Associations Between Diaper Need and Child Sleep in Under-resourced Families

Emma Shaffer, PhD, CPNP,* Sallie Porter, DNP, PhD APN, PED-BC, CPNP, FNAP,†
Eileen Condon, PhD, APRN, FNP-BC,‡ Peijia Zha, PhD,§ Barbara A. Caldwell, PhD, APN-BC‖

ABSTRACT: *Objective:* Sleep is critical for child health, but factors related to poverty create barriers to the achievement of healthful sleep. In this study, we examined the associations of insufficient diaper supply, a measure of material hardship, with child sleep. *Methods:* This cross-sectional study included 129 parents of very young children. Each participant responded to an online material hardship assessment and the Brief Infant Sleep Questionnaire–Revised. Multiple linear regression was used to analyze the relationship between diaper need and sleep. *Results:* Controlling for family and socioeconomic variables, diaper need was associated with disrupted, shorter sleep periods ($\beta = -11.95$, $p < 0.001$) and lower total sleep scores ($\beta = -6.49$, $p = 0.004$). High diaper need was associated with parent perception of poor sleep ($\beta = -7.28$, $p = 0.017$). *Conclusion:* The findings suggest that an inadequate supply of diapers adversely affects children's sleep. Further research should evaluate how screening and connecting families to resources may improve pediatric sleep.

(*J Dev Behav Pediatr* 00:1–7, 2022) **Index terms:** diaper need, material hardship, infant sleep, toddler sleep, BISQ-R.

Adequate sleep is important for child and toddler health and a common parental concern. Sleep promotes brain development and solidifies learning and memory. Sleep for all periods of childhood is associated with development and behavioral and physical health.[1-3] In toddlers, sleep has a dose-dependent positive effect on social-emotional well-being.[4] Compromised sleep patterns are a proposed link between food insecurity, childhood obesity, and emotional and behavioral problems.[5] Healthy sleep is characterized by adequate duration, timing, quality, consistency, and lack of disturbances. The American Academy of Sleep Medicine recommends 12 to 16 hours of sleep per 24-hour period for infants and 11 to 14 hours of sleep per 24-hour period for toddlers.[6]

Poverty is a risk factor for sleep problems among young children.[7-9] Young children who experience food insecurity are 2.25 times more likely to have poor sleep

quality.[5] Sleep regulation in under-resourced families is influenced by chaos in the physical environment, cultural beliefs, parent stress, and depression symptoms.[7,10] Disrupted family rhythms may also be a factor.[11] Food insecurity and housing insecurity have been associated with difficulty implementing nightly bedtime routines for toddlers from racially and economically marginalized backgrounds.[12] Diaper need, a measure and manifestation of poverty among families, may also contribute to unhealthful sleep.

Diaper need is an increasingly recognized social determinant of health measure among families with young children. Diaper need is defined as the inability to afford the diapers needed to maintain infant hygiene.[13] Diapers are essential care items that are used daily during the foundational early childhood years. Diapers are not covered by the primary federal safety net programs Supplemental Nutrition Assistance Program (formerly known as food stamps) or by the Special Supplemental Nutrition Program for Women, Infants, and Children. Approximately one-third of US mothers report difficulty affording diapers,[14] and prevalence during the COVID-19 pandemic is likely much higher.[15]

Diaper need is associated with an increased incidence of diaper dermatitis and urinary tract infections.[16] It is also related to increased maternal mental health symptoms.[17] Based on the bioecological model,[18] social factors (i.e., diaper need) may contribute to the child's health and developmental outcomes (i.e., sleep quality) and be potentially ameliorable factors for intervention.[9,19] However, despite the established importance of sleep during early childhood, little is known about child behavioral outcomes of diaper need. The aim

of this study was to examine the relationship between diaper need and child sleep.

METHODS

This cross-sectional study was conducted in early 2021. The sample included 129 under-resourced families with neurodiverse, young children. Participants were recruited online by e-mail with purposeful sampling of families involved in local and national early development, home visiting, and disability support programs associated with Rutgers, The State University of New Jersey. The recruitment e-mail contained a link to the online questionnaire. The parents were asked to complete a demographics questionnaire, a material hardship assessment, and the Brief Infant Sleep Questionnaire–Revised (BISQ-R).[20] A demographics questionnaire items included the following variables: participant age, sex, race/ethnicity, region of residence, and 2019 household income and child age, sex, history of prematurity, developmental conditions, and developmental concerns. The developmental conditions question was based on a modification of the National Health Interview Survey.[21] The original question asked respondents whether their child had received a diagnosis of any of the following developmental disabilities: diagnoses of attention-deficit/hyperactivity disorder, autism spectrum disorder, blindness, cerebral palsy, moderate-to-profound hearing loss, learning disability, intellectual disability, seizures, stuttering or stammering, and/or other developmental delays. The modified developmental disability question was revised to only include age-appropriate conditions for children ages birth to three years, i.e., learning disability and stuttering or stammering were excluded from the list of conditions. The material hardship assessment included a food security screener[22] and a diaper need assessment. This study was available in English and Spanish. Participants received a 15-dollar gift card after survey completion. Consent was obtained from all participants. This study was approved by the Rutgers Institutional Review Board.

Diaper Need Assessment

The diaper need assessment had 3 items and was developed based on Massengale et al.[23] and recent National Diaper Bank Network (NDBN) recommendations. The NDBN recommendations were to ask families whether they have "enough diapers to last the month." Diaper need was categorized as "any" or "none." Any diaper need was defined as inadequate supply at least once per year. Any diaper need was further delineated into high and low diaper need. High diaper need was defined as needing supplies to get through the month. Low diaper need was defined as needing supplies at least once per year but usually having enough to last the month. The questions and list of possible consequences are based on expert interviews with staff members from a diaper bank, a charity organization that provides diapering supplies to families.[23] The assessment was originally developed in 2017 and as of yet has limited validity and reliability testing. We revised the assessment by incorporating expert opinion from the NDBN, which aligns the assessment with other material hardship screening measures.

Brief Infant Sleep Questionnaire–Revised

The Brief Infant Sleep Questionnaire–Revised (BISQ-R) is a clinical and research tool designed to measure day and nighttime sleep among children aged 36 months and younger.[20,24] The authors of the questionnaire use the term "infant" to describe children aged birth to 36 months, the questionnaire has been validated for children aged birth to 36 months, and the scoring system is adjusted for age. The BISQ-R is composed of 3 subscales. The Infant Sleep (IS) subscale includes sleep onset latency (time from wakefulness to sleep), number of night wakings, longest stretch, and total nighttime sleep (in minutes). The Parent Perception (PP) subscale consists of caregivers' assessment of child bedtime difficulty, nighttime sleep, and sleep problems. The third subscale is Parent Behavior (PB) and measures sleep ecology to include bedtime routines, response to wakings, and sleep locations. The total score is an average of the 3 subscales.

The norm-referenced, age-based BISQ-R scores for this sample were calculated in conjunction with the BISQ-R sleep team using the algorithms proposed by Mindell et al. The scoring algorithms were developed from large US samples, scores ranged from 0 to 100, and higher scores indicated better sleep quality and quantity.[20] The BISQ-R measures sleep patterns and sleep behaviors over the past 2 weeks. The BISQ kappa value is 0.939 {95% confidence interval [CI] (0.858–1.00), $p < 0.001$}. Test-retest reliability is excellent. Criterion validity was established against daily sleep logs ($r = 0.61, 0.27, 0.83, p < 0.05$) and actigraphy ($r = 0.54, 0.23, 0.42, p < 0.05$) for sleep onset, duration, and waking, respectively.[24]

Statistical Analysis

Descriptive statistics were conducted on demographics, food insecurity, and diaper need variables. Four participants did not respond to questions about income and were excluded from multiple linear regression. One respondent did not complete all sleep questions and was excluded from the IS and total scores univariate and multiple regression modeling. Analysis was performed with SAS version 9.4. Normal distribution was assumed and tested by using Fisher's skewness and kurtosis measures. The α level was set at less and equal to 0.05 for statistical significance.

Before model building, independent t tests were used to examine relationships between demographic and material hardship variables and IS and total scores. Multiple linear regression was used to explore diaper need as a predictor of total score (a composite of IS, PP, and PB subscales) while controlling for food insecurity and significant demographic variables (child age, household

income, child disability status, and race). Multiple linear regression was also used to explore diaper need as a predictor of IS and PP while controlling for food insecurity, significant demographic variables (child age, household income, and child disability status), and PB. In this sample, many of the children were at risk of or diagnosed with a developmental disability. Children with a disability are at higher risk of sleep disorders than their typically developing peers.[25] Disability was measured and controlled for in all statistical models.

The aim of this study was to measure the relationship between diaper need and child sleep. We used the IS subscale, PP subscale, and total score to quantify child sleep. The IS subscale, PP subscales, and total scores were considered outcome measures (dependent variables). The PB subscale, separate from the total score, was not used as an outcome measure in our analysis because it was not a direct measure of child sleep. In previous studies, parent behavior has been identified as a factor that affects pediatric sleep.[19] Therefore, the PB subscale was included as a covariate in multiple linear regression models for the association of diaper need with IS subscale scores and the association of high diaper need with PP subscale scores.

RESULTS
Sample Description

One hundred and twenty-nine caregivers were consented and completed the study. Sample demographics are shown in Table 1. Most of the participants were female (76%, n = 98). Sixty-two percent (n = 80) identified as White, and 14% (n = 18) identified as Latinx. Twenty-eight percent (n = 35) had an annual 2019 total household income of $35,000 to 50,000. The mean child age was 9.4 (SD = 9.6) months. A third of the children had a diagnosed developmental disability, and 47.3% of parents had concerns about their child's development. Most of the participants (88%) were food insecure, and 76% of the participants reported diaper need. Greater than a third (n = 51) reported high diaper need. The mean Infant Sleep (IS) score was 56.99 (SD = 17.63), the average Parent Perception (PP) score was 69.90 (SD = 18.78), and the average total score was 65.64 (SD = 13.77).

Bivariate Analysis

The bivariate analysis is present in Table 2. Total sleep scores were an average of the IS subscale (duration of sleep and sleep disruption), PP subscale, and Parent Behavior (PB) subscale scores. Diaper need was significantly associated with total score ($t = 2.83$, $p = 0.005$, $t = 2.19$, $p = 0.030$). On average, total scores among families with diaper need were 7.83 percentiles lower than families without diaper need ($p = 0.005$). Any diaper need was significantly associated with lower IS scores ($t = 4.28$, $p < 0.001$). On average, IS scores among families with diaper need were 14.59 percentiles lower than families without diaper need ($p < 0.001$). High diaper need was associated with PP scores ($t = 2.27$, $p = 0.025$). PP scores were an average of

7.54 percentiles lower among families with high diaper need compared with those with low or no diaper need ($p = 0.025$).

Multivariate Analysis

The multiple linear regression model for the association of diaper need with total score is present in Table 3. The overall model was significant (F = 19.82, $p < 0.001$) and explained 55% of the variability of total scores ($R^2 = 0.55$). In the model, compared with children from families without diaper need, children from families with diaper need had lower total scores (worse sleep quantity, quality, and ecology) ($\beta = -6.49$, $p = 0.004$) after controlling for child age, child disability status, parent race, household income, and food insecurity.

Table 4 summarizes the multiple linear regression model for the association of diaper need with IS. Parent behavior is theoretically and, in this study, statistically a significant covariant of sleep and was controlled for in the model. In the model, children from families with diaper need had lower IS scores than did children from families without diaper need, controlling for child age, total household income, food security, child disability, and PB scores ($\beta = -11.95$, $p < 0.001$). This overall model was significant (F = 19.96, $p < 0.001$) and explained 48% of the variability in IS scores ($R^2 = 0.48$).

Table 4 also contains the multiple linear regression model for the association of high diaper need with PP score. PB score was a statistically significant covariate and was included in the final model. Compared with parents with low or no diaper need, parents with high diaper need were more likely to have lower PP scores (report their child's sleep as problematic or difficult) ($\beta = -7.28$, $p = 0.017$). This overall model was significant (F = 8.54, $p < 0.001$) and explained 32% of the variability in PP scores ($R^2 = 0.32$).

DISCUSSION

This study is the first to examine the relationship between diaper need and sleep. Our findings are congruent with the literature showing that diaper need affects parent and child health[16,17,26] and with findings that material hardship is associated with decreased child sleep quantity and quality.[5,7,8] We found that diaper need was associated with lower total sleep scores (poorer sleep quality, quantity, and environment). Furthermore, diaper need was associated with poor sleep when controlling for parent behavior (PB). This finding suggests the unique effect of diaper need beyond the sleep environment. Sleep ecology, including bedtime routines, is measured in the PB subscale. It is theorized to have an important role in the relationship between economic adversity and child sleep.[11,12,19] In our study, parent behaviors (PB scores) were significantly associated with infant sleep (Infant Sleep [IS] scores) in the bivariate multivariate model (Table 2). These findings may suggest the importance of both appropriate rhythms (e.g., sleep

Table 1. Sample Demographics

(N = 129)	Response Sample, No. (%)
Caregiver-level and family-level characteristics	
Respondent language	
English	121 (94)
Spanish	8 (6)
Female sex	98 (76)
Age, yr	
18–24	5 (3.9)
25–34	77 (59.7)
35–44	44 (34)
45–54	2 (1.6)
55–64	1 (0.8)
Household income for 2019, USD (n = 125)	
<10,000	5 (4)
10,000–20,000	5 (4)
20,000–35,000	23 (18.4)
35,000–50,000	35 (28)
50,000–70,000	27 (21.6)
70,000–100,000	20 (16)
>100,000	10 (8)
Race	
Latinx	18 (14)
Native American	9 (7)
Asian	6 (4.6)
Native Hawaiian or other Pacific Islander	5 (3.9)
Black/African-American	10 (7.7)
White	80 (62)
Two or more races	1 (0.8)
Geographic region (n = 128)[a]	
Northeast	26 (20.3)
Midwest	25 (19.5)
South	36 (28.1)
West	41 (32)
Household members, median (IQR), mean (SD)	4 (3–5), 4.2 (1.4)
Child-level characteristics	
Child's age, median (IQR), mo, mean (SD)	4 (2–16), 9.4 (9.6)
Prematurity	30 (23.3)
Female sex	57 (44.2)
Developmental concerns	61 (47.3)
Developmental disability	
Autism spectrum disorder	7 (5.4)
Blindness	2 (1.6)
Cerebral palsy	4 (3.1)
Intellectual disability	3 (2.3)
Seizures	3 (2.3)
Developmental delay	16 (12.4)
Hearing loss	7 (5.4)

(Table continues)

Table 1. Continued

(N = 129)	Response Sample, No. (%)
Any	42 (32.6)
Material hardship	
Food insecure	113 (87.6)
Diaper need[b]	
High	51 (39.5)
Low	47 (36.4)

Participants reported current (2021) diaper need. Source: Shaffer E, Porter S, Zha P, et al. Diaper need as a measure of material hardship during COVID-19. *Nurs Res.* 2021. [a]Northeast includes CT, ME, MA, NH, NJ, NY, PA, RI, and VT. Midwest includes IL, IN, IA, KS, MI, MN, MO, NE, ND, OH, SD, and WI. South includes AL, AR, DE, DC, FL, GA, KY, LA, MD, MS, NC, OK, SC, TN, TX, VA, and WV. West includes AK, AZ, CA, CO, HI, ID, MT, NV, NM, OR, UT, WA, and WY. [b]High diaper need is defined as an insufficient supply of diapers to get through the month. IQR, interquartile range; USD, US dollars.

hygiene and consistent calming bedtime routines) and diapering supplies for child sleep promotion.

Although we did find a relationship between diaper need and infant sleep (IS score), we did not find a relationship between diaper need and parent perceptions of sleep (PP score). A discrepancy between parents' positive perceptions of child sleep and child sleep compared with current recommendations has been noted previously.[7,27] However, we did find a significant relationship between high diaper need and parent perceptions of poor child sleep (PP score). This finding may suggest that parents' perspective of sleep becomes more negative when diaper need is a greater challenge.

Limitations

This was a cross-sectional study. The results indicate significant relationships but cannot determine causation, nor can the findings be generalized to all populations. The sample was a small, nonprobability sample and purposefully sampled to contain families experiencing diaper need. Purposeful sampling and the small sample size could lead to sampling bias. Furthermore, survey responses may be subject to social desirability and recall bias. In addition, the BISQ-R has only 1 question that has direct consideration for diaper need: "When your child wakes up during the night, what do you usually do?"

We did not measure or control for all possible covariables in our analysis. There are many additional variables, including household chaos and maternal depressive symptoms, that have been associated with sleep in children from under-resourced families. Furthermore, when food insecurity was included in our model, 2019 household income was only significant when grouped into less than and equal to 100,000 US dollars and greater than 100,000. This may be related to the role of food security as a measure of poverty, disruptions in the supply chain during the year 2020, or the small sample size. Longitudinal studies, population-based studies, and studies with diverse populations could help mitigate these limitations and are areas for future research. Future studies with a larger sample size, random sampling, and consideration of other social determinant factors are needed to understand the associations described in this article.

Table 2. Diaper Need and Sleep Scores Bivariate Analysis

Diaper Need	Total Score[a] (n = 129)					
	b	SE	CI 95% Lower	CI 95% Upper	t	p
No (ref.)	—	—	—	—	—	—
Yes	−7.83	2.76	−13.30	−2.36	2.83	0.005
No/low[b] (ref.)	—	—	—	—	—	—
High	−5.36	2.44	−10.19	−0.52	2.19	0.030

Diaper Need	Infant Sleep Subscale[c] (n = 128)					
	b	SE	CI 95% Lower	CI 95% Upper	t	p
No (ref.)	—	—	—	—	—	—
Yes	−14.59	3.41	−21.35	−7.84	4.28	<0.001
No/low[b] (ref.)	—	—	—	—	—	—
High	−2.97	3.36	−9.29	3.36	0.93	0.355

Diaper Need	Parent Perception Subscale[d] (n = 129)					
	b	SE	CI 95% Lower	CI 95% Upper	t	p
No (ref.)	—	—	—	—	—	—
Yes	−5.54	3.85	−13.17	2.08	1.44	0.153
No/low[b] (ref.)	—	—	—	—	—	—
High	−7.54	3.33	−14.13	−0.95	2.27	0.025

CI, confidence interval. [a]Total sleep scores were an average of Infant Sleep subscale, Parent Perception subscale, and Parent Behavior subscale scores. [b]Low diaper need is defined as typically having enough diapers to get through the month but needing diapers once to several times a year. No diaper need is defined as always having a sufficient supply of diapers. High diaper need is defined as an insufficient supply of diapers to get through the month. [c]The Infant Sleep subscale includes sleep onset latency, night wakings, longest stretch, and total nighttime sleep. Scores are norm-referenced and range from 0 to 100. Higher scores indicate better sleep. [d]Higher Parent Perception (PP) subscale scores indicate parent belief that the child has higher sleep quality, easier bedtime, and fewer sleep difficulties. PP subscale scores are norm-referenced and range from 0 to 100.

Implications

Sleep is a priority for many families, but socioeconomic barriers can impede the achievement of healthful sleep.[7,28] Obtaining adequate sleep is critical in the infant and toddler period. Adequate sleep is associated with child flourishing and socioemotional health.[4,29]

Table 3. Multiple Linear Regression Model for the Association of Diaper Need with Total Sleep Score (n = 125)[a]

Variable	Total Sleep Score[b] Model					
	b	SE	CI 95% Lower	CI 95% Upper	t	p
Diaper need						
No (ref.)						
Yes	−6.49	−0.96	−10.81	−2.16	−2.97	0.004
Child age	−0.96	0.09	−1.14	−0.78	−10.51	<0.001
Household income						
≤$100,000 (ref.)						
>$100,000	7.77	7.77	1.32	14.21	2.39	0.019
Food security						
Secure (ref.)						
Insecure	−0.56	−0.56	−6.02	4.89	−0.21	0.838
Disability						
No (ref.)						
Yes	−5.97	−5.97	−9.87	−2.08	−3.04	0.003
Race						
White (ref.)						
Latinx	−7.45	−7.45	−12.93	−1.97	−2.69	0.008
Black/African-American	−2.59	−2.59	−10.81	−2.16	−0.81	0.003
Other[c]	−1.21	−1.21	−5.99	3.57	−0.50	0.616

CI, confidence interval. [a]Model adjusted R^2 = 0.55. [b]Total score is an average of 3 subscales — Infant Sleep subscale (quantity and wakings), Parent Perception subscale (caregiver appraisal of child sleep), and Parent Behavior subscale (sleep ecology such as bedtime routines, response to wakings, and sleep locations). Scores are norm-referenced and range from 0 to 100. Higher scores indicate better sleep. [c]Other race includes Asian, Native American, Native Hawaiian or other Pacific Islander, and 2 or more races.

Table 4. Multiple Linear Regression Models (n = 124, 125)

Variable	Association of Diaper Need with Infant Sleep Score[a,b]					
	b	SE	CI 95% Lower	CI 95% Upper	t	p
Diaper need						
No (ref.)						
Yes	−11.95	10.06	−17.72	−6.18	−4.10	<0.001
Child age	−0.78	0.16	−1.12	−0.47	−4.88	<0.001
Household income						
≤$100,000 (ref.)						
>$100,000	10.40	4.38	1.72	19.08	2.37	0.019
Food security						
Secure (ref.)						
Insecure	−2.16	3.75	−9.59	5.28	−0.57	0.567
Disability						
No (ref.)						
Yes	−3.14	2.60	−8.29	2.01	−1.21	0.230
Parent behavior (PB)[c]	0.24	0.11	0.02	0.46	2.14	0.035
Variable	Association of High Diaper Need with Parent Perception Score[d,e]					
	b	SE	CI 95% Lower	CI 95% Upper	t	p
Diaper need						
No/low (ref.)						
High	−7.28	3.01	−13.25	−1.32	−2.42	0.017
Food security						
Secure (ref.)						
Insecure	4.62	4.26	−3.81	13.05	1.09	0.280
Disability						
No (ref.)						
Yes	−12.59	3.18	−18.89	−6.29	−3.95	<0.001
Race						
White (ref.)						
Latinx	−7.41	4.12	−15.56	0.75	−1.80	0.075
Black						
African-American	−6.99	5.31	−17.50	3.52	−1.32	0.191
Other[f]	−2.71	4.04	−10.71	5.29	−0.67	0.504
Parent behavior (PB)[c]	0.33	0.14	0.05	−0.61	2.32	0.022

Scores are norm-referenced and range from 0 to 100. Higher scores indicate better sleep quality and quantity. PP, Parent Perception. [a]Association of diaper need with Infant Sleep score model. Model adjusted R^2 = 0.47. [b]The Infant Sleep subscale includes sleep onset latency, night wakings, longest stretch, and total nighttime sleep. Scores are norm-referenced and range from 0 to 100. Higher scores indicate better sleep. [c]The Parent Behavior subscale quantifies sleep ecology including bedtime routine, parental response to night wakings, and sleep locations. [d]Association of high diaper need with PP subscale score model. Adjusted R^2 = 0.32. [e]Higher PP subscale scores indicate parent belief that the child has higher sleep quality, easier bedtime, and fewer sleep difficulties. PP subscale scores are norm-referenced and range from 0 to 100. [f]Other race includes Asian, Native American, Native Hawaiian or other Pacific Islander, and 2 or more races.

The COVID-19 pandemic has uncovered health disparities among children and the importance of measures that minimize social determinants of health.[30] There are many complexities and considerations related to social determinants of health, parents' perceptions, and ability to manage sleep. While diaper need is not an independent nor the only factor, ensuring adequate access to diapering supplies may contribute to improved sleep outcomes for children at a critical period in their development. This is especially important for children with or at risk for developmental disability. Regulated sleep is often challenging for these children at baseline, and appropriate sleep patterns are associated with improved health and better developmental outcomes.[1,4,5]

Possible interventions include screening for diaper need or material hardship in pediatric care settings. All children should be screened for social determinants of healthy, developmentally appropriate sleep patterns, and providers should provide guidance on appropriate sleep practices at all well-child visits. Clinicians may consider asking specifically about diapers when the family is at risk for diaper need, i.e., family is food insecure, child uses diapers, and/or history of multiple episodes of diaper dermatitis.[16,23] Providers can connect families to resources after a positive

screen and include organizations that provide diapering supplies on resource lists and parent handouts. Finally, this study has policy implications, including the possible inclusion of diaper supplies in safety net programs.

CONCLUSION

Diapers are important hygiene items during the foundational early childhood years. Sleep is critical for child health and growth. In this study, we found that an inadequate supply of diapers was associated with decreased pediatric sleep. Access to diapers is a potentially modifiable factor with possible benefits to child sleep quantity and quality.

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