Received: 22 November 2019 | Revised: 17 March 2020 | Accepted: 19 March 2020

DOI: 10.1111/jsr.13047

REGULAR RESEARCH PAPER

Journal of Sleep Research

Maternal perinatal depression and infant sleep problems at 1 year of age: Subjective and actigraphy data from a population-based birth cohort study

Camila S. Halal[1,2] | Diego G. Bassani[3,4] | Iná S. Santos[4] | Luciana Tovo-Rodrigues[4] | Bianca Del-Ponte[4] | Mariangela F. Silveira[4] | Andréa D. Bertoldi[4] | Fernando C. Barros[4,5] | Magda L. Nunes[6]

[1]PhD Program of Medicine and Health Sciences, Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS), Porto Alegre, Brazil

[2]Conceição Hospital Group, Hospital Criança Conceição, Porto Alegre, Brazil

[3]Centre for Global Child Health, The Hospital for Sick Children and Department of Paediatrics, University of Toronto, Toronto, ON, Canada

[4]Postgraduate Program in Epidemiology, Federal University of Pelotas, Pelotas, Brazil

[5]Graduate Studies Program in Health and Behaviour, Universidade Católica de Pelotas, Pelotas, Brazil

[6]Division of Neurology, Pontifícia Universidade Católica do Rio Grande do Sul School of Medicine, Brain Institute (BRAIns), Porto Alegre, Brazil

Correspondence
Camila dos Santos El Halal, Gerência de Internação, Hospital Criança Conceição, Avenida Francisco Trein, 596, CEP 91350-200, Porto Alegre, RS, Brazil.
Email: camilahalal@hotmail.com

Funding information
CNPq - Brazilian National Council for Scientific and Technological Development; Wellcome Trust, Grant/Award Number: 095582; FAPERGS - Research Support Foundation of the State of Rio Grande do Sul

Abstract

This study used data from 2,222 mothers and infants participating in a population-based birth cohort to verify whether maternal depression in the perinatal period was associated with poor infant sleep. Mothers who scored ≥13 points on the Edinburgh Postnatal Depression Scale at 16–24 weeks of gestation and/or 3 months after delivery were considered perinatally depressed. The main outcome variable was poor infant sleep at 12 months of age, defined as >3 night wakings, nocturnal wakefulness >1 hr or total sleep duration <9 hr. Infant sleep data were obtained with the Brief Infant Sleep Questionnaire (BISQ) and 24-hr actigraphy monitoring. Prevalence of perinatal depression in the sample was 22.3% (95% confidence interval [CI], 20.5–24.0). After Poisson regression, infants of depressed mothers showed an adjusted relative risk (RR) of 1.44 (95% CI, 1.00–2.08; $p = .04$) for >3 night wakings with questionnaire-derived data. When actigraphy data were analysed, no association was found between perinatal depression and poor infant sleep (adjusted RR, 1.20; 95% CI, 0.82–1.74; $p = .35$). In conclusion, although mothers in the depressed group were more likely to report more night wakings, objective data from actigraphy did not replicate this finding. Dysfunctional cognition, maternal behavioural factors and sleep impairment associated with perinatal depression may affect the mother's impression of her infant's sleep.

KEYWORDS
actigraphy, cohort studies, depression, antenatal, postpartum, sleep, surveys and questionnaires

1 | INTRODUCTION

Maternal perinatal depression, defined as an episode of major depression occurring from pregnancy to the first 12 months after delivery, is a highly prevalent condition, affecting up to 20% of childbearing women (Gelaye, Rondon, Araya, & Williams, 2016; O'Hara & McCabe, 2013; Stuart-Parrigon & Stuart, 2014). Perinatal depression has been associated with altered child sleep behaviour from birth throughout childhood, with evidence of longer periods of indeterminate sleep (not clearly characteristic of active versus quiet sleep) in neonates, as well as shorter sleep duration, longer sleep latency, more night wakings and, in objective measurements of sleep, lower efficiency and altered sleep microstructure (Armitage et al., 2009; Bat-Pitault et al., 2017; Diego, Field, & Hernandez-Reif, 2005; Field et al., 2007; O'Connor et al., 2007).

Maternal depression may influence infant sleep through several mechanisms. In depressive states, higher than average levels of corticotropin-releasing hormone (CRH) produced by the placenta can cause abnormal autonomic activity in the foetal brain and reprogramming of the foetal hypothalamic-pituitary axis to increasing cortisol production (Field, Diego, & Hernandez-Reif, 2006). Elevated corticosteroid levels may alter the normal pattern of development of the foetal sleep–wake cycle, which can last beyond birth, possibly presenting as longer periods of crying and active vigil states in the first weeks of life (de Weerth, van Hees, & Buitelaar, 2003). Alternatively, higher levels of catecholamines in depressive states following sympathoadrenal hyperactivation could increase blood pressure and uterine artery resistance, hence reducing foetal oxygenation and ultimately reprogramming the development of key structures in circadian rhythmicity, such as the suprachiasmatic nucleus (Field et al., 2006; de Weerth, Zijl, & Buitelaar, 2003).

Behavioural mechanisms are also likely to play a role in mediating maternal depression and infant sleep. In pregnancy, neurocognitive changes in maternal reward and motivational neural networks prepare mothers to engage with their infant and respond to their signals (Pearson et al., 2012). Disturbance of such neurocognitive rearrangement in depressive states may therefore impair maternal emotional perception of and responsiveness to infant discomfort and night-time fussing. Parenting may be directly affected through the aforementioned neural mechanisms in depressive states, as well as indirectly through interparental conflict (Sadeh, Tikotzky, & Scher, 2010; Stein et al., 2014). Compromised parenting quality may facilitate behaviours that may be hazardous to infant sleep quality, such as irregular sleep and bedtime schedules (Field, 2010). Moreover, throughout a healthy pregnancy, total maternal sleep time gradually decreases and sleep fragmentation increases (Lee, Zaffke, & McEnany, 2000). Depression is highly and bidirectionally correlated with insomnia symptoms (Dørheim, Bondevik, Eberhard-Gran, & Bjorvatn, 2009). Thus, maternal sleep deprivation in the postpartum period may enhance depressive symptoms, and depression may, likewise, enhance maternal difficulty in initiating or maintaining sleep. In this context, maternal hyperarousal states in depression may facilitate maternal perception of infant night-time waking. Furthermore, maternal difficulty in resuming sleep may lead to the perception of longer infant night-time vigils and lower infant sleep quality.

Sleep health is intimately linked to brain development and child behaviour, and sleep disturbances very early in life may play a long-lasting detrimental role in the child's overall health and well-being (Field, 2017). Thus, the objective of this study was to evaluate whether 12-month-old infants exposed to maternal perinatal depression were at higher risk of sleep disturbances, as measured through a standardized questionnaire and actigraphy monitoring, compared to unexposed infants. We hypothesized that, compared to infants of mothers without perinatal depression, those whose mothers were depressed in the perinatal period would show a higher risk of presenting more than three night wakings, sleeping less than 9 hr in 24 hr, or spending more than 1 hr awake during the night.

2 | METHODS

2.1 | Context and enrolment

This study used data from the 2015 Pelotas Birth Cohort Study, conducted by the Federal University of Pelotas, Brazil (Hallal et al., 2017). Pelotas is a city of approximately 330,000 inhabitants located in southern Brazil, of which around 95% live in the urban area. The 2015 cohort is a population-based study designed to include all children born to mothers living in the urban area of the municipality throughout that year.

Enrolment started during gestation, with weekly visits by trained fieldworkers to the 123 public and private antenatal care clinics, ultrasound facilities and laboratories between May 2014 and December 2015, aiming to recruit pregnant women with a due date from January 1 through to December 31, 2015. In the initial interview, expectant mothers between 16 and 24 weeks gestation responded to a structured computer-assisted questionnaire containing information on demographic, socioeconomic and behavioural characteristics, as well as on reproductive history, antenatal care and chronic or acute illnesses. To enrol mothers who had not been reached during gestation, and to conduct maternal and neonatal assessments, interviewers also paid daily visits to the city's five maternity hospitals, in which approximately 99% of all deliveries occur, from January 1 to December 31, 2015. Neonates were weighed using SECA portable paediatric scales, model 376 (SECA, seca gmbh and co. kg, Hamburg, Germany), and gestational age was calculated from first or second trimester ultrasound or last menstrual period. Hospital charts were reviewed to collect Apgar scores. Need for intensive care after birth was assessed through the questionnaire answered by the mother and from hospital records. Further information on the cohort's development and methodology can be found elsewhere (Hallal et al., 2017).

Women taking part in the Physical Activity for Mothers Enrolled in Longitudinal Analysis (PAMELA) study and mothers of children participating in a sleep intervention trial (Sleep Study) were excluded from the analyses (Domingues et al., 2015; Santos et al., 2016). The decision to exclude participants of the two trials was based on the assumption that taking part in a physical activity trial could impact maternal depressive symptoms, and that the sleep trial could attenuate poor sleep symptoms in infants.

2.2 | Follow-up

Mothers who had been enrolled and evaluated during gestation were interviewed within 48 hr of delivery. Those who had not been identified during antenatal care were invited to participate during the interviewer´s visit to the maternity hospital and were likewise

interviewed in the first 48 hr after delivery. Mothers were also interviewed 3 and 12 months after delivery.

2.3 | Evaluation of maternal depressive symptoms

Maternal depression was assessed during gestation and 3 months after delivery using the Edinburgh Postnatal Depression Scale (EPDS) (Cox, Holden, & Sagovsky, 1987), previously validated for the Brazilian population (Santos et al., 2007). The EPDS is a 10-item scale in which each item has four possible responses (from 0 to 3), with a minimum total score of 0 and a maximum of 30. The scale expresses the intensity of depressive symptoms over the preceding 7 days. Mothers with EPDS scores ≥13 (sensitivity and specificity of 59.5% and 88.4%, respectively (Santos et al., 2007)) during pregnancy and/or at 3 months after delivery were considered at increased risk of perinatal depression. Mothers who were recruited during pregnancy answered the EPDS during gestation, and then at 3 months. Those who were contacted first in the perinatal period answered the EPDS only at 3 months after delivery.

2.4 | Assessment of child sleep

2.4.1 | Subjective assessment

Child sleep was evaluated 12 months after birth, in a visit previously scheduled for the period between 7 days before and after the child's birthday. Mothers answered the Brief Infant Sleep Questionnaire (BISQ), designed by Sadeh et al. and previously adapted and validated for the Brazilian population (Del-Ponte et al., 2020; Nunes, Kampff, & Sadeh, 2012; Sadeh, 2004). The BISQ is a 5- to 10-min-long questionnaire containing questions related to the infant's sleep periods over the preceding week, and can be applied from 0 to 3 years of age. Questions include sleep organisation, habitual sleep position, soothing techniques, daytime and nocturnal sleep duration, number of night wakings, nocturnal wakefulness, sleep latency, habitual bedtime and maternal impression of the child's sleep quality.

2.4.2 | Objective assessment

For objectively evaluating sleep, the infants wore an actigraphy monitor, model *wGT3X-BT* (ActiGraph), on the wrist for 3 days. Due to the logistic planning of the main cohort, the actigraphy devices were placed in the morning or afternoon of the day of the interview and removed 3 days later, thus allowing for information on one full day of sleep monitoring. Placement of the actigraphy device was chosen after a pilot study indicated better adherence to the device when used on the wrist in comparison to one of the lower limbs (Ricardo et al., 2017). The Sadeh algorithm was used for data extraction with 1-min epochs, in which minimal sleep period length was set at 15 min, sleep onset was defined as three uninterrupted minutes of reduced movements, night-time wakings were defined as at least five consecutive 1-min epochs preceded and followed by sleep, and awake time was defined as 15 min of increased body movement (Sadeh, Acebo, Seifer, Aytur, & Carskadon, 1995).

2.5 | Sleep outcomes

Main sleep outcomes were number of night wakings (episodes of awakening of 5 min or more), nocturnal wakefulness (sum of the time awake after first night-time sleep onset until awakening the following morning), nocturnal sleep duration (minutes), daytime sleep duration (minutes) and total sleep duration in 24 hr (minutes). Infants whose mothers reported >3 night wakings, >1 hr of nocturnal wakefulness or total sleep duration <9 hr during the 24-hr period were considered poor sleepers, based on the findings by Sadeh (2004). Other data retrieved from the BISQ questionnaire were preferred sleeping position, soothing technique, daytime and nocturnal sleep duration (minutes), usual sleep time, sleep latency (time from bedtime to sleep onset in minutes), and maternal impression of infant's problematic sleep. As for actigraphy, nocturnal and daytime sleep duration (minutes), sleep efficiency (a ratio between total sleep duration and time in bed) and usual bedtime (clock time after 19:00 hours in which the infant falls asleep, or clock time of sleep onset if sleep initiated before 19:00 hours and continued past this hour) were retrieved.

2.6 | Confounders

Potential confounders included maternal characteristics prior to delivery. To be considered a confounder, the variable had to be associated with both the exposure (maternal perinatal depression) and the sleep outcomes with a p-value <.20 and could not be part of the causal pathway between maternal perinatal depression and infant sleep outcomes (Maldonado & Greenland, 1993). This decision was based on a conceptual framework describing the postulated hierarchical relations between exposures, and included maternal age in complete years (<20, 20–29, 30–39, ≥40), complete years of formal education (0–4, 5–8, 9–11, ≥12), self-reported skin colour (white/non-white), presence of partner or spouse (yes/no), parity including current gestation (1, 2, ≥3), history of abortion (yes/no), number of relatives (0, 1, ≥2) and offspring (0, 1, ≥2) living in the same household, planning of the pregnancy (yes/no), number of antenatal care appointments (1–4, 5–8, ≥9), intragestational morbidities such as high blood pressure (yes/no) and diabetes mellitus (yes/no), physical activity during pregnancy (yes/no), smoking during pregnancy (yes/no), alcohol consumption during pregnancy (yes/no), any illegal drug use during pregnancy (yes/no), feeling supported by the child's father (yes/no), and intention to breastfeed (yes/no) (Victora, Huttly, Fuchs, & Olinto, 1997). Maternal socioeconomic status was assessed by the Brazilian Criteria of Economic Classification, which divides families into five

categories (A to E, with A as the wealthiest) and takes into account the head-of-family's educational level and the household assets (ABEP Associação Brasileira de Empresas de Pesquisa, 2016).

2.7 | Analyses

Prevalence of maternal perinatal depression with 95% confidence interval (95% CI) was calculated first. Then, infant sleep indicators at 12 months were analysed according to maternal perinatal depressive status and the association was tested with the chi-squared test of heterogeneity (for categorical indicators). Poisson regression was performed to estimate crude and adjusted relative risks (RRs) and their respective 95% CI. All the analyses used Stata version 14.2 (StataCorp LP).

2.8 | Exploratory Analysis

Exploratory analyses were performed to verify whether maternal depression at specific points in time might have a greater effect on infant sleep characteristics. We considered maternal depression in four distinct presentations: (a) maternal depression limited to the gestational period; (b) maternal depression limited to the postpartum; (c) maternal depression in the postpartum, starting either during pregnancy or after delivery; and (d) maternal depression both during pregnancy and in the postpartum. Confounders included those already taken into consideration in the main analysis. However, when maternal depression limited to the postpartum was analysed, the infant's perinatal characteristics (mode of delivery, birthweight, gestational age, sex, 5-min Apgar score, need for intensive care at birth, and length of hospital stay after birth) were also included as potential confounders. For these analyses, all independent variables were entered into the adjusted models and were then selected in backward stepwise fashion, starting with the variable with the highest *p*-value and stopping when all the remaining variables were associated with the outcome at *p*-value ≤.20.

2.9 | Ethics and consent

The Institutional Review Board of the Federal University of Pelotas, affiliated with the Brazilian National Committee for Research Ethics (CONEP), approved the study protocols for all of the cohort's waves. Mothers signed a written informed consent form. Mothers with severe depressive symptoms were referred to mental health care services.

3 | RESULTS

A total of 4,275 live neonates were enrolled in the 2015 Pelotas Birth Cohort, 3,199 of whose mothers (73.8%) were enrolled during gestation. After exclusion of participants from the PAMELA trial (*n* = 424) and Sleep Study (*n* = 586) and accounting for refusals, deaths and losses from birth to the 12-month follow-up (*n* = 541), as well as for mothers with missing information on depression during pregnancy and/or at 3 months follow-up (*n* = 502), 2,222 mother–infant dyads were included in the analyses. Figure 1 shows the flowchart of the enrolment process and final sample.

Prevalence of perinatal depression in our sample was 22.3% (*n* = 495; 95% CI, 20.5–24.0). Of these mothers, 267 (53.9%) were only depressed during pregnancy, 99 (20%) were only depressed at 3 months after delivery, and 129 (26.1%) were depressed both during pregnancy and after delivery. The majority of mothers (*n* = 1,727; 77.3%) did not meet the criteria for depression in any of the analysed time frames.

Table 1 shows the mothers' characteristics. Nearly half of the mothers (46.3%) were 20–30 years of age; 36.2% had from 9 to 11 years of formal education and 22% were in one of the extremes of socioeconomic status. Most of the mothers self-identified as white (72.2%), living with a spouse/partner and not sharing the household with other family members. Slightly over half of the mothers were not primiparous (51.4%), 34.5% reported a previous history of abortion and about half had at least one other child in the household. Almost half the women had not planned the pregnancy and only a few (6.4%) had attended fewer than five antenatal appointments. Nearly all the mothers said they intended to breastfeed. Few mothers (13.9%) reported physical activity during the pregnancy. Gestational morbidities such as high blood pressure, diabetes mellitus and smoking were reported by 26.5%, 9.9% and 15.1% of mothers, respectively, whereas 27 mothers (1.2%) reported illegal drug use and 7.1% (*n* = 157) reported any alcohol consumption during pregnancy. Two-thirds (66.0%) of the deliveries were by Caesarean section. Most mothers (88%) said they felt supported by their spouse or partner.

The prevalence of low birthweight (<2,500 g) was 11.3% and 16.6% of the neonates were preterm. As shown in Table 2, fewer than 1% had a 5-min Apgar score below 7, 11.8% required intensive care at birth and 70% were discharged from hospital within 4 days.

BISQ data and actigraphy records were available for 2,222 and 1,462 of the infants, respectively (Figure 1). Table 3 shows the means and proportions of infant sleep characteristics according to the data source (BISQ or actigraphy) and maternal depression status. Sleep characteristics were similar between groups, with children of depressed mothers taking around 3 min longer to fall asleep according to the BISQ (*p* = .01). Nocturnal wakefulness was greater in both groups according to actigraphy when compared to data reported by the mothers in BISQ. The number of night wakings did not differ between the groups, regardless of the data source. There were no differences in soothing techniques employed by depressed versus non-depressed mothers, but depressed mothers were more likely to consider their infant's sleep problematic (*p* = .005).

Figure 2 shows the prevalence rates for poor infant sleep as reported by depressed and non-depressed mothers. Prevalence rates were similar between the groups, except for prevalence of more than three night wakings, which was higher in infants of depressed

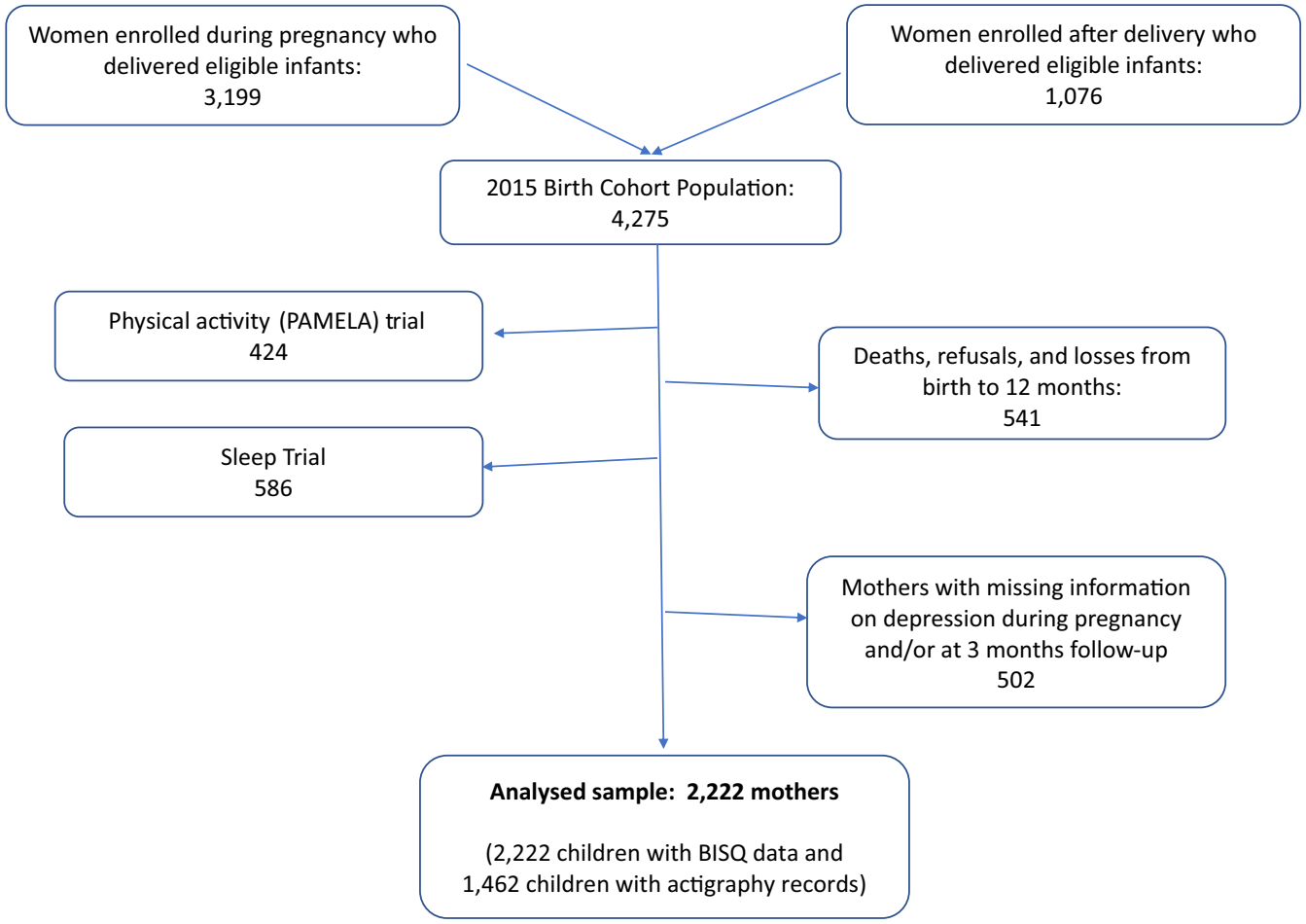

FIGURE 1 Study participants flowchart

versus non-depressed mothers, but only according to the BISQ data (8.2% versus 5.6%, respectively; $p = .04$).

Table 4 presents the results from crude and adjusted Poisson regression analyses. According to the BISQ data, the risk of sleep problems (as measured by night wakings) was 45% higher in infants of depressed mothers compared to those of non-depressed mothers (RR = 1.45; 95% CI, 1.01–2.08; $p = .04$) and 44% higher (RR = 1.44; 95% CI, 1.00–2.08; $p = .04$) when the data were adjusted for confounding. However, based on the actigraphy data, the risk did not differ between the groups, even after adjusting for confounding (adjusted RR = 1.20; 95% CI, 0.82–1.74; $p = .35$). As seen in Table 4, according to both crude and adjusted analyses of both BISQ and actigraphy data, infants of depressed mothers did not show greater risk of short total sleep duration or long nocturnal wakefulness.

3.1 | Exploratory analysis

Regardless of the data source (BISQ or actigraphy), none of the time frames of maternal depression (limited to the pregnancy; limited to the postpartum; during postpartum and having started either during or after the pregnancy; or present in both the pregnancy and postpartum) was particularly associated with increased risk of any infant sleep outcome. Tables S1–S4 show the results of an exploratory analysis.

4 | DISCUSSION

In our study, although questionnaire-derived data suggested a higher risk of sleep problems (in the form of more night wakings) at 12 months of age among infants of mothers with perinatal depression, the findings were not replicated when objective (actigraphy) data were analysed. In addition, infants of depressed mothers did not experience greater risk of other outcomes suggestive of poor sleep. In exploratory analyses, even when maternal depression was disaggregated (gestational depression, postpartum depression, postpartum depression starting in pregnancy or after delivery up to 3 months, or depression in both periods), no effect of maternal depression on infant sleep was detected.

Earlier studies have used objective instruments to asses sleep in infants of mothers with current or previous depression. In Armitage et al. (2009), infants of depressed mothers assessed in the first 6 months of life showed longer sleep latency, lower sleep efficiency and more arousals than infants of non-depressed mothers, as measured by actigraphy. A study that assessed sleep with

TABLE 1 Maternal characteristics in the analysed sample. 2015 Pelotas Birth Cohort

Characteristics	*n* (%)
Age (years)	
<20	316 (14.2)
20–29	1,028 (46.3)
30–39	812 (36.6)
≥40	65 (2.9)
Schooling (years)	
0–4	178 (8.0)
5–8	567 (25.5)
9–11	802 (36.2)
≥12	673 (30.3)
Socioeconomic status[a]	
A	84 (3.9)
B	551 (25.7)
C	1,114 (51.9)
D-E	398 (18.5)
White self-reported skin colour	1,604 (72.2)
Living with spouse/partner (yes)	1,840 (82.8)
Number of relatives sharing the household	
0	1,545 (69.5)
1	237 (10.7)
≥2	440 (19.8)
Number of children sharing the household	
0	1,130 (50.9)
1	726 (32.7)
≥2	366 (16.4)
Parity	
1	1,078 (48.6)
2	709 (31.9)
≥3	434 (19.5)
Previous abortion(s) (no)	848 (65.5)
Planned pregnancy (yes)	1,151 (51.8)
Number of antenatal appointments	
1–4	142 (6.4)
5–8	934 (42.3)
≥9	1,130 (51.3)
Physical activity during pregnancy (yes)	309 (13.9)
Intention to breastfeed (yes)	2,191 (98.9)
Mode of delivery	
Vaginal	756 (34.0)
Caesarean	1,465 (66.0)
Gestational hypertension (yes)	589 (26.5)
Gestational diabetes (yes)	221 (9.9)
Smoking during pregnancy (yes)	335 (15.1)
Alcohol consumption during pregnancy (yes)	157 (7.1)
Illegal drug use during pregnancy (yes)	27 (1.2)
Felt supported by spouse/partner (yes)	1,944 (88.5)

[a]According to the Brazilian Criteria of Economic Classification.

TABLE 2 Characteristics of neonates in the analysed sample. 2015 Pelotas Birth Cohort

Characteristics	*n* (%)
Sex	
Female	1,117 (50.3)
Male	1,105 (49.7)
Gestational age (weeks)	
<37	369 (16.6)
≥37	1,853 (83.4)
Birthweight (grams)	
<2,500	251 (11.3)
≥2,500	1,970 (88.7)
5-min Apgar score	
≥7	2,202 (99.2)
<7	17 (0.8)
Intensive care at birth	
No	1,959 (88.2)
Yes	263 (11.8)
Length of hospital stay (days)	
<4	1,553 (70)
≥4	667 (30)

24-hr polysomnography at birth and 6 months of age found macro and microstructural sleep differences between infants of mothers diagnosed with depression compared to those of mothers with no personal history of depression (Bat-Pitault et al., 2017). Both studies assessed sleep at different ages to those in our study, and considering the important changes in sleep maturation throughout the first year of life, the findings may not be comparable. For example, total expected sleep time in 24 hr decreases from 14–17 hr between birth and 3 months of age down to 11–14 hr at 12 months of age. Sleep also shifts from a polyphasic pattern to a circadian rhythm in the first 6 months, with reduction in the number of daytime naps and night-time wakings. (Hirshkowitz et al., 2015; McLaughlin Crabtree & Williams, 2009).

Importantly, questionnaires measure signalled night wakings, whereas actigraphy measures motor awakenings, not necessarily noticed by the mother. However, our study did not compare subjective versus objectively measured infant sleep, but exposure versus non-exposure to maternal depression according to method of sleep assessment separately.

Although the BISQ has proved to be a suitable method for evaluating poor sleep in infancy (Sadeh, 2004), our findings suggest that maternal depression may play a role in interpretation of infants' number of wakings, possibly through a dysfunctional cognition regarding infants' sleep quality and behaviour and, consequently, in the form of a memory bias. Studies by Teti & Crosby, Cornish et al., Morrell & Steele and Sadeh et al. suggest that depression plays a role in maternal perception of infant temperament, including difficulty in initiating and maintaining sleep (Cornish et al., 2006; Morrell & Steele, 2003; Sadeh, Flint-Ofir,

TABLE 3 Mean (standard deviation) or proportion (%) of infants' sleep characteristics measured with the Brief Infant Sleep Questionnaire (BISQ) and actigraphy, according to maternal perinatal depression

	BISQ			Actigraphy		
Sleep characteristics	Non-depressed mothers	Depressed mothers	*p*	Non-depressed mothers	Depressed mothers	*p*
Preferred sleep position, *n* (%)						
Back	482 (28.8)	133 (28.0)	.73			
Belly	369 (22.0)	99 (20.8)				
Side	823 (49.2)	243 (51.2)				
Soothing technique, *n* (%)						
Feeding	684 (41.2)	183 (39.5)	.12			
Rocking	218 (13.1)	73 (15.8)				
Holding	220 (13.2)	53 (11.4)				
Left in bed alone	203 (12.2)	72 (15.6)				
Left in bed near parent	337 (20.3)	82 (17.7)				
Mother considers infant's sleep a problem, *n* (%)						
Not a problem at all	1,537 (91.5)	414 (86.4)	<.01			
Minor problem	115 (6.8)	53 (11.1)				
Very serious problem	29 (1.7)	12 (2.5)				
Nocturnal sleep duration (min), mean (± *SD*)	510.9 (84.8)	503.7 (89.6)	.11	459.9 (90.3)	464.6 (93.6)	.41
Daytime sleep duration (min), mean (± *SD*)	192.3 (96.1)	187.9 (100.1)	.38	136.8 (63.7)	137.3 (66.3)	.90
Number of night wakings (*n*), average (± *SD*)	1.0 (1.3)	1.1 (1.6)	.24	1.9 (1.3)	1.9 (1.3)	.18
Nocturnal wakefulness (min), mean (± *SD*)	50.3 (64.7)	53.0 (67.7)	.43	88.2 (84.1)	82.7 (80.9)	.28
Sleep latency (min), mean (± *SD*)	26.4 (24.6)	29.8 (29.6)	.01			
Total sleep duration (min), mean (± *SD*)	704.5 (107.1)	692.4 (118.6)	.03	597.8 (101.6)	605.9 (109.2)	.20
Sleep efficiency, % (± *SD*)				80.3 (14.2)	78.6 (15.0)	.07
Usual sleep time, mean (± *SD*)	22:10 (01:20)	22:15 (01:21)	.30	21:15 (01:41)	21:14 (01:50)	.94

Note: 2015 Pelotas Birth Cohort.

Tirosh, & Tikotzky, 2007; Teti & Crosby, 2012). This hypothesis is corroborated by the fact that despite very similar sleep characteristics between the groups, depressed mothers were more likely to report their infant's sleep as problematic. Also, because depression and sleep problems such as onset and maintenance insomnia are intimately linked, depressed mothers may be more easily awakened by the infant's night-time wakings (Morin et al., 2015; Swanson, Pickett, Flynn, & Armitage, 2011). Moreover, depressed mothers may express greater difficulty in resuming sleep after a night-time arousal, thus negatively influencing maternal perception of infant sleep quality (Suri et al., 2017).

In a bidirectional pattern, infant sleep difficulties themselves may contribute to maternal depressive symptoms (Sadeh et al., 2010). In a study including only non-depressed mothers in the immediate postpartum, Dennis & Ross found that those whose infants presented with more night wakings and shorter total sleep duration at 4 and 8 weeks after birth were more likely to develop depressive symptoms (Dennis & Ross, 2005). Likewise, Hiscock & Wake found that infant sleep problems and maternal depressive symptoms both decreased significantly after a brief infant behavioural intervention to improve infant sleep in the first 8 months of life (Hiscock & Wake, 2002). The same authors found that mothers who reported that their 6–12-month-old infants had sleep problems were more than twice as likely to present higher scores on depression, compared to mothers who did not report such infant sleep problems (Hiscock & Wake, 2001). However, after adjusting for maternal sleep quality, infant sleep was no longer a predictor of maternal mood. Likewise, Goyal et al. found that maternal but not infant sleep predicted maternal depressive symptoms 3 months after delivery (Goyal, Gay, & Lee, 2009). Considering the important changes in infant sleep during the first year of life, including the development of longer uninterrupted sleep and self-regulation capacity, the results are likely to be influenced by infant age, especially in the first 6 months of life. In a systematic literature review, Douglas and Hill (2013) identified failure to distinguish normal neurodevelopment in the first semester of life as one of the methodological limitations undermining the hypothesis that infant sleep interventions may improve maternal depression scores.

Our study has several strengths. This was a longitudinal population-based study, recruiting the majority of eligible families and with very few refusals and losses to follow-up. In recent decades, actigraphy has played an important role in assessing sleep in clinical

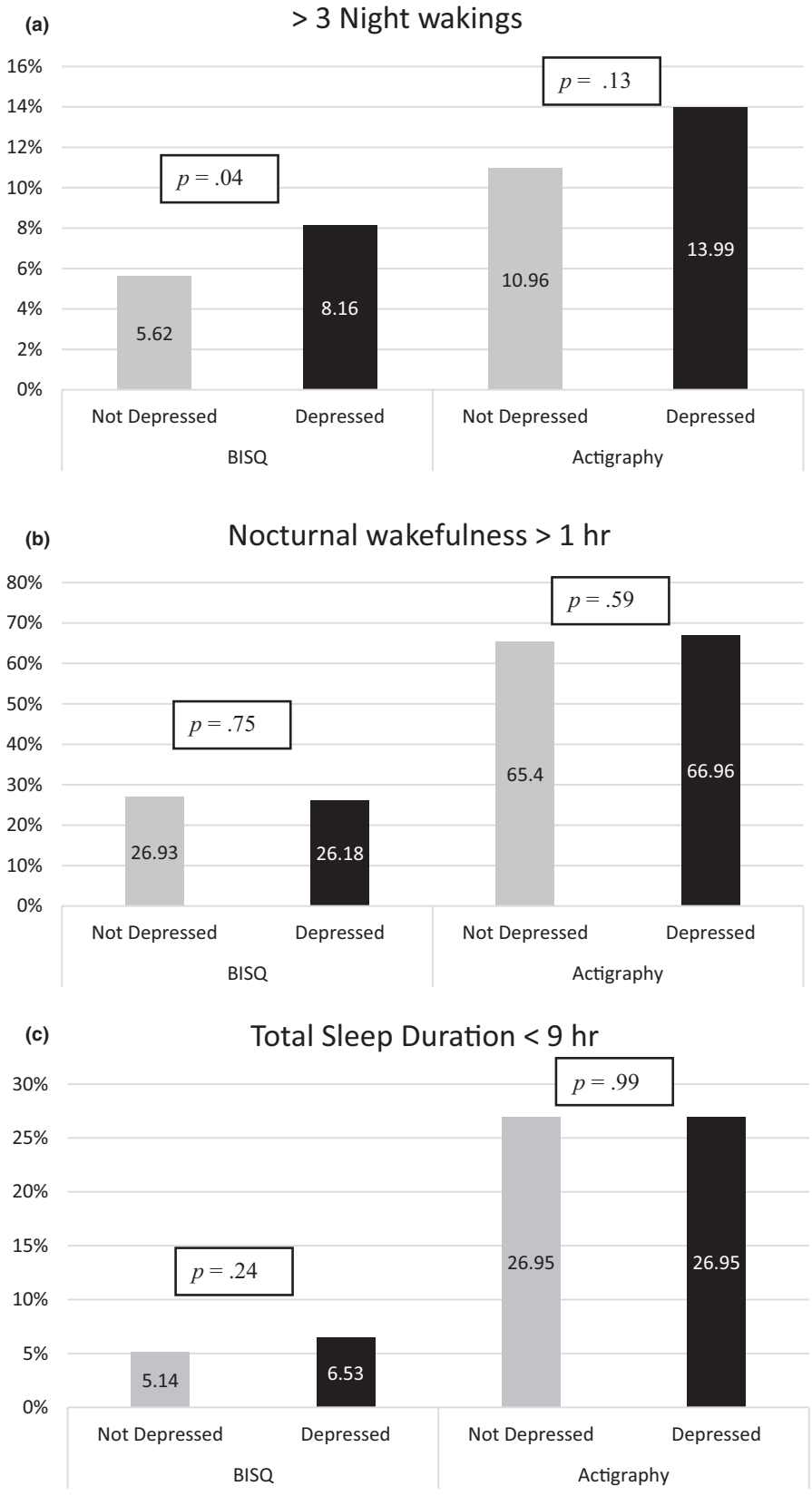

FIGURE 2 Prevalence of main sleep outcomes according to exposure to maternal perinatal depression and to method of obtainment of data. (a) >3 night wakings. (b) Nocturnal wakefulness>1 hr. (c) Total sleep duration in 24 hr < 9 hr

practice and research, especially due to its lower cost, non-invasiveness and non-interruption of daily activities when compared to polysomnography (Sadeh, 2011; Smith et al., 2018). Several studies have validated the use of this tool as a method for analysing most sleep parameters in infancy and childhood, with sensitivity and specificity ranging from 83.4% to 99.3% and from 17.0% to 97.8%, respectively (Martin & Hakim, 2011; Meltzer, Montgomery-Downs, Insana, & Walsh, 2012; Smith et al., 2018). The use of the correct algorithm

TABLE 4 Crude and adjusted relative risks (RRs) and 95% confidence intervals (95% CI) for poor infant sleep at 12 months, according to maternal perinatal depression

	RR (95% CI)	*p*
Maternal perinatal depression and > 3 night wakings – BISQ		
Crude analysis	1.45 (1.01–2.08)	.04
Adjusted Analysis[a]	1.44 (1.00–2.08)	.04
Maternal perinatal depression and > 3 night wakings – actigraphy		
Crude analysis	1.28 (0.93–1.74)	.12
Adjusted Analysis[b]	1.20 (0.82–1.74)	.35
Maternal perinatal depression and total sleep duration < 9 hr – BISQ		
Crude analysis	1.27 (0.85–1.89)	.24
Adjusted Analysis[c]	1.03 (0.68–1.57)	.88
Maternal perinatal depression and total sleep duration < 9 hr – actigraphy		
Crude analysis	0.92 (0.75–1.11)	.38
Adjusted Analysis[d]	0.86 (0.70–1.06)	.16
Maternal perinatal depression and nocturnal wakefulness > 1 hr – BISQ		
Crude analysis	0.97 (0.82–1.15)	.75
Adjusted Analysis[e]	0.92 (0.77–1.09)	.34
Maternal perinatal depression and nocturnal wakefulness > 1 hr – actigraphy		
Crude analysis	0.96 (0.86–1.07)	.49
Adjusted Analysis[f]	1.00 (0.88–1.15)	.94

Note: 2015 Pelotas Birth Cohort Study.

[a]Maternal age, planned pregnancy, gestational diabetes, illegal drug use.

[b]Number of relatives sharing the household, number of children sharing the household, history of abortion.

[c]Maternal schooling, self-reported skin colour, smoking during pregnancy.

[d]Socioeconomic status, number of children sharing the household.

[e]Maternal age, number of children sharing the household, parity, planned pregnancy, gestational diabetes, feeling supported by spouse/partner.

[f]History of abortion, gestational hypertension.

for the selected age group is paramount for optimization of results (Bélanger, Bernier, Paquet, Simard, & Carrier, 2013). Sleep quality and characteristics may be influenced by factors such as illness, medication and sleep duration variations from night to night as well as between weekdays and weekends. Therefore, most studies recommend at least five nights of continuous monitoring for accurate sleep characterization (Acebo et al., 1999). Although actigraphy data were only available for 24 hr in our study, to our knowledge this was the first study to assess sleep with an objective method in a large population-based setting.

A limitation of our study was the fact that sleep diaries could not be included, due to the large number of participants, although they would have been useful for detecting artefacts in actigraphy data. Another potential limitation was the exclusion of children who slept fewer than 15 hr a day at 3 months, who were participating in the nested Sleep Trial. However, at baseline, mean EPDS scores of mothers in the intervention group were similar to those in the control group (5.8 and 5.2, respectively) (Santos et al., 2019). Additionally, in our sample, 81.5% of mothers who were depressed in the perinatal period were still depressed at 12 months after delivery (n = 212 of 260 perinatally depressed mothers whose 12-month depression rates were available).

5 | CONCLUSION

The study's main findings were that infants of mothers with perinatal depression did not show shorter sleep or longer nocturnal wakefulness at 1 year of age, and that depressed and non-depressed mothers used similar soothing techniques. Although subjective sleep data were associated with higher risk of more than three night wakings at 12 months among infants of perinatally depressed mothers, this finding was not replicated by the actigraphy data. Maternal dysfunctional cognition, hyperarousal and sleep-resuming difficulties in depressive states may potentially explain the subjective impression of poorer infant sleep among depressed mothers.

ACKNOWLEDGEMENTS

This article is based on data from the study "Pelotas Birth Cohort, 2015" conducted by the Graduate Studies Program in Epidemiology at Universidade Federal de Pelotas, with the collaboration of the Brazilian Association of Collective Health (ABRASCO). The 2015 Pelotas (Brazil) Birth Cohort is funded by the Wellcome Trust (095582). Funding for specific follow-up visits was also provided by the Brazilian National Council for Scientific and Technological Development (CNPq) and the Research Support Foundation of the State of Rio Grande do Sul (FAPERGS). CSH was supported by the Brazilian Federal Agency for Support and Evaluation of Graduate Education (CAPES). ISS, MFS, ADB and MLN were supported by CNPq.

CONFLICT OF INTEREST

The authors have indicated that they have no potential conflicts of interest to disclose.

AUTHOR CONTRIBUTIONS

CSH and MLN designed the study. CSH performed the analysis and wrote the manuscript. DGB, MFS, ADB and FCB participated in the design and conduct of the original cohort studies. ISS, LT-R and BD-P defined and coordinated sleep instruments and data acquisition. All authors reviewed the manuscript and contributed to interpretation of the results, having approved the final version and agreed to be accountable for all aspects of the work.

ORCID

Camila S. Halal https://orcid.org/0000-0002-0801-7806

Bianca Del-Ponte https://orcid.org/0000-0003-2318-6170

REFERENCES

Associação Brasileira de Empresas de Pesquisa (ABEP). (2016). *Brazilian Criteria of Economic Classification*. At: http://www.abep.org/criterio-brasil

Acebo, C., Sadeh, A., Seifer, R., Tzischinsky, O., Wolfson, A. R., Hafer, A., & Carskadon, M. A. (1999). Estimating sleep patterns with activity monitoring in children and adolescents: How many nights are necessary for reliable measures? *Sleep*, *22*(1), 95–103.

Armitage, R., Flynn, H., Hoffmann, R., Vazquez, D., Lopez, J., & Marcus, S. (2009). Early developmental changes in sleep in infants: The impact of maternal depression. *Sleep*, *32*(5), 693–696.

Bat-Pitault, F., Sesso, G., Deruelle, C., Flori, S., Porcher-Guinet, V., Stagnara, C., … Franco, P. (2017). Altered sleep architecture during the first months of life in infants born to depressed mothers. *Sleep Medicine*, *30*, 195–203. https://doi.org/10.1016/j.sleep.2016.11.018

Bélanger, M., Bernier, A., Paquet, J., Simard, V., & Carrier, J. (2013). Validating actigraphy as a measure of sleep for preschool children. *Journal of Clinical Sleep Medicine*, *9*(7), 701–706. https://doi.org/10.5664/jcsm.2844

Cornish, A. M., McMahon, C. A., Ungerer, J. A., Barnett, B., Kowalenko, N., & Tennant, C. (2006). Maternal depression and the experience of parenting in the second postnatal year. *Journal of Reproductive and Infant Psychology*, *24*(2), 121–132.

Cox, J. L., Holden, J. M., & Sagovsky, R. (1987). Detection of postnatal depression. Development of the 10-item Edinburgh Postnatal Depression Scale. *British Journal of Psychiatry*, *150*, 782–786.

de Weerth, C., van Hees, Y., & Buitelaar, J. K. (2003). Prenatal maternal cortisol levels and infant behavior during the first 5 months. *Early Human Development*, *74*(2), 139–151. https://doi.org/10.1016/S0378-3782(03)00088-4

de Weerth, C., Zijl, R. H., & Buitelaar, J. K. (2003). Development of cortisol circadian rhythm in infancy. *Early Human Development*, *73*(1-2), 39–52. https://doi.org/10.1016/S0378-3782(03)00074-4

Del-Ponte, B., Xavier, M. O., Bassani, D. G., Tovo-Rodrigues, L., Halal, C. S., Shionuma, A. H., … Santos, I. S. (2020). Validity of the brief infant sleep questionnaire (BISQ) in Brazilian children. *Sleep Medicine*, *69*, 65–70. https://doi.org/10.1016/j.sleep.2019.12.018

Dennis, C. L., & Ross, L. (2005). Relationships among infant sleep patterns, maternal fatigue, and development of depressive symptomatology. *Birth*, *32*(3), 187–193. https://doi.org/10.1111/j.0730-7659.2005.00368.x

Diego, M., Field, T., & Hernandez-Reif, M. (2005). Prepartum, postpartum and chronic depression effects on neonatal behavior. *Infant Behavior & Development*, *28*, 155–164.

Domingues, M. R., Bassani, D. G., da Silva, S. G., Coll, C. D. V. N., da Silva, B. G. C., & Hallal, P. C. (2015). Physical activity during pregnancy and maternal-child health (PAMELA): Study protocol for a randomized controlled trial. *Trials*, *16*, 227. https://doi.org/10.1186/s13063-015-0749-3

Dørheim, S. K., Bondevik, G. T., Eberhard-Gran, M., & Bjorvatn, B. (2009). Sleep and depression in postpartum women: A population-based study. *Sleep*, *32*(7), 847–855. https://doi.org/10.1093/sleep/32.7.847

Douglas, P. S., & Hill, P. S. (2013). Behavioral sleep interventions in the first six months of life do not improve outcomes for mothers or infants: A systematic review. *Journal of Developmental and Behavioral Pediatrics*, *34*(7), 497–507. https://doi.org/10.1097/DBP.0b013e31829cafa6

Field, T. (2010). Postpartum depression effects on early interactions, parenting, and safety practices: A review. *Infant Behavior and Development*, *33*(1), 1–6. https://doi.org/10.1016/j.infbeh.2009.10.005

Field, T. (2017). Infant sleep problems and interventions: A review. *Infant Behavior and Development*, *47*, 40–53. https://doi.org/10.1016/j.infbeh.2017.02.002

Field, T., Diego, M., & Hernandez-Reif, M. (2006). Prenatal depression effects on the fetus and newborn: A review. *Infant Behavior and Development*, *29*(3), 445–455. https://doi.org/10.1016/j.infbeh.2006.03.003

Field, T., Diego, M., Hernandez-Reif, M., Figueiredo, B., Schanberg, S., & Kuhn, C. (2007). Sleep disturbances in depressed pregnant women and their newborns. *Infant Behavior and Development*, *30*(1), 127–133. https://doi.org/10.1016/j.infbeh.2006.08.002

Gelaye, B., Rondon, M. B., Araya, R., & Williams, M. A. (2016). Epidemiology of maternal depression, risk factors, and child outcomes in low-income and middle-income countries. *The Lancet Psychiatry*, *3*(10), 973–982. https://doi.org/10.1016/S2215-0366(16)30284-X

Goyal, D., Gay, C., & Lee, K. (2009). Fragmented maternal sleep is more strongly correlated with depressive symptoms than infant temperament at three months postpartum. *Archives of Women's Mental Health*, *12*(4), 229–237. https://doi.org/10.1007/s00737-009-0070-9

Hallal, P. C., Bertoldi, A. D., Domingues, M. R., da Silveira, M. F., Demarco, F. F., da Silva, I. C. M., … Bassani, D. G. (2017). Cohort profile: The 2015 pelotas (Brazil) Birth cohort study. *International Journal of Epidemiology*, *47*(4), 1048–1048h. https://doi.org/10.1093/ije/dyx219

Hirshkowitz, M., Whiton, K., Albert, S. M., Alessi, C., Bruni, O., DonCarlos, L., … Adams Hillard, P. J. (2015). National sleep foundation's sleep time duration recommendations: Methodology and results summary. *Sleep Health*, *1*(1), 40–43. https://doi.org/10.1016/j.sleh.2014.12.010

Hiscock, H., & Wake, M. (2001). Infant sleep problems and postnatal depression: A community-based study. *Pediatrics*, *107*(6), 1317–1322.

Hiscock, H., & Wake, M. (2002). Randomised controlled trial of behavioural infant sleep intervention to improve infant sleep and maternal mood. *BMJ*, *324*(7345), 1062–1065.

Lee, K. A., Zaffke, M. E., & McEnany, G. (2000). Parity and sleep patterns during and after pregnancy. *Obstetrics and Gynecology*, *95*(1), 14–18. https://doi.org/10.1016/s0029-7844(99)00486-x

Maldonado, G., & Greenland, S. (1993). Simulation study of confounder-selection strategies. *American Journal of Epidemiology*, *138*, 923–936. https://doi.org/10.1093/oxfordjournals.aje.a116813

Martin, J. L., & Hakim, A. D. (2011). Wrist actigraphy. *Chest*, *139*(6), 1514–1527. https://doi.org/10.1378/chest.10-1872

McLaughlin Crabtree, V., & Williams, N. A. (2009). Normal sleep in children and adolescents. *Child and Adolescent Psychiatric Clinics of North America*, *18*(4), 799–811. https://doi.org/10.1016/j.chc.2009.04.013

Meltzer, L. J., Montgomery-Downs, H. E., Insana, S. P., & Walsh, C. M. (2012). Use of actigraphy for assessment in pediatric sleep research. *Sleep Medicine Reviews*, *16*(5), 463–475. https://doi.org/10.1016/j.smrv.2011.10.002

Morin, C. M., Drake, C. L., Harvey, A. G., Krystal, A. D., Manber, R., Riemann, D., & Spiegelhalder, K. (2015). Insomnia disorder. *Nature Reviews Disease Primers*, *1*(1), 15026. https://doi.org/10.1038/nrdp.2015.26

Morrell, J., & Steele, H. (2003). The role of attachment security, temperament, maternal perception, and care-giving behavior in persistent infant sleeping problems. *Infant Mental Health Journal*, *24*(5), 447–468. https://doi.org/10.1002/imhj.10072

Nunes, M., Kampff, J., & Sadeh, A. (2012). BISQ questionnaire for infant sleep assessment: Translation into Brazilian Portuguese. *Sleep Science*, *5*(3), 89–91.

O'Connor, T. G., Caprariello, P., Blackmore, E. R., Gregory, A. M., Glover, V., Fleming, P., & Team, A. S. (2007). Prenatal mood disturbance predicts sleep problems in infancy and toddlerhood. *Early Human Development*, *83*(7), 451–458. https://doi.org/10.1016/j.earlhumdev.2006.08.006

O'Hara, M. W., & McCabe, J. E. (2013). Postpartum depression: Current status and future directions. *Annual Review of Clinical Psychology*, *9*(1), 379–407. https://doi.org/10.1146/annurev-clinpsy-050212-185612

Pearson, R. M., Melotti, R., Heron, J., Joinson, C., Stein, A., Ramchandani, P. G., & Evans, J. (2012). Disruption to the development of maternal

responsiveness? The impact of prenatal depression on mother-infant interactions. *Infant Behavior and Development*, *35*(4), 613–626. https://doi.org/10.1016/j.infbeh.2012.07.020

Ricardo, L. I. C., da Silva, I. C. M., Martins, R. C., Wendt, A., Gonçalves, H., Hallal, P. R. C., & Wehrmeister, F. C. (2017). Protocol for objective measurement of infants' physical activity using accelerometry. *Medicine and Science in Sports and Exercise*, *50*(5), 1084–1092. https://doi.org/10.1249/MSS.0000000000001512

Sadeh, A. (2004). A brief screening questionnaire for infant sleep problems: Validation and findings for an Internet sample. *Pediatrics*, *113*(6), e570–577. https://doi.org/10.1542/peds.113.6.e570

Sadeh, A. (2011). The role and validity of actigraphy in sleep medicine: An update. *Sleep Medicine Reviews*, *15*(4), 259–267. https://doi.org/10.1016/j.smrv.2010.10.001

Sadeh, A., Acebo, C., Seifer, R., Aytur, S., & Carskadon, M. A. (1995). Activity-based assessment of sleep-wake patterns during the 1st year of life. *Infant Behavior and Development*, *18*(3), 329–337. https://doi.org/10.1016/0163-6383(95)90021-7

Sadeh, A., Flint-Ofir, E., Tirosh, T., & Tikotzky, L. (2007). Infant sleep and parental sleep-related cognitions. *Journal of Family Psychology*, *21*(1), 74–87. https://doi.org/10.1037/0893-3200.21.1.74

Sadeh, A., Tikotzky, L., & Scher, A. (2010). Parenting and infant sleep. *Sleep Medicine Reviews*, *14*(2), 89–96. https://doi.org/10.1016/j.smrv.2009.05.003

Santos, I. S., Bassani, D. G., Matijasevich, A., Halal, C. S., Del-Ponte, B., da Cruz, S. H., … Hallal, P. C. (2016). Infant sleep hygiene counseling (sleep trial): Protocol of a randomized controlled trial. *BMC Psychiatry*, *16*(1), 307. https://doi.org/10.1186/s12888-016-1016-1

Santos, I. S., Del-Ponte, B., Tovo-Rodrigues, L., Halal, C. S., Matijasevich, A., Cruz, S., … Bassani, D. G. (2019). Effect of parental counseling on infants' healthy sleep habits in Brazil: a randomized clinical trial. *JAMA Network Open*, *2*(12), e1918062. https://doi.org/10.1001/jamanetworkopen.2019.18062

Santos, I. S., Matijasevich, A., Tavares, B. F., Barros, A. J. D., Botelho, I. P., Lapolli, C., … Barros, F. C. (2007). Validation of the Edinburgh Postnatal Depression Scale (EPDS) in a sample of mothers from the 2004 Pelotas Birth Cohort Study. *Cadernos De Saúde Pública*, *23*(11), 2577–2588. https://doi.org/10.1590/S0102-311X2007001100005

Smith, M. T., McCrae, C. S., Cheung, J., Martin, J. L., Harrod, C. G., Heald, J. L., & Carden, K. A. (2018). Use of actigraphy for the evaluation of sleep disorders and circadian rhythm sleep-wake disorders: An American Academy of Sleep Medicine clinical practice guideline. *Journal of Clinical Sleep Medicine*, *14*(7), 1231–1237. https://doi.org/10.5664/jcsm.7230

Stein, A., Pearson, R. M., Goodman, S. H., Rapa, E., Rahman, A., McCallum, M., … Pariante, C. M. (2014). Effects of perinatal mental disorders on the fetus and child. *Lancet*, *384*(9956), 1800–1819. https://doi.org/10.1016/S0140-6736(14)61277-0

Stuart-Parrigon, K., & Stuart, S. (2014). Perinatal depression: An update and overview. *Current Psychiatry Reports*, *16*(9), 468. https://doi.org/10.1007/s11920-014-0468-6

Suri, R., Stowe, Z. N., Cohen, L. S., Newport, D. J., Burt, V. K., Aquino-Elias, A. R., … Altshuler, L. L. (2017). Prospective longitudinal study of predictors of postpartum-onset depression in women with a history of major depressive disorder. *Journal of Clinical Psychiatry*, *78*(8), 1110–1116. https://doi.org/10.4088/JCP.15m10427

Swanson, L. M., Pickett, S. M., Flynn, H., & Armitage, R. (2011). Relationships among depression, anxiety, and insomnia symptoms in perinatal women seeking mental health treatment. *Journal of Women's Health*, *20*(4), 553–558. https://doi.org/10.1089/jwh.2010.2371

Teti, D. M., & Crosby, B. (2012). Maternal depressive symptoms, dysfunctional cognitions, and infant night waking: The role of maternal nighttime behavior. *Child Development*, *83*(3), 939–953. https://doi.org/10.1111/j.1467-8624.2012.01760.x

Victora, C. G., Huttly, S. R., Fuchs, S. C., & Olinto, M. T. (1997). The role of conceptual frameworks in epidemiological analysis: A hierarchical approach. *International Journal of Epidemiology*, *26*, 224–227.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

How to cite this article: Halal CS, Bassani DG, Santos IS, et al. Maternal perinatal depression and infant sleep problems at 1 year of age: Subjective and actigraphy data from a population-based birth cohort study. *J Sleep Res*. 2021;30:e13047. https://doi.org/10.1111/jsr.13047