Does Teething Disrupt Infant Sleep? A Longitudinal Auto-Videosomnography Study

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Objective To examine prospectively the relationship between teething and infant sleep using objective sleep measurements.

Study design Over a 4-week period, 849 infants aged 3-18 months (mean = 8.4 ± 1.8) from the US and Canada were monitored using auto-videosomnography, based on computer-vision technology to decode video footage from crib camera monitors. Parents also provided reports of tooth eruption timing, symptoms, and management strategies. Objective sleep metrics, including total sleep time, night-time awakenings, and parental crib visits, were compared between teething and nonteething nights using generalized estimating equations and changepoint analysis.

Results Both analytic approaches showed no significant differences in sleep metrics between teething and non-teething nights. Although over one-half of the parents reported sleep disturbances during teething, these subjective reports were not corroborated by the objective data.

Conclusions These findings challenge the widely held belief that teething disrupts sleep and highlight the need for pediatric health care professionals to consider alternative explanations for infant sleep problems. Educating parents with evidence-based information may prevent potentially harmful management strategies for teething (eg, excessive use of analgesics and local anesthetics) and improve sleep problem management. Future research should explore these relationships using multiple objective measures and more diverse populations. *(J Pediatr 2025;279:114461)*.

Infancy marks a period of constant development, with infant sleep a domain of particularly dynamic evolution. Newborn infants typically sleep in multiple short bouts scattered throughout the 24-hour day, and consolidation of sleep into one major nocturnal episode emerges only around 4-12 months of age, with further consolidation occurring throughout the first few years of the child's life.[1-3] During this time, parents often struggle with disruptions to their own sleep due to the fragmented nature of infant sleep, which creates significant misalignment between parent and infant sleep schedules.[4,5] These disruptions can exact a toll on parental well-being, manifesting as impairments across physical, cognitive, behavioral, and emotional domains.[6-10] Thus, parents are often substantially concerned about infant sleep, and diligently seek to discern underlying patterns and attributions for their infant's unpredictable sleep-wake patterns. Among such attributions are extrinsic factors, such as sleep associations and bedtime practices, as well as intrinsic factors, such as temperament, motor milestone acquisition, illness, growth spurts, and particularly often teething.[11-14]

Teething refers to the transition of the tooth from its position within the jawbone to eruption through the gums into the oral cavity.[15] The first tooth eruption typically occurs between the ages of 4-10 months, and by around 30 months of age, most children have all 20 primary teeth in place.[16,17] Historically, teething has frequently been held responsible for various symptoms, including drooling, diarrhea, fever, irritability, and also sleep disturbances.[18,19] However, research evidence has not consistently supported these common beliefs.

Studies exploring the links between teething and infant sleep disruptions have thus far relied on subjective reports and yielded mixed findings. Surveys of pediatricians and other child health experts reveal widespread professional endorsement of the teething-sleep disruption link.[20,21] When assessing parents' retrospective accounts, a substantial portion report that teething adversely affects their baby's sleep, typically through single-item questions about sleep disturbances or sleeplessness. For instance, in a study of 92 Australian parents of infants completing a symptoms checklist during routine infant health visits, 78%

GEE	Generalized estimating equations
WBS	Wild binary segmentation

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reported sleep disturbances during teething.[22] Similarly high rates were observed in parents from the US (87% of 120 parents)[23] and Iraq (64% of 200 parents).[24] A large-scale Jordanian study (n = 1500) found that 81% of parents believed teething could cause sleep disturbance, though notably, this study assessed general beliefs rather than reports of their own children's experiences.[19] Lower, yet still substantial, rates were documented among Polish parents. In a sample of 630 healthy infants aged 5-36 months, sleep disorders were reported by 37% of parents whose infants were in the active phase of tooth eruption (determined via oral examination) compared with 30% of those not in this phase, with an overall rate of 32%.[25] The lowest rate was found among Brazilian parents, where 10% of 378 parents of 12-month-olds participating in a randomized trial reported sleep disturbances as a symptom of teething.[26]

Acknowledging the inherent biases associated with retrospective reporting, 3 prospective studies have endeavored to explore the relationship between teething and sleep disruptions. In one such study, spanning 90 tooth eruptions among 21 Australian infants, researchers utilized daily questionnaires completed by parents and daycare staff. The study did not find changes in sleep on tooth eruption days or the preceding 5 days compared with nonteething days.[27] A prospective examination by Macknin et al[28] involving 475 tooth eruptions among 125 healthy infants in the US indicated marginal decreases in sleep duration and upticks in awakenings as reported by parents during the days proximal to tooth eruptions, yet these changes were not clinically meaningful. In contrast, a study tracking 231 tooth eruptions across 47 Brazilian infants over 8 months revealed a heightened frequency of sleep disturbance on the day of eruption and the subsequent day compared with days devoid of eruptions, as reported by mothers.[29]

Despite their prospective nature, these studies were significantly limited by their reliance on parental reports of infant sleep. Such reports may be impacted by recall bias, particularly due to the challenges of recalling night-time events.[30,31] Parents may not be aware of every awakening or the extent of sleep or wakefulness, since not all infants become vocal or move in ways that are audible upon each awakening.[32] In addition, parents' preconceived expectations regarding the effects of teething on sleep may shape their perceptions and behaviors on teething nights. For example, parents anticipating sleep disturbances due to teething may become more vigilant on such nights, potentially interpreting minor signals as teething-related awakenings. In line with these notions, a recent review of teething signs and symptoms emphasized the need for further research using objective measures to provide clearer insights into existing findings.[33] To date, studies have not utilized objective assessments of infant sleep to investigate the impact of teething.

The present study thus aimed to fill a critical gap in the literature by using auto-videosomnography to examine objectively the relationship between tooth eruption and sleep-wake patterns in infants. Through a longitudinal investigation spanning 4 weeks, we compared sleep on teething vs nonteething nights, hypothesizing that poorer sleep will be found on teething nights.

Methods

Participants and Procedures

Participants were parents of infants aged 3-18 months from the US or Canada who reported that their infant had a tooth eruption within the past 4 weeks. Parent users of the Nanit baby monitor, who had previously consented to make their infant's objective sleep data available for research purposes, were invited via email in April 2023 to complete an online survey about teething symptoms and sleep. Interested parents could access an online informed consent form to complete questionnaire data and share their child's automated sleep data for 1 month. Participants were offered a chance to win 1 of 5 Nanit 1-year subscriptions as a reward for their participation. Data collection was anonymous, and the study was approved by the Institutional Review Board of Tel Aviv University (protocol number 0006141-6).

The inclusion criteria were: (1) being a parent of an infant aged 3-18 months; (2) recalling the exact date of the child's tooth eruption within the past 4 weeks; and (3) having auto-videosomnography data from the 3 weeks prior to and 1 week following the reported eruption.

Measures

Auto-videosomnography. Infant sleep was assessed objectively using Nanit camera monitors (Nanit). This system features a camera mounted above the infant's crib, paired with an application that allows caregivers to define the child's sleeping area. The system uses computer vision algorithms to detect motion-stillness patterns and translate them into sleep–wake metrics. This method is similar to actigraphy, but monitors full-body movement rather than just wrist or ankle movement. The algorithm also tracks caregiver visits to the crib area. Metrics derived from this technology have been validated against both actigraphy and polysomnography.[34,35]

Auto-videosomnography data were considered valid if sleep onset occurred between 4:00 PM and 11:59 PM, sleep offset occurred between 3:00 AM and 10:30 AM, and total sleep duration exceeded 5 hours. These criteria were selected in accordance with prior research,[36,37] to ensure accurate recording of nocturnal sleep and exclude non-nocturnal episodes. The study utilized 3 key metrics: (1) total night-time sleep time (total minutes scored as sleep within the night sleep period); (2) number of night-time awakenings, categorized as movement episodes lasting ≥3 min within the sleep period; and (3) number of night-time parental visits to the crib.

Parent Online Survey. Parents completed an online questionnaire detailing their infant's latest tooth eruption within the preceding 4 weeks. The questionnaire was developed for

this study based on previous investigations.[27,28] In addition to providing the date of eruption, parents were queried about whether this marked their infant's initial tooth eruption, their perception of associated teething symptoms, and any strategies they employed to alleviate these symptoms. Parents were also asked to choose the location of the tooth that erupted from a list of possible locations (eg, "Bottom incisor – one of the 2 most central teeth positioned at the lower gum"). In addition, participants furnished sociodemographic details (eg, education level and household income).

Statistical Analysis

To investigate the association between infants' sleep patterns and tooth eruption, we first defined the teething period as comprising 3 consecutive nights: the night before the parent-identified tooth eruption, the night directly following the tooth eruption, and the subsequent night, aligning with previous research.[29] The comparative nonteething period was defined as the 6 days preceding and succeeding the teething period. Generalized Estimating Equations (GEE) were used to compare sleep metrics between teething and nonteething periods, implemented in R using the 'geepack' package. GEE facilitates parameter estimation utilizing all available nights of auto-videosomnography data, nested within each infant and period. This approach accounts for correlations among observations and accommodates missing nights within each period. Considering the nature of distributions, a linear model was fitted for total sleep duration, and Poisson log-linear models were applied for the number of night-time awakenings and parental visits, given that these are count variables.

To bolster the robustness of our findings, we additionally performed changepoint analyses spanning 21 days before and 7 days following tooth eruption. Changepoint analyses identify sudden mean changes in time series data. To begin, we calculated the within-subject mean of each sleep metric over all the nights available, except the 3 nights of the teething period. Secondly, we determined the deviation for each sleep metric on each night, including the 3 teething-period nights, compared with the within-subject mean. This deviation measure estimated the extent to which a sleep metric differs from nights with no tooth eruption. For example, an infant with a parental visits deviation score of 5 on teething nights was visited 5 more times during that night than their average parental visits on nonteething nights. Lastly, we performed changepoint analysis on these deviations to identify changes within infants' nightly sleep metrics compared with the within-subject mean. We analyzed the deviation from within-subject means to adjust for the multilevel nature of the data. For this study, the Wild Binary Segmentation (WBS) approach was utilized with the R package WBS within R version 4.0.2. WBS determines the reliable location and number of changepoint estimates while maintaining computational efficiency. WBS computes the cumulative sum for random intervals in a sequence and subsequently tests this sum against a threshold to search for significant changepoints. A date is considered a significant changepoint if the corresponding sum is above the threshold. This approach does not make any assumptions about the number of changepoints or the location of changepoints, as it employs random intervals. We used a large $M = 10\,000$ number of random draws and a threshold constant of $C = 1$, based on previous publications.[38,39]

Results

Of the 996 parents who completed the survey, 849 were eligible and included. Missing data for specific survey items or individual nights among the final sample were minimal, ranging from 0% to 3.9%. Infant and parent characteristics are presented in **Table I**. Mean age of infants was 8.4 ± standard deviation 1.8 months.

Figure 1 presents nightly sleep metrics throughout 4 weeks of continuous monitoring, illustrating descriptive patterns. Visual inspection shows no discernible trends toward increased or decreased sleep duration, awakenings, or parental visits around the eruption day (denoted as day "0"). Consistent with these observations, GEE models revealed no significant differences in infant nighttime sleep duration (Wald = 0.29, $P = .59$), number of awakenings (Wald = 0.41, $P = .52$), or parental crib visits (Wald = 0.05, $P = .82$) between teething and nonteething periods. Estimated means and standard errors for each period are detailed in **Table II**.

Correspondingly, changepoint analyses did not reveal any significant change point around the time of tooth eruption for any of the auto-videosomnography metrics (see **Figure 2**). Notably, these analyses identified trends indicating a progressive increase in night-time sleep duration, and a decrease in the number of night-time wakings and parental visits across the 4-weeks analyzed. These developmental trends are in line with the anticipated maturation of infant sleep-wake patterns. Average deviations per date of all sleep measures and estimated threshold values and median absolute deviations per analysis are shown in **Supplementary Tables S1** and **S2**; available at www.jpeds.com, respectively.

As for retrospective parent reports, among the symptoms associated with teething, 436 (51.3%) parents reported noticing changes in their child's sleep. Of these, 241 (55.3%) observed that their child slept less, 29 (6.6%) noted that their child slept more, 381 (87.4%) reported increased night awakenings, and 171 (39.2%) found bedtime to be more challenging on teething days. To manage teething symptoms, 115 (13.5%) parents used local anesthetics, 480 (56.5%) administered acetaminophen or ibuprofen, 514 (67.6%) provided a frozen teething ring or washcloth, 114 (13.4%) used homeopathic remedies, and 318 (37.4%) breastfed or gave a bottle.

Table I. Infant and Parent Characteristics*

Characteristic	Entire sample n = 849
Infant age (months)	8.4 (1.8)
Infant sex, boys	464 (54.6%)
Room sharing with parents	87 (10.2%)
Parent gender, mothers	723 (85.2%)
Parent age (years)	
≤24	7 (0.8%)
25-29	95 (11.2%)
30-34	417 (49.1%)
35-39	269 (31.7%)
40-44	54 (6.4%)
≥45	4 (0.5%)
Parent education	
Highschool degree/less	9 (1.1%)
Some college	39 (4.6%)
College degree	413 (48.6%)
Postgraduate degree	381 (44.9%)
Parent ethnicity	
Asian	74 (8.7%)
African American	14 (1.6%)
Hispanic	57 (6.7%)
White/Caucasian	668 (78.7%)
Other	26 (3.1%)
Parent employment status	
Full-time	610 (71.8%)
Part-time	71 (8.3%)
At home parent	123 (14.5%)
On parental leave	15 (1.8%)
Unemployed	11 (1.3%)
Other	19 (2.2%)
Residence	
Rural	82 (9.6%)
Suburban	501 (59.0%)
Urban	266 (31.3%)
Household income	
<$50,000	15 (1.8%)
$50,000-$100,000	100 (11.8%)
$100,000-$150,000	133 (15.7%)
$150,000-$200,000	135 (15.9%)
>$200,000	410 (48.3%)
Erupted tooth location	
Bottom center incisors	456 (53.7%)
Top center incisors	199 (23.4%)
Bottom lateral incisors	53 (6.3%)
Top lateral incisors	59 (6.9%)
Bottom canine	20 (2.3%)
Top canine	47 (5.5%)
Bottom molar	9 (1%)
Top molar	3 (0.3%)
First (vs nonfirst) eruption	445 (52.4%)

*Data are presented as means (standard deviations) for continuous variables, and as *n* (%) for categorical variables.

Discussion

The belief that teething disrupts infant sleep is widely held, despite mixed findings from existing research. Our study approach using objective sleep assessment to examine the impact of tooth eruption on infant sleep is unique. Analyzing auto-videosomnography data collected over 3 weeks before and 1 week after tooth eruption, we found no significant changes in infant night-time sleep duration, the number of night-time awakenings, or parental night-time crib visits between teething and nonteething days. These findings were consistent across both traditional regression-based analyses and changepoint analyses.

Our results align with those of Wake et al,[27] whose prospective study showed no significant increase in sleep disruptions around tooth eruption days compared with nonteething days. Similarly, they are consistent with the prospective study from Macknin et al,[28] which found no meaningful changes in infant sleep duration or quality during periods of tooth eruption. However, our results contradict several previous studies that have linked teething with increased sleep disturbances.[19,22-26,40] Importantly, all but one of these studies[40] were retrospective, assessing the impact of tooth eruption on sleep after these had already occurred. Moreover, none of these previous studies employed objective measures of sleep, instead relying exclusively on parent or daycare staff reports.

Notably, retrospective parent reports in our study were consistent with previous retrospective impressions that teething is associated with sleep disruptions. Over half of the parents in our sample reported changes in their infants' sleep during tooth eruption days, with the vast majority of these (87%) observing increased night-time awakenings, and many also reporting reduced sleep duration (55%) and more challenging bedtimes (39%).

The discrepancies between findings based on parent reports and those obtained from objective sleep assessments may stem from several factors. First, parent reports, especially when collected retrospectively, are susceptible to recall bias. This bias may be particularly pronounced with longer intervals between tooth eruption and data collection, and given that recalling night-time sleep-related events may be less reliable than recalling daytime events.[30,31] Furthermore, prior parent expectations about teething's impact on sleep may bias their attention towards distress signals, and lead them to attribute these signals to teething pain. Such beliefs could heighten parents' awareness of awakenings and crying bouts during teething nights, resulting in confirmation bias.[41] Indeed, previous studies have shown that parental cognitive biases can significantly shape their perceptions of their infants' emotions and behavior.[42] Future research could benefit from prospectively assessing parents' expectations regarding teething's impact on sleep, and test whether these expectations predict greater parent-reported vs objectively assessed sleep disturbances around tooth eruption nights.

Discrepancies between parent reports and auto-videosomnography data may also arise from inherent differences between these methodologies. Certain aspects of infant sleep, especially more subjective ones, may be disrupted during teething but not captured by auto-videosomnography. For instance, although the number of awakenings may not increase on teething vs nonteething nights, infants might be more likely to cry or appear more intensely distressed upon waking. Moreover, although auto-videosomnography provides objective real-time recordings of sleep-wake patterns, it only captures these patterns while the infant is in the crib. Sleep fragmentation might be more pronounced when infants are outside the crib, and this increased fragmentation or distress may thus be reflected only in parent reports. Alternative objective sleep assessment methods, such as

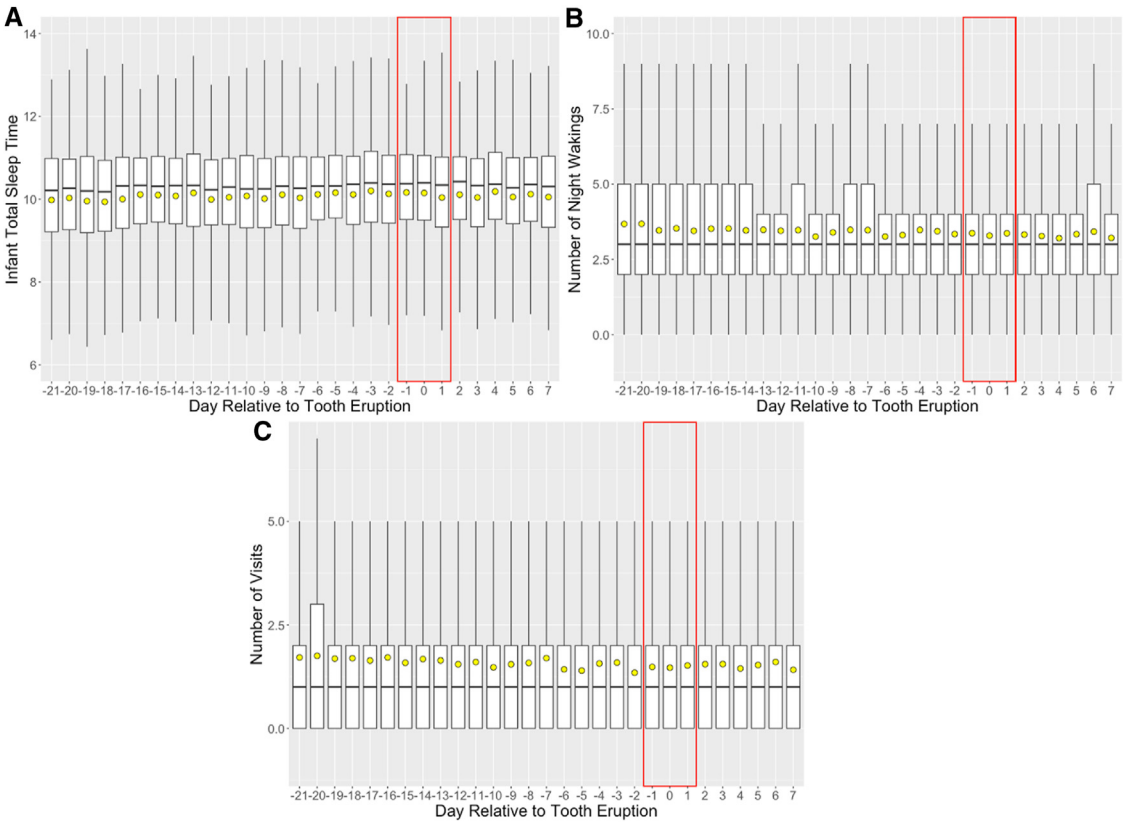

Figure 1. Boxplots of total sleep time (**A**), night-time awakenings (**B**), and parent crib visits (**C**), from 21 days before to 7 days after tooth eruption. Yellow dots represent daily averages. Red rectangles mark the teething period (1 day before to 1 day after the reported tooth eruption).

actigraphy, which monitor sleep regardless of the child's location, could offer further insights into the relationship between teething and sleep-wake patterns.

Nevertheless, data from 2 of the 3 prospective studies investigating the teething-sleep disruption link dovetail with our data derived from objective measures, casting serious doubt on the notion that teething is associated with disrupted sleep.[27,28] These potentially unfounded beliefs – held by both parents and pediatric health professionals[19-21,24] – may have maladaptive consequences. For instance, concerns that teething will disrupt sleep may lead parents to overuse analgesic medications. Our findings show that 56.5% of parents administered acetaminophen or ibuprofen to manage their infants' teething symptoms, consistent with prior research.[19,25] Excessive and prolonged use of analgesics in infants carries risks, including hypersensitivity reactions, gastrointestinal bleeding, and renal impairment.[43] Other common management strategies, such as the use of amber necklaces or local anesthetics, also pose risks like choking, intoxication, and methemoglobinemia.[44,45] Furthermore, misattributing sleep disruptions to teething may delay the proper diagnosis and treatment of pediatric insomnia or other sleep and nonsleep-related issues. This misattribution could prevent parents from implementing brief, cost-effective behavioral sleep interventions, such as extinction or modified extinction,[46-48] potentially prolonging the sleep problem unnecessarily.

Pediatricians and other child health care practitioners should thus aim to inform parents about evidence from prospective and objective studies, suggesting that tooth eruption is not significantly associated with sleep disruptions. Challenging this long-standing myth could lead to more accurate

Table II. Auto-videosomnography Metrics for Teething and Nonteething Periods

Sleep metric	Teething period M(SE), 95% CI	Nonteething period M(SE), 95% CI	Wald (p)
Infant night-time sleep duration (h)	9.99 (0.04), 9.92-10.07	10.01 (0.04), 9.92-10.09	0.29 (0.59)
Number of infant night-time awakenings	3.29 (0.06), 3.18-3.40	3.31 (0.06), 3.19-3.44	0.41 (0.52)
Number of parent night-time crib visits	1.52 (0.06), 1.40-1.65	1.53 (0.07), 1.39-1.67	0.05 (0.82)

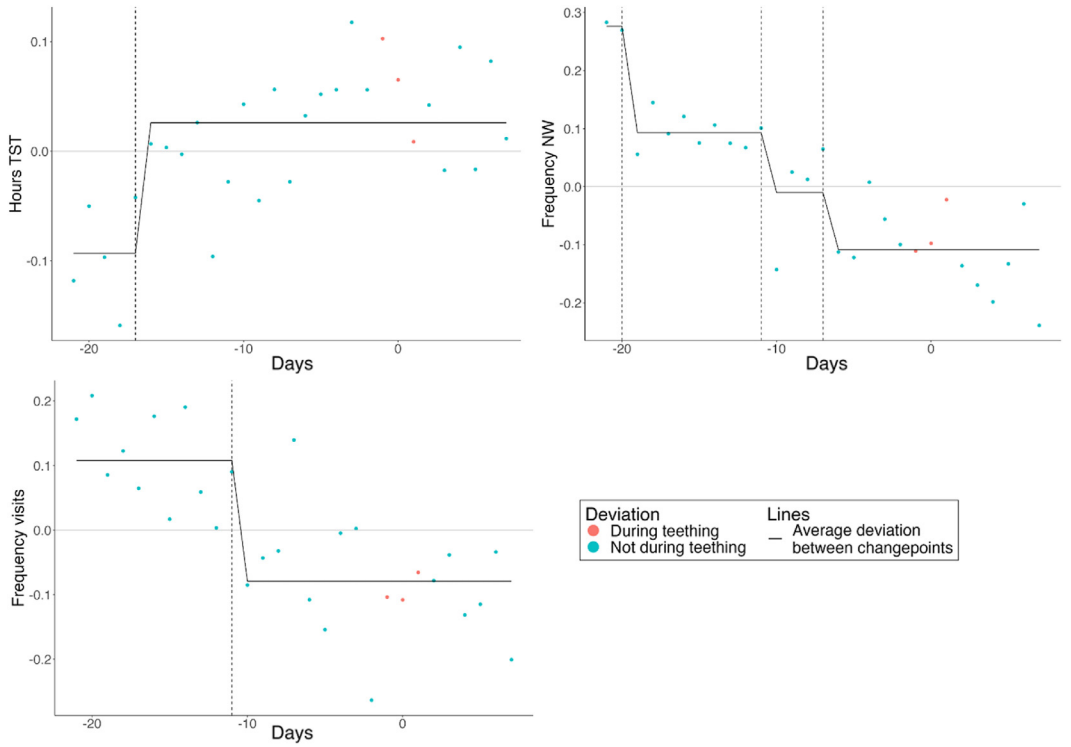

Figure 2. Daily deviation values from baseline for each sleep metric are shown for teething days in red, while for nonteething days in green. Dashed vertical lines indicate changepoints identified in the analyses. None of the changepoints fall within the teething period.

identification and management of infant sleep problems. At the same time, pediatric health professionals should also be careful not to discount parents' impressions and experiences with their individual infants. For some parents, the belief that their infant's sleep disruptions have a specific physiological 'cause' may provide reassurance. Therefore, practitioners should approach these discussions with sensitivity, presenting the most current evidence while also respecting parents' perspectives.

This study has several strengths, including the use of a large sample of infants and the application of objective measures to prospectively assess sleep-wake patterns over a 4-week period. However, there are also some limitations. First, as mentioned earlier, auto-videosomnography does not capture sleep-wake patterns that occur outside the crib. Thus, our findings may not pertain to infants who regularly share a bed with their parents, or spend most of the night out of their crib. Second, although sleep was assessed objectively, the timing of tooth eruption was reported retrospectively by parents, and may therefore be affected by recall bias. To mitigate this, we limited recruitment to parents whose infants had experienced a tooth eruption within the past month, yet some degree of bias may remain. Third, we assessed the use of analgesics, local anesthetics, and other teething management strategies in general, rather than on the specific nights surrounding the tooth eruption examined in this study. As a result, we could not control for these factors in our analysis, and it is possible that the lack of observed changes in sleep is due to the mitigating effects of these interventions. Lastly, the generalizability of our findings is limited primarily to families of white/Caucasian ethnicity, with middle to high education levels and socioeconomic status, residing in North America. Beliefs about teething and strategies for managing its impact may vary considerably across cultural contexts, and future studies should explore these relationships using objective measurements within more diverse samples.

Notwithstanding these limitations, objective metrics of infant sleep over a 4-week period provided no evidence of increased sleep loss or fragmentation on teething nights compared with nonteething nights. Parents and pediatric professionals should recognize that expectations regarding teething disrupting sleep may not be accurate, and in cases where sleep problems are persistent and disruptive, consider the diagnosis and management of underlying sleep issues, rather than attributing them solely to teething. ■

CRediT authorship contribution statement

Michal Kahn: Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Maristella Lucchini:** Writing – review & editing, Writing – original draft, Visualization, Project administration, Methodology, Investigation, Formal analysis, Data

curation, Conceptualization. **Emily Oster:** Writing – review & editing, Supervision, Methodology, Conceptualization. **Shambhavi Thakur:** Writing – review & editing, Investigation, Data curation. **Mali Waugh:** Writing – review & editing, Investigation, Formal analysis. **Natalie Barnett:** Writing – review & editing, Supervision, Resources, Methodology, Investigation, Data curation, Conceptualization.

Declaration of Competing Interest

M.L., S.T., and N.B. serve as consultants for Nanit.

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Data Statement

Data sharing statement available at www.jpeds.com.

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