–556

3. Sivertsen B, Harvey AG, Reichborn-Kjennerud T, Torgersen L, Ystrom E, Hysing M. Later emotional and behavioral problems associated with sleep problems in toddlers: a longitudinal study. *JAMA Pediatr*. 2015;169(6):575–582

4. Ross CN, Karraker KH. Effects of fatigue on infant emotional reactivity and regulation. *Infant Ment Health J*. 1999;20(4):410–428

5. Spruyt K, Aitken RJ, So K, Charlton M, Adamson TM, Horne RS. Relationship between sleep/wake patterns, temperament and overall development in term infants over the first year of life. *Early Hum Dev*. 2008;84(5):289–296

6. Moore M, Mindell JA. The impact of behavioral interventions for sleep problems on secondary outcomes in young children and their families. In: Wolfson A, Montgomery-Downs H, eds. *Oxford Handbook of Infant, Child, and Adolescent Sleep and Behavior*. New York: Oxford Press; 2013:547–557

7. Teti DM, Crosby B, McDaniel BT, Shimizu M, Whitesell CJ. Marital and emotional adjustment in mothers and infant sleep arrangements during the first six months. *Monogr Soc Res Child Dev*. 2015;80(1):160–176

8. Hall WA, Hutton E, Brant RF, et al. A randomized controlled trial of an intervention for infants' behavioral sleep problems. *BMC Pediatr*. 2015;15(1):181

9. Wu Y, Zhai L, Zhang D. Sleep duration and obesity among adults: a meta-analysis of prospective studies. *Sleep Med*. 2014;15(12):1456–1462

10. Fatima Y, Doi SA, Mamun AA. Longitudinal impact of sleep on overweight and obesity in children and adolescents: a systematic review and bias-adjusted meta-analysis. *Obes Rev*. 2015;16(2):137–149

11. Taveras EM, Rifas-Shiman SL, Oken E, Gunderson EP, Gillman MW. Short sleep duration in infancy and risk of childhood overweight. *Arch Pediatr Adolesc Med*. 2008;162(4):305–311

12. Tikotzky L, DE Marcas G, Har-Toov J, Dollberg S, Bar-Haim Y, Sadeh A. Sleep and physical growth in infants during the first 6 months. *J Sleep Res*. 2010;19(1 pt 1):103–110

13. Bell JF, Zimmerman FJ. Shortened nighttime sleep duration in early life and subsequent childhood obesity. *Arch Pediatr Adolesc Med*. 2010;164(9):840–845

14. Taveras EM, Gillman MW, Peña MM, Redline S, Rifas-Shiman SL. Chronic sleep curtailment and adiposity. *Pediatrics*. 2014;133(6):1013–1022

15. Hart CN, Carskadon MA, Considine RV, et al. Changes in children's sleep duration on food intake, weight, and leptin. *Pediatrics*. 2013;132(6). Available at: www.pediatrics.org/cgi/content/full/132/6/e1473

16. Woo Baidal JA, Locks LM, Cheng ER, Blake-Lamb TL, Perkins ME, Taveras EM. Risk factors for childhood obesity in the first 1,000 days: a systematic review. *Am J Prev Med*. 2016;S0749-3797(15)00752-7

17. Touchette E, Petit D, Paquet J, et al. Factors associated with fragmented sleep at night across early childhood. *Arch Pediatr Adolesc Med*. 2005;159(3):242–249

18. Moore T, Ucko LE. Night waking in early infancy. I. *Arch Dis Child*. 1957;32(164):333–342

19. Parmelee AH Jr, Wenner WH, Schulz HR. Infant sleep patterns: From birth to 16 weeks of age. *J Pediatr*. 1964;65:576–582

20. Anders TF, Keener M. Developmental course of nighttime sleep-wake patterns in full-term and premature infants during the first year of life. I. *Sleep*. 1985;8(3):173–192

21. James-Roberts IS, Conroy S, Hurry J. Links between infant crying and sleep-waking at six weeks of age. *Early Hum Dev*. 1997;48(1-2):143–152

22. Glotzbach SF, Edgar DM, Boeddiker M, Ariagno RL. Biological rhythmicity in normal infants during the first 3 months of life. *Pediatrics*. 1994;94(4 pt 1):482–488

23. Joseph D, Chong NW, Shanks ME, et al. Getting rhythm: how do babies do it? *Arch Dis Child Fetal Neonatal Ed*. 2015;100(1):F50–F54

24. Anders TF. Night-waking in infants during the first year of life. *Pediatrics*. 1979;63(6):860–864

25. Adair R, Bauchner H, Philipp B, Levenson S, Zuckerman B. Night waking during infancy: role of parental presence at bedtime. *Pediatrics*. 1991;87(4):500–504

26. Pinilla T, Birch LL. Help me make it through the night: behavioral entrainment of breast-fed infants' sleep patterns. *Pediatrics*. 1993;91(2):436–444

27. Paul IM, Savage JS, Anzman SL, et al. Preventing obesity during infancy: a pilot study. *Obesity (Silver Spring)*. 2011;19(2):353–361

28. Mindell JA, Du Mond CE, Sadeh A, Telofski LS, Kulkarni N, Gunn E. Efficacy of an internet-based intervention for infant and toddler sleep disturbances. *Sleep*. 2011;34(4):451–458

29. Mindell JA, Du Mond CE, Sadeh A, Telofski LS, Kulkarni N, Gunn E. Long-term efficacy of an internet-based intervention for infant and toddler sleep disturbances: one year follow-up. *J Clin Sleep Med*. 2011;7(5):507–511

30. Paul IM, Williams JS, Anzman-Frasca S, et al. The Intervention Nurses Start Infants Growing on Healthy Trajectories (INSIGHT) study. *BMC Pediatr*. 2014;14:184

31. Birch LL, Parker L, Burns A, eds. *Early Childhood Obesity Prevention Policies*. Washington, DC: National Academy of Sciences; 2011

32. Karp H. *Happiest Baby on the Block: The New Way to Calm Crying and Help Your Baby Sleep Longer*. New York, NY: Bantam; 2006

33. Sadeh A. A brief screening questionnaire for infant sleep problems: validation and findings for an Internet sample. *Pediatrics*. 2004;113(6). Available at: www.pediatrics.org/cgi/content/full/113/6/e570

34. Karp H. *The happiest baby on the block*. New York, NY: Bantam Books; 2002

35. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)—a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform*. 2009;42(2):377–381

36. Henderson JA, Jordan SS. Development and preliminary evaluation of the bedtime routines questionnaire. *J Psychopathol Behav Assess*. 2010;32(2):271–280

37. Savage JS, Birch LL, Marini M, Anzman-Frasca S, Paul IM. INSIGHT parenting intervention reduces rapid infant weight gain and overweight at age 1 year. *JAMA Pediatr*. 2016, In press

38. Mindell JA, Lee C. Sleep, mood, and development in infants. *Infant Behav Dev*. 2015;41:102–107

39. Hysing M, Sivertsen B, Garthus-Niegel S, Eberhard-Gran M. Pediatric sleep problems and social-emotional problems. A population-based study. *Infant Behav Dev*. 2016;42:111–118

40. McDonald L, Wardle J, Llewellyn CH, et al. Sleep and nighttime energy consumption in early childhood: a population-based cohort study. *Pediatr Obes*. 2015;10(6):454–460

41. Werner H, Molinari L, Guyer C, Jenni OG. Agreement rates between actigraphy, diary, and questionnaire for children's sleep patterns. *Arch Pediatr Adolesc Med*. 2008;162(4):350–358

42. Eshel N, Daelmans B, de Mello MC, Martines J. Responsive parenting: interventions and outcomes. *Bull World Health Organ*. 2006;84(12):991–998