# Safe Sleep Behaviors and Factors Associated With Infant Second Sleep Practices

Mersine A. Bryan, MD, MPH,<sup>a,b</sup> Alexis Florence, BA ,<sup>a</sup> Aubrey D. Gower, BS,<sup>a</sup> Yolanda N. Evans, MD, MPH,<sup>a,b</sup> Megan A. Moreno, MD, MPH, MSEd<sup>c</sup>

**OBJECTIVES:** To examine the prevalence and safety of infant second-sleep practices.

**METHODS:** A cross-sectional online survey of parents with infants  $\leq 12$  months assessed parentreported sleep practices: position, use of a separate sleep surface, and sleep location at 2 time points (sleep onset and after nighttime waking). A composite score examined if all 3 safe sleep practices were used at each time point. Safe sleep was defined as: supine position, sleeping in a separate space, and in a crib, bassinet, cradle, or playard. Wilcoxon sign rank test was used to examine changes between the time points. Poisson regression models compared parents who reported a second-sleep location with those who did not.

**RESULTS:** Of participants (n = 1500), 74% were female, 65% were White, 12% were Black, and 17% were of Hispanic ethnicity. Thirty-nine percent (n = 581) reported a second-sleep practice. Of parents who reported a second-sleep practice, 28% (n = 137) met all 3 safe sleep criteria at sleep onset; 9% (n = 42) met all 3 safe sleep criteria at both time points. A higher proportion of changes in sleep practices were to less-safe practices (P < .001). Factors associated with a second-sleep practice were parental age <25 years, parental race and ethnicity, first-time parents, homes with smoke exposure, and infants born at <37 weeks.

**CONCLUSIONS:** Less than 10% of infants met all 3 safe sleep criteria at sleep onset and after nighttime waking. Interventions focused on safe sleep should highlight the importance of safe sleep practices after nighttime waking.

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<sup>a</sup>University of Washington, Seattle, Washington; <sup>b</sup>Seattle Children's Research Institute, Seattle, Washington; and <sup>c</sup>Department of Pediatrics, University of Wisconsin-Madison, Madison, Wisconsin

Dr Bryan conceptualized the study design, conducted the data analysis and contributed to the manuscript, and critically revised this to provide key intellectual content; Ms Florence contributed to the study design, interpreted study data, and contributed to the first draft of the manuscript; Dr Evans and Ms Gower contributed to the study design and interpretation of study data, and critically reviewed the manuscript to provide key intellectual content; Dr Moreno contributed to the study design, supervised the data gathering, analysis, and interpretation, and revised the manuscript to provide intellectual content; and all authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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abstract

WHAT'S KNOWN ON THE SUBJECT: Unsafe sleep practices contribute to sleep-related death, an important cause of mortality in infants. One previous small study using video assessment demonstrated that infant sleep practices after nighttime waking are often less safe than at sleep onset.

WHAT THIS STUDY ADDS: In a national survey of parents of infants aged  $\leq 12$  months, we identified that changes in infant sleep practices after nighttime waking are common and are often less safe than practices at sleep onset.

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Sleep-related death is an important cause of infant mortality.<sup>1</sup> Despite the early success of public health campaigns such as "Back to Sleep," there has been a plateau in the reduction of sleep-related death.<sup>2</sup> Unsafe sleep practices, such as prone positioning and bed-sharing, are modifiable factors that increase the risk of sleep-related death.<sup>3–5</sup> The American Academy of Pediatrics (AAP) guidelines recommend safe sleep practices including: supine positioning, separate sleep spaces, and approved sleep surfaces such as cribs.<sup>3</sup> Despite these recommendations, previous studies demonstrate that many parents frequently use unsafe sleep practices.<sup>3,6-9</sup>

Though nighttime waking is common for infants,<sup>6,10</sup> less attention has been paid to the safety of second-sleep practices. One video study reported 28% of infants had a second-sleep location, and 91% of second-sleep locations were unsafe (eg, bed-sharing or using an unapproved surface).<sup>6</sup> Despite the potential risk of unsafe second-sleep practices, the safety of second-sleep practices after nighttime waking has yet to be fully explored.

Previous studies have identified differences in infant sleep practices by demographic characteristics including race, ethnicity, maternal age, and infant age.<sup>9,11–15</sup> These differences are particularly important in light of continued disparities in rates of sleep-related mortality in non-Hispanic Black infants.<sup>16,17</sup> However, no studies have specifically explored the associations between demographic characteristics and the use and safety of second-sleep practices.

The primary objective of this study was to examine infant second-sleep practices and to assess the safety of second-sleep practices consistent with the AAP Safe Sleep

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recommendations. Our secondary objective was to examine the associations between parent demographic characteristics and the use and safety of second-sleep practices.

## **METHODS**

We conducted a cross-sectional survey of a national sample of parents with infants aged  $\leq 12$ months between March 6, 2018, and April 9, 2018. This study was conducted online; all recruitment and data collection were completed using Qualtrics, a web-based survey platform. This study was approved by the University of Wisconsin-Madison institutional review board.

## Recruitment

The target study population was a diverse sample of 1500 parents of children aged  $\leq 12$  months. We recruited via Qualtrics survey panels. Qualtrics recruits panel members using web-based advertisements. Qualtrics collects demographic characteristics from participants at the time of enrollment. A background check is completed to verify the participants' identities before panel enrollment. Once participants are part of the Qualtrics panel, they are invited to complete surveys for which they are eligible. For each survey completed, participants receive credit toward rewards. Compared with traditional approaches, online survey panels such as Qualtrics allow for lower cost and larger sampling pools.<sup>18</sup> Sampling parameters for this study aimed to represent the geographic distribution by region (Northeast, South, Midwest, and West) and the racial and ethnic distribution representative of the US census population. Online survey methods such as Qualtrics can achieve demographic attributes that are within a 10% range of their corresponding values in the US population.<sup>19,20</sup>

A Qualtrics survey manager contacted eligible parents of infants aged ≤12 months between March and April 2018 via e-mail. Englishspeaking participants were included. Participants completed informed consent electronically before participation. Parents were asked about their infant sleep practices and to report demographic characteristics. Participants who completed the survey received an incentive through Qualtrics.

## **Measures**

Our primary outcome was to examine the safety of parentreported infant sleep practices at two time points: (1) sleep onset, and (2) after nighttime waking. We assessed the safety of a sample of 3 sleep practices by comparing parent-reported sleep practices, including (1) sleep position, (2) use of a separate sleep space, and (3) use of an approved sleep surface, to AAP safe sleep recommendations for these practices. Our secondary outcome was to examine the demographic characteristics associated with second-sleep practices and adherence to AAP safe sleep recommendations.

## **Survey Development**

We adapted questions from previously published surveys including the National Infant Sleep Position Study, the Pregnancy Risk Assessment Monitoring System and the Study of Attitudes and Factors Effecting Infant Care.<sup>11,21–25</sup> Questions measured parent-report of (1) infant sleep position (supine, side, or stomach), (2) use of a separate sleep space or bed-sharing, and (3) where their infant slept (eg, crib, or adult bed). Adapted questions were reviewed by an expert panel, including sleep medicine and health services researchers, and pilot-tested by a sample of 50 parents. Participants were asked if they had put their

infant back to sleep in a different place or location after nighttime waking in the past 2 weeks. They were asked to report sleep practices at two time points: sleep onset and after nighttime waking. Second-sleep practices were defined as the parent-reported sleep practice after nighttime waking. Based on the AAP 2016 Safe Infant Sleep Guidelines, safe sleep parameters were if parents reported that the infant slept: (1) supine, (2) in a separate sleep space, and (3) on an approved sleep surface (eg, bassinet, crib, cradle, or playard).<sup>3</sup> For participants who reported different infant sleep practices at the 2 time points, the safety of each time point was evaluated independently. We generated a composite score that examined if all 3 safe sleep behaviors (supine, separate sleep space, and approved surface) were used at both time points.

Participants were asked to report demographic characteristics including: infant age in months, parent age category in years, parent sex, infant sex, parent race or ethnicity, parent education, marital status, the number of children the parent had, whether anyone in the home smokes, whether the infant was preterm (<37 weeks' gestation), and infant birth weight. Infant age was examined as a continuous variable and a categorical variable (0–3, 4–6, or  $\geq$ 7 months).<sup>4</sup> We asked parents how many nights a week they were the primary caretaker of the infant (Supplemental Fig 1).

## **Analysis**

We calculated the proportion of participants who reported a secondsleep practice and the proportion of participants who adhered to AAP recommendations for each of the 3 sleep practices. Of participants who reported a second-sleep practice, we compared the proportion of parents who reported changes from a safe first-sleep practice to an unsafe second-sleep practice with the proportion who reported an unsafe first-sleep practice to a safe secondsleep practice using the Wilcoxon sign rank test for each practice and the composite score. We estimated prevalence ratios using multivariable Poisson regression models with robust variance to examine the association between each sleep practice and the composite score at each time point.<sup>26</sup> All models were adjusted for infant age in months, categorical parent age in years, parent race and ethnicity, parent education, geographic region, whether anyone in the home smoked, whether the infant was born <37 weeks' gestation, and the number of nights participants reported being the primary caretaker (dichotomized to 7 and <7). We included the primary caretaker variable because we sought to quantify the respondent's engagement with the infant's sleep practices.

Summary statistics were used to examine the demographic characteristics for all participants. We compared the demographic variables by whether participants reported a second-sleep practice using bivariate and multivariable Poisson regression models with robust variance to estimate prevalence ratios.<sup>26</sup> Lastly, we compared the demographic characteristics of participants who reported meeting each safe sleep criteria and the safe sleep composite to those who did not at each time point independently using bivariate and multivariable Poisson regression models with robust variance.

## **Sensitivity Analysis**

We conducted a sensitivity analysis for infants aged  $\leq 3$  months because infants in this age range are at the highest risk for sleep-related death. We examined the proportion of parents who reported a change in sleep practice and the safety of each practice at both time points as described above.

## **RESULTS**

Of 1500 respondents, 39% (n = 581) reported a second sleep practice the previous night (Table 1).

### **Supine Positioning**

Sixty-seven percent of participants placed their infant supine at sleep onset. Of those who reported a second sleep position (n = 564), 42% (n = 239) of parents placed their infant supine at both time points. Thirteen percent (n = 75) of parents who placed their infant supine at the first time point did not after nighttime waking compared with 7% (n = 37) who changed from nonsupine to supine positioning (P < .001). Participants who reported supine positioning at the first time point had a higher adjusted prevalence of placing their infant supine after nighttime waking (adjusted prevalence ratio [aPR] 4.5 [95% confidence interval (CI) 3.3-6.1]) (Table 1).

## **Sleeping in a Separate Space**

Of all participants, 72% (n = 1036) used a separate sleep space at sleep onset. Of those who reported a second-sleep space (n = 508), 63% (n = 322) used a separate space at sleep onset, and 54% (n = 272) of infants slept in a separate space after nighttime waking. Eighteen percent of infants (n = 93) who used a separate space at sleep onset slept with another person after nighttime waking; 8% (n = 43) of infants whose first-sleep space was shared slept in a separate space after nighttime waking (P < .001). Participants who reported that their infant slept in a separate space at sleep onset had a higher adjusted prevalence of reporting a separate space after nighttime waking (aPR 2.5 [95% CI 2.0-3.0]) (Table 1).

	<b>TABLE 1</b>	Parent-Report	of Infant First-	and Second-Slee	o Practices at th	e First and Se	econd Time Point
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	Total		Total	
First sleep practice	n (%)	Second-Sleep Practice	n (%)	aPR (95% CI)
Supine positioning	1481		564 (38)	
Back at first time point	998 (67)	Back	239 (42)	4.5 (3.3-6.1)*
		Not back	75 (13)*	
Not back at first time point	482 (33)	Back	37 (7)*	
		Not back	213 (38)	
Separate-sleep space	1441		508 (35)	
Separate sleep space at first time point	1036 (72)	Separate to separate	229 (45)	2.5 (2.0–3.0)*
		Separate to shared	93 (18)*	
Shared sleep space at first time point	405 (28)	Shared to separate	43 (8)*	
		Shared to shared	143 (28)	
Location	1470		560 (38)	
Crib <sup>a</sup> at first time point	1042 (71)	Crib to crib	176 (31)	1.9 (1.5-2.4)*
		Crib to not crib	168 (30)*	
Not Crib <sup>a</sup> at first time point	428 (29)	Not crib to crib	57 (10)*	
		Not crib to not crib	159 (28)	
Composite score <sup>b</sup>	1402		482 (34)	
Safe at first time point	617 (44)	Safe to safe	42 (9)	3.6 (2.4–5.6)*
		Safe to not safe	95 (20)*	
Not safe at first time point	785 (56)	Not safe to safe	28 (6)*	
		Not safe to not safe	317 (66)	

All models were adjusted for infant age in months, categorical parent age in years, parent race and ethnicity, parent education, geographic region, whether anyone in the home smoked (dichotomized as yes/no), whether the infant was born before 37 weeks (dichotomized as yes/no), and the number of nights participants reported being the primary caretaker (dichotomized to 7 and <7). \* P < 001

<sup>a</sup> Crib includes crib, bassinet, cradle, or playard; not crib includes adult bed, sofa, cosleeper, infant swing, car seat, in the arms of a caregiver.

<sup>b</sup> Composite score includes all 3 infant safe sleep parameters: on back, in a separate sleep space, on an approved sleep surface (crib/bassinet/cradle/playard).

#### **Sleep Location**

Seventy-one percent of respondents used an approved sleep surface at sleep onset. Of parents who reported sleep location at both time points (n = 560), 61% (n = 344)used an approved surface at sleep onset, and 42% (n = 233) reported an approved surface after nighttime waking. Thirty percent (n = 168) of infants were moved from a safe to an unsafe location; 10% (n = 57) of infants were moved from an unsafe to a safe location at the second time point (P < .001). Participants who reported an approved location at sleep onset had a higher adjusted prevalence of using an approved location after nighttime waking (aPR 1.9 [95% CI 1.5-2.4]) (Table 1).

#### **Safe Sleep Composite**

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Forty-four percent of participants met all 3 safe sleep practices at sleep onset. Of participants who reported all 3 sleep practices at both time points (n = 482), 29% (n = 137) met all 3 safe sleep criteria at sleep onset; 9% (n = 42) met all 3 safe sleep criteria at both time points. Twenty percent (n = 95) of participants changed from using all 3 safe sleep practices to not using them after nighttime waking; 6% (n = 28) of participants did not meet all 3 safe sleep criteria at sleep onset and met safe sleep criteria after nighttime waking (P <.001). Participants who used all 3 safe sleep practices at sleep onset had a higher adjusted prevalence of using all 3 safe sleep practices after nighttime waking (aPR 3.6 [95% CI 2.4–5.6]) (Table 1).

## **Demographic Characteristics**

Of 1500 participants, the mean infant age was 6.6 months (SD 3.3 months); 24% of infants were  $\leq$ 3 months. Seventy-four percent of participants were women. Sixty-five percent identified as White, 12% identified as Black, and 17% identified as of Hispanic ethnicity. The most common parent age categories were 25 to 29 and 30 to 34 years (30% each) (Table 2). In multivariable models, parents in age categories  $\geq$  30 years had a lower prevalence of reporting a second-sleep practice. Participants who identified as Black non-Hispanic and of Hispanic ethnicity had a higher prevalence of reporting a second-sleep practice. Parents with a 4-year degree or higher education level reported a higher prevalence of second-sleep practices. Infants born at <37 weeks' gestation, first-born children, and children with smokers in the home had a higher prevalence of second-sleep practices. There was a higher prevalence of participants reporting a second-sleep practice when they identified as the primary caregiver <7 nights per week. There were no differences by infant age, parent sex, infant sex, birth weight, or marital status (Table 2).

Of 1402 participants who reported all 3 sleep practices at sleep onset, 44% (n = 617) met all 3 safe sleep

	<b>TABLE 2</b> Demographic Characterist	cs of the Study Population	and By Parent-Report o	f a Second-Sleep Practice
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	Total Population	No Second Practice	Second Practice		
	n = 1500 n (%)	n = 886 n (%)	n = 581 n (%)	Prevalence Ratio (95% Cl	) aPR No. (95% Cl)
Mean age in mo (SD)	6.6 (3.3)	6.8 (3.3)	6.2 (3.4)	1.0 (0.9-1.0)***	1.0 (1.0-1.0)
Infant age category, mo		()	(,		
0–3	319 (24)	173 (22)	146 (28)	Ref	Ref
4–6	408 (31)	240 (30)	168 (32)	0.9 (0.8-1.1)	1.0 (0.9-1.2)
7–12	606 (45)	391 (49)	215 (41)	0.8 (0.7-0.9)**	0.9 (0.8-1.1)
Parent age category, y					
18–24	246 (16)	127 (14)	114 (20)	Ref	Ref
25–29	452 (30)	254 (29)	182 (31)	0.9 (0.7-1.0)	0.8 (0.7-1.0)*
30–34	451 (30)	287 (32)	158 (27)	0.8 (0.6-0.9)**	0.8 (0.7-1.0)*
35–39	239 (16)	148 (17)	87 (15)	0.8 (0.6-1.0)*	0.8 (0.6-1.0)*
>40	112 (7)	70 (8)	40 (7)	0.8 (0.6-1.0)	0.8 (0.6-1.1)
Parent sex (% female)	1113 (74)	694 (78)	400 (69)	0.8 (0.7-0.9)***	1.0 (0.9–1.2)
Infant sex (% female)	690 (46)	429 (49)	248 (43)	0.9 (0.8-1.0)*	0.9 (0.8-1.0)
Race/ethnicity					
White Non-Hispanic	968 (65)	608 (69)	342 (59)	Ref	Ref
Black Non-Hispanic	186 (12)	103 (12)	79 (14)	1.2 (1.0-1.5)*	1.3 (1.1–1.5)*
Hispanic	260 (17)	129 (15)	123 (21)	1.4 (1.2-1.6)***	1.4 (1.2–1.6)***
Other/Asian American/	86 (6)	46 (5)	37 (6)	1.2 (1.0-1.6)	1.3 (1.0–1.6)
American Indian					
Parent education					
High school or less	321 (21)	200 (23)	110 (19)	Ref	Ref
Some college/2-y degree	487 (32)	289 (33)	192 (33)	1.1 (0.9–1.4)	1.2 (1.0–1.4)
4-y degree	395 (26)	238 (27)	147 (25)	1.1 (0.9–1.3)	1.3 (1.1–1.6)*
Graduate school or more	289 (19)	157 (18)	128 (22)	1.3 (1.0–1.5)*	1.4 (1.2–1.8)***
Prefer not to answer/missing	8 (1)	2 (0)	4 (1)	—	_
Region	7 (0, (0, 1)	(= ( (00)		<b>P</b> (	
Midwest	312 (21)	174 (20)	138 (24)	Ref	Ret
Northeast	327 (22)	188 (21)	139 (24)	1.0 (0.8–1.1)	0.9 (0.8–1.1)
South	481 (33)	296 (33)	185 (32)	0.9 (0.7-1.0)	0.8 (0.8-1.1)
West	347 (24)	228 (26)	119 (20)	U.8 (U.6-U.9)** 1.0 (1.4 1.9)***	0.8 (0.6-0.9)**
Preterm delivery (yes/no)	241 (16)	100 (11)	136 (24)	1.6 (1.4–1.8)****	1.4 (0.2–1.6)****
	500 (30)	710 (76)	060 (45)	Dof	Dof
1	JOD (JJ)	313 (30)	202 (43)	NUI	NCI NCI NCI
2	40Z (JZ)	145 (16)	107 (27)	$0.7 (0.0-0.3)^{+++}$	10(0.0-0.9)
5	200 (17)	143 (10)	58 (10)	0.9 (0.6-1.1)	1.0 (0.0-1.1)
_4 Unknown	8 (1)	107 (12)	<i>A</i> (1)	0.0 (0.0-1.0)	0.0 (0.0-1.0)
Infant's weight Ihs	0 (1)	4 (0)	4 (1)		
 	321 (21)	157 (17)	156 (27)	Ref	Ref
6-7	408 (27)	250 (28)	145 (25)	0.7 (0.6-0.9)***	0.8 (0.7–1.0)
7-8	426 (28)	254 (29)	163 (28)	0.8 (0.7-0.9)**	10 (0.8-1.2)
>8	340 (23)	223 (25)	114 (20)	0.7 (0.6-0.8)***	0.9(0.7-1.1)
Unknown	5 (0)	2 (0)	3 (1)		_
Marital status	- (0)	- (-)	- (1)		
Married	1158 (77)	685 (77)	448 (77)	1.0 (0.9-1.2)	1.0 (0.9-1.2)
Not married	336 (22)	200 (23)	129 (22)	Ref	Ref
Unknown	6 (0)	1 (0)	4 (1)		
Smoking (yes)	273 (19)	124 (14)	149 (26)	1.5 (1.3-1.7)***	1.3 (1.1–1.5)***
How many nights are you the					
primary caretaker of the					
infant?					
<6	421 (28)	194 (22)	216 (37)	Ref	Ref
7	1073 (72)	681 (78)	361 (62)	0.7 (0.6-0.7)***	0.7 (0.7-0.9)***
Missing	6 (1)	1 (0)	4 (1)		

Data were missing for n = 33, whether they moved infant to a second location. Percentages may not add up to 100% because of rounding and missing data. All models are adjusted for region, categorical infant age, birth weight, parity, parentage category, education, and race and ethnicity. \* P < .05, \*\* P < .01, \*\*\* P < .001. Ref, reference value; ---, not applicable.

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criteria. After nighttime waking, 521 (35%) parents reported all 3 sleep practices, with 14% (n = 72) meeting all 3 safe sleep criteria. There was a higher adjusted prevalence of participants aged 30 to 34 and >40 years meeting all 3 safe sleep criteria at sleep onset, but lower prevalence of safe sleep after nighttime waking for parents aged 30 to 34 years. Female participants had a higher adjusted prevalence of meeting all 3 safe sleep criteria at sleep onset, with no difference after nighttime waking. Compared with White non-Hispanic participants, participants who identified as Black non-Hispanic and other had a similar prevalence of meeting all 3 safe sleep criteria at sleep onset, and a higher prevalence after nighttime waking. Parents of infants who were born preterm and those with a smoker in the home had a lower adjusted prevalence of meeting all 3 safe sleep criteria at sleep onset only. Participants who identified as the primary caretaker 7 nights per week had a higher prevalence of meeting all 3 safe sleep criteria at sleep onset only. There were no differences in the adjusted prevalence of meeting all 3 safe sleep criteria by infant age, infant sex, parent education, geographic region, the number of children, or marital status at either time point (Table 3, Supplemental Table 5).

## **Sensitivity Analysis**

In infants aged  $\leq 3$  months, we identified similar findings to the primary analysis for each individual sleep practice; there were no statistically significant differences for the composite score (Table 4).

## DISCUSSION

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We conducted an online crosssectional survey of a large, nationally representative sample of parents to examine infant sleep practices at 2 time points: sleep onset and after nighttime waking. We identified that 39% of parents report changes in their sleep practices after nighttime waking. We compared sleep practices at both time points to the AAP Safe Sleep guidelines<sup>3</sup> for supine positioning, sleeping in a separate space, and sleep location. Less than half (44%) of parents adhered to all 3 safe sleep recommendations and a significantly larger proportion of changes in sleep practices were from a safe to an unsafe sleep practice, similar to a previous video study.<sup>6</sup>

One of the strengths of this study is that we enrolled a large, diverse, geographically representative sample of parents of infants aged  $\leq$ 12 months. The previous study on this topic enrolled only infants aged  $\leq$ 6 months and identified that, at 6 months of age, there were frequently changes to less safe sleep practices overnight.6 In our sensitivity analysis, we had similar findings when examining infants aged  $\leq$ 3 months compared with the entire sample. Although many studies have focused on interventions to promote safe sleep in young infants (<4 months),<sup>27-30</sup> to our knowledge, these interventions have not focused on the safety of second-sleep practices after nighttime waking. We identified that parents who reported a safe sleep practice at sleep onset had a higher adjusted prevalence of reporting a safe sleep practice after nighttime waking. Thus, we hypothesize that expansion of existing strategies to promote infant safe sleep practices to include sleep practices after nighttime waking can have a positive impact on infant safe sleep.

This study is the first to our knowledge to examine the demographic characteristics associated with a change in sleep practices after nighttime waking and the safety of second-sleep practices. Parent characteristics including age <25 years, first-time parents, parents who identified as Black non-Hispanic or Hispanic ethnicity, parent education, smoking, and infants born at <37 weeks' gestation were associated with second-sleep practices after nighttime waking. These findings highlight that many parents may benefit from discussion with their pediatrician specifically focused on the importance of continued safe sleep practices after nighttime waking.

When we examined the safety of sleep practices using the composite score, a higher prevalence of parents aged >30 years and who were the primary caretaker 7 nights per week met all 3 recommended safe sleep practices at sleep onset. Households with cigarette smoke exposure and babies born <37 weeks' gestation had a lower prevalence of meeting all 3 safe sleep criteria at sleep onset, which is particularly important because these populations are at higher risk of sleep-related death.<sup>1,4</sup> These findings are similar to other studies examining the relationship between demographic characteristics and sleep practices.<sup>9,11-15</sup> Unlike previous studies, we included how many nights per week the respondent was the primary caretaker of the infant. The higher prevalence of safe sleep practices by parents who care for their infants 7 nights per week may reflect better knowledge of safe sleep practices or development of sleep practice patterns after nighttime wakings and is worthy of future investigation.

Interestingly, we identified effect modification by parent age, race, and ethnicity. Parents aged >30 years had a higher prevalence of meeting all 3 safe sleep criteria at sleep onset and a lower prevalence after

## TABLE 3 Demographic Variables Associated With Safe sleep Composite Score

	Met all 3 Safe sleep Criteria At First Time Point $n = 617$	Did Not Meet All 3 Safe sleep Criteria At First Time Point	Adjusted Prevalence	Met All 3 Safe sleep Criteria At Second Time Point $n = 72$	Did Not Meet All 3 Safe sleep Criteria At Second Time Point $n = 449^{a}$	Adjusted Prevalence Ratio
	n (%)	n = 785 n (%)	Ratio (95% CI)	n (%)	n (%)	(95% CI)
Mean age in mo (SD) Infant age category,	6.7 (3.2)	6.4 (3.5)	1.0 (1.0–1.0)	6.6 (3.7)	6.1 (3.3)	1.0 (0.9–1.1)
mo						
0-3	122 (22)	183 (25)	Ref	18 (26)	117 (28)	Ref
4-6	159 (29)	231 (32)	1.0 (0.8–1.1)	17 (25)	137 (33)	0.6 (0.3-1.1)
7–12	274 (49)	308 (43)	1.1 (0.9–1.3)	33 (49)	158 (38)	1.0 (0.6–1.6)
Parent age category						
18–24	84 (13)	146 (19)	Ref	20 (28)	80 (18)	Ref
25-29	173 (28)	249 (32)	1.1 (0.9–1.4)	25 (35)	137 (31)	0.9 (0.5–1.6)
30-34	214 (35)	208 (26)	1.3 (1.1–1.6)	11 (15)	130 (29)	0.5 (0.2-0.9)
SS−S9	97 (16)	129 (16)	1.2 (0.9 - 1.5)	8 (11)	73 (16)	0.7 (0.3 - 1.5)
>4U Depent pay (% female)	49 (8)	55 (7) 550 (57)	1.4 (1.1 - 1.9) 1.0 (1.0 1.5)*	8 (11) 59 (10)	29 (6)	1.5 (0.7-5.4)
Infant any (% female)	492 (47)	345 (53)	1.2(1.0-1.3)	30 (10)	JUZ (04)	1.1 (0.0-2.1)
Paco/othnicity	303 (47)	343 (33)	1.1 (1.0-1.2)	56 (17)	104 (03)	1.0 (0.0-1.9)
White Non-Hispanic	423 (69)	481 (61)	Ref	32 (44)	279 (62)	Ref
Black Non-Hispanic	68 (11)	107 (14)		14 (19)	58 (13)	18 (10-32)*
Hisnanic	93 (15)	151 (19)	0.9 (0.7-1.0)	19 (26)	87 (19)	1.5 (0.8–2.8)
Other/Asian	33 (5)	46 (6)	0.9 (0.6-1.1)	7 (10)	25 (6)	2 4 (1 2-4 7)*
American/	00 (0)	10 (0)	0.0 (0.0 1.1)	. (,	20 (0)	2 (2)
American Indian						
Parent education						
High school or less	122 (20)	179 (23)	Ref	14 (20)	75 (17)	Ref
Some college/2-y	197 (32)	255 (33)	1.0 (0.9-1.2)	29 (41)	149 (33)	1.0 (0.5-1.8)
degree						
4-year degree	184 (30)	190 (24)	1.1 (0.9–136)	19 (26)	117 (26)	0.8 (0.4-1.6)
Graduate school or	113 (18)	157 (20)	0.9 (0.7-1.1)	9 (13)	105 (24)	0.7 (0.3-1.6)
more						
Prefer not to	1 (0)	4 (0)	—	1 (0)	3 (0)	—
answer/missing						
Region						
Midwest	126 (20)	168 (21)	Ref	16 (22)	106 (24)	Ref
Northeast	129 (21)	178 (23)	1.0 (0.8–1.2)	12 (17)	112 (25)	0.7 (0.4–1.2)
South	200 (32)	269 (34)	1.0 (0.8-1.1)	29 (40)	141 (31)	0.5 (0.2 - 1.0)
West Distance delivery (vec)	162 (26)	170 (22)	1.1 (1.0 - 1.3)	15 (21)	90 (20)	1.1(0.3-2.3)
Preterni delivery (yes)	12 (12)	146 (19)	0.0 (0.7-1.0)	11 (10)	107 (24)	0.0 (0.4-1.3)
1	244 (40)	301 (38)	Dof	30 (54)	102 (13)	Pof
2	244 (40)	253 (32)		17 (24)	122 (40)	0.7 (0.4 - 1.2)
3	95 (15)	146 (19)	0.8 (0.7-1.0)	7 (10)	85 (19)	0.5 (0.2 - 1.0)
≥4	74 (12)	82 (10)	1.0 (0.8 - 1.2)	8 (11)	48 (11)	1.0 (0.5-2.1)
Unknown	4 (0)	3 (0)		1 (1)	2 (0)	
Infant's weight, Ibs						
<6	123 (20)	171 (22)	Ref	23 (32)	114 (25)	Ref
6-7	161 (26)	220 (28)	0.9 (0.8-1.1)	21 (29)	110 (25)	0.9 (0.5-1.5)
7–8	184 (30)	218 (28)	0.9 (0.8-1.1)	18 (25)	124 (28)	0.6 (0.3-1.1)
>8	148 (24)	174 (22)	0.9 (0.7-1.1)	8 (11)	100 (22)	0.4 (0.2–0.8)**
Unknown	1 (0)	2 (0)	_	2 (3)	1 (0)	—
Marital status						
Not married	126 (20)	188 (24)	Ref	14 (20)	96 (22)	Ref
Married	490 (80)	596 (76)	1.1 (0.9–1.3)	57 (80)	350 (78)	1.6 (0.8–2.8)
Unknown	1 (0)	1 (0)		1 (0)	3 (0)	—
Smoking (yes)	80 (31)	176 (69)	0.8 (0.6–0.9)**	11 (15)	60 (85)	0.6 (0.3–1.2)
How many nights are						
you the primary						
caretaker of the infant?						

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	Met all 3 Safe sleep Criteria At First Time Point <i>n</i> = 617 <i>n</i> (%)	Did Not Meet All 3 Safe sleep Criteria At First Time Point n = 785 n (%)	Adjusted Prevalence Ratio (95% Cl)	Met All 3 Safe sleep Criteria At Second Time Point <i>n</i> = 72 <i>n</i> (%)	Did Not Meet All 3 Safe sleep Criteria At Second Time Point $n = 449^{a}$ n (%)	Adjusted Prevalence Ratio (95% Cl)
<7	137 (22)	238 (30)	Ref	17 (24)	170 (38)	Ref
7	77 (78)	545 (70)	1.2 (1.1–1.4)**	55 (76)	275 (61)	1.7 (1.0-3.1)
Missing	43 (0)	2 (0)	_	0 (0)	4 (1)	—

Safe sleep criteria included supine positioning, sleeping on a separate surface, and sleep location of a crib, bassinet, or playard. All models were adjusted for infant age, parent age category, parent race and ethnicity, parent education, geographic region, preterm delivery, whether anyone in the home smoked cigarettes, and the number of nights per week the respondent was the primary caregiver (dichotomized to 7 and <7). Percentages may not add up to 100% because of rounding and missing data. \*P < 05, \*\*P < 01, \*\*\*P < 001. Ref, reference value; —, not applicable.

<sup>a</sup> Thirty-nine participants had a complete second-sleep composite score, but an incomplete first-sleep composite score, thus are missing from Table 2.

nighttime waking. It is possible that parents have intentions to adhere to safe sleep recommendations at sleep onset, which change because of fatigue after nighttime wakings. Conversely, Black non-Hispanic parents and parents of Hispanic ethnicity had a higher prevalence of meeting all 3 safe sleep criteria after nighttime waking. When advising families about infant sleep, pediatricians should discuss nighttime wakings with parents because they are common and reinforce the need for safe sleep practices every time. Using our findings to foster safe sleep education that includes evidencebased recommendations with respect for ethnic and cultural practices could improve safe sleep habits and foster trust between parent and health care provider.

#### Limitations

There are several limitations of this study. First, we sampled parents using an online survey platform. Although this method offers a broader reach compared with traditional approaches,<sup>18</sup> it is only available to parents enrolled in Qualtrics panels with internet and computer access. This study relied on self-report and only asked parents to report 2 time points. Parents who have previously received education about safe sleep may be more likely to report safe sleep practices because of prosocial bias. There are factors that could influence the safety of second-sleep

TABLE 4 Sensitivity Analysis of Parent-Report of Infant First- and Second-Sleep Practices for Infants ≤3 Months Old

Sleep Practice	Total <i>n</i> (%)		Total <i>n</i> (%)	aPR (95% CI)
Supine positioning	323	Second time point	141 (44)	
Back first time point	214 (66)	Back	53 (38)	10.4 (3.6-29.4)***
Not back	15 (11)*			
Not back at first time point	109 (34)	Back	4 (3)*	
Not back	69 (49)			
Separate sleep space	320		136 (43)	
Separate sleep space at first time point	252 (79)	Separate to separate	81 (60)	3.5 (2.1-5.8)***
Separate to shared	20 (15)*			
Shared sleep space at first time point	68 (21)	Shared to separate	8 (6)*	
Shared to shared	25 (18)			
Location	315		136 (43)	
Crib <sup>a</sup> at first time point	215 (68)	Crib to crib	53 (39)	1.6 (1.1-2.4)**
Crib to not crib	28 (21)			
Not crib <sup>a</sup> at first time point	100 (32)	Not crib to crib	22 (16)	
Not crib to not crib	33 (24)			
Composite score <sup>b</sup>	305		124 (41)	
Safe at first time point	122 (40)	Safe to safe	8 (6)	3.1 (1.0-9.9)
Safe to not safe	19 (15)			
Not safe at first time point	183 (60)	Not safe to safe	9 (7)	
Not safe to not safe	88 (71)			

All models were adjusted for infant age in months, categorical parent age in years, parent race and ethnicity, parent education, geographic region, whether anyone in the home smoked (dichotomized as yes/no), and whether the infant was born before 37 weeks (dichotomized as yes/no) and the number of nights participants reported being the primary caretaker (dichotomized to 7 and <7).

\*P < .05, \*\*P < .01, \*\*\*P < .001

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<sup>a</sup> Crib includes crib, bassinet, cradle, or playard; not crib includes adult bed, sofa, cosleeper, infant swing, car seat, in the arms of a caregiver.

<sup>b</sup> Composite score includes all 3 infant safe sleep parameters: on back, in a separate sleep space, on an approved sleep surface (crib/bassinet/cradle/playard).

locations, such as breastfeeding, that were not measured. We included only a sample of sleep recommendations from the AAP guidelines.<sup>1</sup> We included parents of infants aged  $\leq 12$  months given that the AAP recommendations for infant safe sleep include infants aged <1year. Many previous studies focus exclusively on infants aged  $\leq 4$ months.<sup>28,31</sup> Importantly, infant age was not a significant variable associated with the safe sleep composite measure, thus parents may benefit from continued education about safe sleep practices. Lastly, we enrolled only Englishspeaking participants. Given the relationship between cultural practices and infant sleep,<sup>12,32</sup> engagement with diverse populations, including non-English speaking parents, is important.

#### Conclusions

In this cross-sectional online survey of a diverse, geographically representative sample of US parents, we identified that changes in sleep practices after nighttime waking are common, with 39% of parents reporting a second-sleep practice. Importantly, a significantly higher proportion of changes were to a less-safe sleep practice (eg, supine to prone). Less than 10% of our sample reported adhering to all 3 recommended infant safe sleep practices at both sleep onset and after nighttime waking. Parent and infant demographic characteristics were both associated with the use and safety of second-sleep practices.

## **ABBREVIATIONS**

AAP: American Academy of Pediatrics aPR: adjusted prevalence ratio CI: confidence interval

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Address correspondence to Mersine A. Bryan, MD, MPH, Department of Pediatrics, University of Washington, 4800 Sandpoint Way NE, Seattle, WA 981005. E-mail: mersine@uw.edu

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