

A Cross-Sectional Study of Maternal Sleep Quality in the First Two Years of Childcare

Sanja Gjorgjeva^{1*}, Marija Topuzovska-Latkovikj², Mirjana Dimovska^{3,4}, Dragan Gjorgjev⁴

¹Dr. Goodnight Sleep Consulting Center Skopje, Skopje, RN Macedonia; ²Institute of Sociological, Political and Juridical Research, Ss. Cyril and Methodius University in Skopje, Skopje, RN Macedonia; ³Institute of Public Health of the Republic of Macedonia, Skopje, RN Macedonia; ⁴Faculty of Medicine, Ss. Cyril and Methodius University in Skopje, Skopje, RN Macedonia

Abstract

Citation: Gjorgjeva S, Topuzovska-Latkovikj M, Dimovska M, Gjorgjev D. A Cross-Sectional Study of Maternal Sleep Quality in the First Two Years of Childcare. Open Access Maced J Med Sci. 2025 Dec 15; 13(4):191-198. https://doi.org/10.3889/oamjms.2025.12086

Keywords: Early childhood; Maternal sleep; North Macedonia; Postpartum; Sleep quality; Sleep disturbances

***Correspondence:** Sanja Gjorgjeva, Dr. Goodnight Sleep Consulting Center Skopje, Skopje, RN Macedonia. E-mail: sanja.gjorgjeva@gmail.com

Received: 02-Oct-2025

Revised: 26-Oct-2025

Accepted: 05-Nov-2025

Ahead of print: 10-Nov-2025

Copyright: © 2025 Sanja Gjorgjeva, Marija Topuzovska-Latkovikj, Mirjana Dimovska, Dragan Gjorgjev.

License: This is an open-access article distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (CC BY-NC 4.0)

Funding: This research did not receive any financial support

Competing Interests: The authors have declared that no competing interests exist

BACKGROUND: The postpartum period and early years of motherhood represent a transformative stage in a woman's life, accompanied by significant physiological, psychological, and social changes. One of the most commonly reported challenges during this period is sleep disruption. Sleep disturbances are common among mothers of young children, yet limited data exist for this issue in the context of North Macedonia. This study explores the prevalence and correlates of poor sleep quality among mothers in the postpartum period.

AIM: To assess the sleep patterns, duration, and quality among mothers with young children and identify key demographic, behavioral, and psychosocial factors associated with sleep disturbances.

METHODS: A cross-sectional survey was conducted among 648 mothers of children aged 0–2 years in North Macedonia. A structured questionnaire was used to collect data on sleep duration, sleep quality (using the Pittsburgh Sleep Quality Index), and associated factors such as maternal age, number of children, employment status, co-sleeping, and perceived stress.

RESULTS: Findings revealed that over 60% of participants reported poor sleep quality, with significant reductions in sleep duration compared to their pre-motherhood period. The most common issues were frequent night awakenings and difficulty falling back asleep. Poor sleep was significantly associated with lack of family support, chronic fatigue, and higher levels of self-reported stress.

CONCLUSION: Maternal sleep quality in North Macedonia is substantially affected during early child-rearing years. Tailored interventions focusing on maternal mental health, family support, and sleep hygiene education are needed to improve sleep health in this vulnerable population.

Introduction

Sleep is not a passive state but an active, indispensable ingredient of a fundamental physiological process essential for physical and mental health, cognitive functioning, and emotional regulation. That's why insomnia and sleep disturbances are increasingly recognized as a major global public health issue, with approximately 30% of adults reporting symptoms of poor sleep quality [1], [2]. During the COVID-19 pandemic, prevalence estimates rose to over 40% due to heightened stress, disrupted routines, and increased screen exposure [3]. Women appear to be disproportionately affected, with rates 40–70% higher than in men, likely due to hormonal, psychosocial, and caregiving factors [4]. Similarly,

older adults are at elevated risk, with up to 50% of individuals aged 65 and above experiencing chronic sleep problems [5]. Sleep disturbances are associated with a range of adverse outcomes, including a twofold increase in the risk of depression, anxiety, cardiovascular disease, and metabolic disorders, as well as impaired cognitive function and reduced daytime performance [6], [7]. The economic burden of insufficient sleep is substantial, with global losses estimated in the hundreds of billions annually due to productivity loss and increased healthcare utilization [8]. Cognitive Behavioral Therapy for Insomnia (CBT-I) is the gold standard for long-term treatment, yet remains underutilized in many healthcare systems. Additionally, disparities in sleep quality are evident among socioeconomically disadvantaged and minority populations, emphasizing the need for more equitable

and integrated sleep health interventions [9]. These findings highlight the importance of addressing sleep disturbances as a key component of preventive medicine and population health.

The postpartum period and early years of motherhood represent a transformative stage in a woman's life, accompanied by significant physiological, psychological, and social changes. One of the most commonly reported challenges during this period is sleep disruption. Mothers of young children, especially those with infants under 12 months, often experience fragmented and poor-quality sleep due to the frequent caregiving demands and hormonal shifts inherent to this stage [10], [11]. Sleep disturbances in this population are multifactorial. Infants and toddlers frequently wake during the night due to feeding needs, illness, or sleep development issues, and many mothers are the primary nighttime caregivers. Beyond the biological rhythms of the child, mothers often experience increased vigilance, stress, and anxiety, contributing to difficulty initiating or maintaining sleep even when the child is asleep [12]. The maternal tendency to prioritize the child's needs and household responsibilities over personal rest often leads to accumulated sleep debt and burnout [13].

The consequences of chronic sleep disruption are extensive. Poor maternal sleep has been associated with increased risk of postpartum depression, anxiety, irritability, impaired cognitive function, and reduced quality of life [14], [15]. Physical health is also affected, with chronic sleep deprivation linked to immune dysfunction, cardiovascular issues, and metabolic disturbances [16]. Importantly, maternal sleep quality impacts parenting capacity, emotional availability, and the broader family environment, potentially influencing infant development and attachment patterns [17].

Multiple factors influence maternal sleep quality, including parity, breastfeeding, maternal age, mental health status, employment, and level of social support [18], [19]. Mothers with insufficient support, single mothers, or those facing economic hardship are especially vulnerable. The interplay between sleep and mental health is bidirectional; sleep deprivation contributes to mood disturbances, while anxiety and depression can worsen sleep [15].

Interventions for maternal sleep disturbances range from behavioral and cognitive-behavioral approaches to psychoeducational programs and infant sleep training. Cognitive Behavioral Therapy for Insomnia (CBT-I) has shown promising outcomes for postpartum women, though access to trained professionals remains limited in many regions. Healthcare professionals should be educated to routinely screen for sleep difficulties in the perinatal period and refer mothers for appropriate support when needed.

Most of the existing literature comes from high-income Western countries, whereas limited data are

available from lower- and middle-income countries, including the Balkans. Cultural expectations, family structures, and economic constraints in these regions may influence the prevalence and perception of sleep issues among mothers. In North Macedonia, where traditional gender roles and extended family systems are still prevalent, maternal sleep challenges may manifest differently but remain under-researched and under-addressed in health policy.

The only study in North Macedonia that treated the problem of sleep quality had the aim to assess sleep quality in medical students from all study years enrolled at the Faculty of Medicine, UKIM, Skopje, during winter semester of the academic year 2022/23. An online survey including the Pittsburgh Sleep Quality Index (PSQI) and a questionnaire regarding demographic variables (age and gender) was available via Google Forms to a cohort of students at three time points (the beginning, the middle and the end) of the winter semester. More than 60% of the students (62.2%; 63.7%; 64.1% respectively) showed poor sleep quality (PSQI >5), with 31% using sleeping medication. Sleep duration in 75% of students was shorter than 7 hours, with 11% sleeping less than five hours. A reduction in overall sleep quality can be observed in medical students during the winter semester [20].

Given the significance of maternal sleep for individual and family health, further research is warranted, particularly in underrepresented populations. This study contributes to that gap by examining the sleep quality of mothers with young children in North Macedonia, identifying key determinants and possible pathways for support and intervention.

The study aimed to determine the sleep pattern and the factors that influence the quality of sleep among mothers of young children in North Macedonia.

Materials and Methods

This study employed a cross-sectional research design and was conducted in May 2025. A purposive sampling method was applied, resulting in a total of n=648 respondents. The sample consisted of women, mothers of young children, who met the following two inclusion criteria: (a) holding Macedonian citizenship, and (b) being a mother of a child aged two years or younger. Participants were recruited from various geographic regions, including the Republic of North Macedonia, as well as Macedonian diaspora communities in Europe, the United States, and Australia. Participation in the study was entirely voluntary and anonymous.

The online survey was distributed through a Facebook page managed by the first author of this study, a certified sleep coach. This platform had already established a strong rapport and trust among its followers, which contributed to a high level of motivation and engagement.

Data was collected using a self-reported questionnaire developed specifically for this study. The survey included selected items from three validated instruments: the Pittsburgh Sleep Quality Index (PSQI), the Jenkins Sleep Evaluation Questionnaire (JSEQ), and the Patient Health Questionnaire-9 (PHQ-9). These items were combined into a single questionnaire for this study. While each instrument has been validated in its original form, the combined version used here has not undergone full psychometric validation. The questionnaire was administered via Google Forms, ensuring broad accessibility across devices, with an average completion time of approximately 8-10 minutes.

Quantitative research methods were employed for data analysis using SPSS (Statistical Package for the Social Sciences). The statistical analysis included both descriptive and inferential procedures. Specifically, the following techniques were applied: frequency distributions, cross-tabulations with Chi-square tests, calculation of mean values, and bivariate correlation analyses using Pearson's correlation coefficient.

Results

Demographic Data

The study includes 648 women—mothers of young children—from various cities in Macedonia, as well as from different cities around the world where the Macedonian diaspora resides. Regarding the age structure of the mothers, nearly 50% are aged 31–35, 27.5% are aged 26–30, and 16% are aged 36–40. Two thirds of the respondents (64%) had one child at the time of the study, and 33.5% had two children. 54% of the women were mothers of children aged 0–12 months, while 41% had children aged 1–2 years.

Personal data about the mother relevant to the study

Just over 69% of the women are employed full-time, and more than 6% work from home. 18% of the women are unemployed. As many as 26% of the respondents consider their job to be quite stressful, and over 15% describe it as very stressful.

None of the participants reported having a medical condition that could affect sleep quality. Only 4.8% of the respondents occasionally, and 1% regularly, use sleep aids—most commonly Diazepam and/or melatonin.

When asked about support from their partner in parenting duties, 26% stated they receive full support, and 20% said they receive support often. More than 18% of the respondents answered negatively to this question.

Sleep quality

The majority of respondents (64.3%) reported sleeping an average of 7–8 hours prior to motherhood. Another 27% reported sleeping more than 8 hours per night. Only 7% of the total group of mothers reported sleeping 5–6 hours on average. After the birth of their first child, the number of mothers reporting quality sleep of 7–8 hours dropped sharply to just 18.3%, while only 1.9% reported sleeping more than 8 hours. In contrast, the percentage of new mothers sleeping only 5–6 hours increased dramatically—from 7% before motherhood to as high as 46.9% after their child was born.

At the same time, due to the fatigue that motherhood brings, **the time needed to fall asleep** has shortened. While 47.3% of mothers reported falling asleep within 0–15 minutes before becoming mothers, this percentage increased to 66.5% after the birth of their first child.

A more noticeable difference is evident in the frequency of nighttime **awakenings**. Only 4.9% of mothers reported waking up multiple times during the night before becoming a mother, but that number increased to 58.3% after the birth of their child.

A similar shift occurred in how mothers perceived the quality of their sleep. Before motherhood, 40.7% of mothers rated their sleep as excellent, and 39.7% as very good. After becoming mothers, these numbers dropped significantly—only 1% rated their sleep as excellent, while 18.1% described it as very poor.

In line with the above, the feeling of exhaustion among mothers increased substantially after the birth of the first child. While only 16% of mothers reported feeling chronic fatigue often or every day before becoming mothers, this number significantly jumped after childbirth, with 58.3% mothers experiencing such fatigue 3-4 days per week or every day.

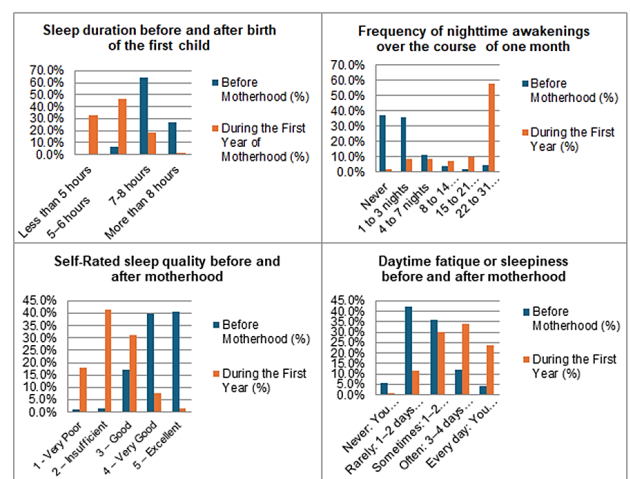


Figure 1: Descriptive statistics of maternal sleep quality pre- and post-motherhood

Data analysis indicates a long-term disruption in sleep quality after becoming a mother, with the most

pronounced decline in the first year, and only partial recovery later. More specifically, mothers generally had high sleep quality before motherhood ($m=4.18$), with the first year of motherhood being identified as the most critical period, with the lowest average sleep quality score ($m=2.33$). The average value for the rating of current sleep quality remains below 3 (on a scale from 1 – very poor to 5 – excellent), meaning that mothers continue to perceive their sleep as unsatisfactory to average (Figure 2).

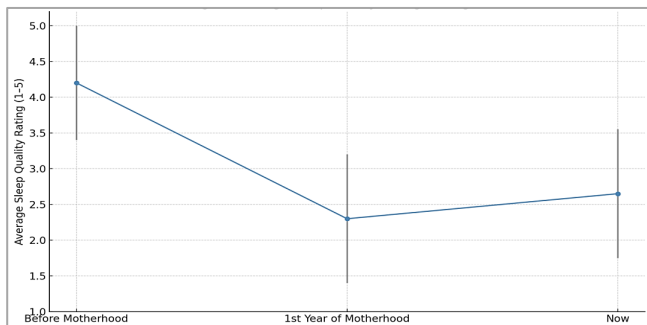


Figure 2: Change in sleep quality before and after motherhood

Bivariate analysis was conducted to examine the factors assumed to influence the sleep quality of mothers of infants and toddlers, and several significant associations were identified (Table 1):

- **Job stress** is weakly but statistically significantly negatively correlated with sleep quality ($r = -0.122$, $p < 0.01$), indicating that mothers who perceive higher job stress tend to report poorer sleep quality.
- **Support from partner/family in nighttime childcare** is positively associated with sleep quality ($r = 0.228$, $p < 0.01$), suggesting that greater support is linked to better sleep.
- **The frequency of nighttime awakenings** is moderately negatively correlated with sleep quality ($r = -0.487$, $p < 0.01$), indicating that more frequent awakenings significantly disrupt sleep.
- **The duration of falling back asleep** after a nighttime awakening is also negatively correlated with sleep quality ($r = -0.230$, $p < 0.01$), with longer time to fall back asleep being associated with poorer sleep quality.
- Finally, **partner/family support** was significantly negatively correlated with the **frequency of nighttime awakenings** ($r = -0.242$, $p < 0.01$), suggesting that mothers receiving more support experience fewer nighttime disruptions.

These findings indicate that maternal sleep quality is most strongly affected by nighttime sleep disruptions, both in terms of frequency and duration. Mothers who experience frequent awakenings or

longer periods of wakefulness during the night are significantly more likely to report poorer sleep quality, highlighting the critical role of uninterrupted sleep in maintaining overall rest and recovery. Psychosocial factors such as job stress and the availability of support from partners or family members also play meaningful roles. Higher perceived job stress is associated with slightly poorer sleep, suggesting that occupational demands may exacerbate sleep difficulties.

Table 1: Correlation matrix of the factors associated with sleep quality

Variables	(1) Job stress	(2) Support from partner/family in nighttime childcare	(3) Night awakenings (monthly)	(4) Duration of falling back asleep (at night)	(5) Sleep quality
(1) Job stress	1				
(2) Support from partner/family in nighttime childcare	0.041 ($p=0.329$) N=556	1			
(3) Night awakenings (monthly)	0.019 ($p=0.664$) N=548	-0.242** ($p=0.000$) N=593	1		
(4) Duration of falling back asleep (at night)	0.022 ($p=0.606$) N=546	-0.064 ($p=0.118$) N=589	0.089* ($p=0.029$) N=597	1	
(5) Sleep quality	-0.122** ($p=0.004$) N=550	0.228** ($p=0.000$) N=595	-0.487** ($p=0.000$) N=603	-0.230** ($p=0.000$) N=599	1

Note: Pearson correlation coefficients are presented. * $p < 0.05$ (*), $p < 0.01$ (**), 2-tailed. N varies due to missing data across variables. The variables included in this correlation matrix are based on questionnaire items as follows:

- (1) Job stress = In your experience, on a scale of 1 to 5, how stressful is your job?
- (2) Support from partner/family = How much support do you receive from your partner/family in nighttime childcare?
- (3) Night awakenings (monthly) = How often, monthly, do you wake up several times during the night?
- (4) Duration of falling back asleep (at night) = When you wake up at night, how long does it take you to fall back asleep?
- (5) Sleep quality = How would you rate the current quality of your sleep?

Contrariwise, greater nighttime support from partners or family not only directly improves maternal sleep quality but also appears to reduce the frequency of nighttime awakenings, demonstrating a buffering effect. These results underscore the multifaceted nature of factors influencing maternal sleep, encompassing both environmental/behavioral and psychosocial dimensions. Interventions aimed at improving maternal sleep should therefore consider both reducing sleep disruptions and enhancing social support networks, as such strategies may jointly contribute to better sleep, improved daytime functioning, and overall maternal well-being.

The following correlation matrix presents the associations between sleep quality and various aspects of the psychophysical functioning of mothers of children up to 2 years of age (Table 2):

- **Chronic fatigue or daytime sleepiness:** There is a strong and statistically significant negative correlation with sleep quality ($r = -0.599$, $p < 0.01$), indicating that mothers who report poorer sleep are significantly more likely to experience daytime fatigue and sleepiness.

This is the strongest correlation in the matrix, reflecting the direct physiological impact of disrupted sleep.

- **Appetite disorders (increased or decreased):** This variable is moderately negatively associated with sleep quality ($r = -0.245$, $p < 0.01$), suggesting that poorer sleep is associated with alterations in appetite. Appetite changes are also moderately positively correlated with chronic fatigue ($r = 0.304$, $p < 0.01$) and with negative effect on mood ($r = 0.433$, $p < 0.01$), highlighting the interrelated nature of these symptoms.
- **Perceived impact of disrupted sleep on daytime functioning and mood:** A moderate negative correlation with sleep quality ($r = -0.378$, $p < 0.01$) indicates that mothers who report poorer sleep quality also feel that it harms their psychological and functional daily life. The strong positive correlation with chronic fatigue ($r = 0.516$, $p < 0.01$) further strengthens the link between sleep and daytime functioning.

Overall, the correlation matrix highlights that poor sleep quality among mothers of young children is most strongly associated with daytime fatigue and sleepiness, indicating a direct physiological consequence of disrupted nocturnal rest. In addition, poorer sleep is moderately associated with appetite disturbances, suggesting that inadequate or fragmented sleep may contribute to irregular eating patterns, which in turn can affect energy levels and overall health. Sleep quality is also moderately negatively correlated with the perceived impact of disrupted sleep on daytime functioning and mood, demonstrating that mothers with poorer sleep not only experience physical tiredness but also report greater challenges in managing daily tasks and maintaining positive mood.

The interrelationships between appetite changes, chronic fatigue, and negative affect further underscore the interconnected nature of psychophysical symptoms, highlighting that disrupted sleep has a cascading effect on multiple dimensions of maternal well-being. These findings emphasize the multifaceted impact of sleep disturbances, encompassing both physiological and psychological domains, and point to the need for interventions that support restorative sleep to enhance overall maternal health.

Cross-tabulation analysis and Chi-square test did not detect statistically significant differences in mothers' (self-)assessment of sleep quality in the first year of motherhood according to the infant's feeding method (breastfeeding, baby formula, combined), nor with the presence of diagnosed chronic diseases in the mothers.

Table 2: Correlation matrix between sleep quality and associated negative effects

Variables	(1) Chronic fatigue or sleepiness during the day	(2) Appetite disorders (increased or decreased)	(3) Disrupted sleep affects mood and functioning	(4) Sleep quality
(1) Chronic fatigue or sleepiness during the day	1			
(2) Appetite disorders (increased or decreased)	0.304** ($p=0.000$) N=595	1		
(3) Disrupted sleep affects mood and functioning	0.516** ($p=0.000$) N=605	0.433** ($p=0.000$) N=610	1	
(4) Sleep quality	-0.599** ($p=0.000$) N=605	-0.245** ($p=0.000$) N=595	-0.378** ($p=0.000$) N=604	1

Note: Pearson correlation coefficients are presented. * $p < 0.05$ (*), $p < 0.01$ (**), 2-tailed. N varies due to missing data across variables. The variables included in this correlation matrix are based on questionnaire items as follows:

(1) Chronic fatigue or sleepiness during the day = Do you feel chronic fatigue or sleepiness during the day?

(2) Appetite disorders (increased or decreased) = I have appetite disorders, increased or decreased appetite.

(3) Disrupted sleep affects mood and functioning = I feel that disrupted sleep negatively affects my mood and functioning during the day.

(4) Sleep quality = How would you rate the current quality of your sleep?

In contrast, a strong and statistically significant association was observed between child sleep problems and maternal sleep quality ($\chi^2 = 128.182$, $p < 0.01$). Specifically, approximately 77.7% of mothers whose children experienced sleep difficulties rated their sleep quality as 'poor', compared to 38.2% of mothers whose children did not have sleep problems (Table 3).

These findings underscore the critical impact of infant sleep patterns on maternal rest, revealing that the presence of sleep difficulties in children exerts a substantially stronger influence on maternal sleep quality than other factors such as feeding method or maternal health status. This highlights the interdependent nature of mother–infant sleep dynamics, where disruptions in the child's sleep not only affect maternal nighttime rest but also contribute to increased daytime fatigue, mood disturbances, and challenges in daily functioning. From a practical perspective, these results emphasize the importance of incorporating strategies to address child sleep behaviors into interventions aimed at supporting maternal sleep. Such approaches could include guidance on infant sleep routines, parental coping strategies for nighttime awakenings, and social support mechanisms, all of which may help improve overall maternal well-being during the postpartum period.

Discussion

This study provides valuable insight into the sleep quality of mothers with young children in North Macedonia, as well as in diaspora communities. The results clearly indicate that sleep quality deteriorates significantly after childbirth, particularly in the first year of motherhood. Infant night awakenings, late bedtimes, and feeding patterns strongly influence maternal sleep,

especially in the first year. Leg Movement during Sleep (LMS) profiles typically persist until stabilization after 12 months [21]. The findings align with existing literature demonstrating that early parenthood is a vulnerable period for maternal sleep disruption [22], [23], [24]. Prior to becoming mothers, the majority of participants reported sleeping 7–8 hours with good perceived sleep quality. However, this situation changed dramatically postpartum. Sleep duration reduced significantly, and nighttime awakenings

became frequent, with 58.3% of mothers reporting waking up multiple times during the night after their first child was born, compared to only 4.9% before. The percentage of mothers reporting very poor sleep rose to 18.1% post-childbirth, while only 1% still considered their sleep excellent. These shifts support prior research showing that maternal sleep is closely linked with infant sleep patterns and undergoes substantial deterioration in the early parenting period [22], [15].

Table 3: Cross tabulation analysis: Sleep quality during the first year of motherhood by presence of child sleep problems

			How do you rate the quality of your sleep in the first year of motherhood?				
			1	2	3	4	5
Have any of your children had sleep problems?	No	Count	18	94	129	43	9
		% within	6.1%	32.1%	44.0%	14.7%	3.1%
	Yes	Count	97	171	72	4	1
		% within	28.1%	49.6%	20.9%	1.2%	.3%

Statistical analysis revealed several significant factors related to sleep quality. Workplace stress was weakly but significantly correlated with lower sleep quality, while the level of partner/family support was positively associated with better sleep. Notably, frequent nighttime awakenings and prolonged time to fall back asleep were moderately correlated with poorer sleep quality. These results reinforce the idea that external psychosocial stressors and inadequate support exacerbate sleep problems in mothers of young children [17].

Furthermore, there is a strong negative correlation between sleep quality and chronic fatigue or daytime sleepiness ($r=-0.599$), indicating that poor nighttime sleep significantly affects mothers' daytime functioning. Additional associations were found between poor sleep and appetite changes, as well as mood and daily performance impairments—findings consistent with the broader literature on the psychophysiological impacts of chronic sleep disruption in adults [25].

Although most research focuses on the first few months postpartum, recent longitudinal studies show that sleep satisfaction and duration often remain below pre-pregnancy levels for several years after childbirth (26). Moreover, studies tracking up to 24 months' postpartum reveal that infant age/stage, nighttime waking, breastfeeding frequency, and bedtime routines significantly influence maternal sleep trajectories over time [22]. Interestingly, the method of infant feeding (breastfeeding vs. formula feeding) and the presence of maternal chronic illness were not significantly associated with sleep quality. However, while breastfeeding per se may not reduce sleep duration, nighttime feed (frequency is strongly linked to poorer sleep quality and efficiency [27]. In our study, children's sleep problems were found to have a statistically significant impact: 77.7% of mothers whose children had sleep problems rated their own sleep during the first year as poor, compared to only 38.2% of mothers whose children did not.

The importance of family support in early motherhood should not be neglected. A study with 817 Chinese women at six weeks postpartum examined the relative contributions of husband and mother-in-law support, marital satisfaction, and general social support. It found that family relationships and support significantly influenced both depression and sleep quality, with stronger family ties linked to better outcomes (28). The respondents in our study who received family support confirmed the better quality of their sleep.

Taking together, these results illustrate the complex, multifactorial nature of maternal sleep disruption. The interplay of infant sleep, maternal stress, and available support plays a central role in shaping sleep experiences. Given the well-established consequences of chronic sleep deprivation on mental health, parenting effectiveness, and maternal well-being, these findings underscore the need for supportive interventions tailored to this population.

Limitations

This study has several limitations. First, its cross-sectional design precludes conclusions about causality. Second, all sleep measures were self-reported, which may be subject to reporting bias. Third, purposive sampling via social media may have introduced selection bias, as mothers who are more digitally active or have concerns about their sleep may have been more likely to participate. This may limit the generalizability of our findings, and future studies should consider more diverse recruitment strategies to mitigate this bias. Fourth, although the items were drawn from established and validated instruments (PSQI, JSEQ, PHQ-9), the combined version used here was not subjected to full psychometric validation (e.g., factor analysis, construct validity). Future studies should address this by validating combined measures in similar populations. Finally, the study population from

North Macedonia may not fully represent mothers in diaspora communities, and caution is warranted when extrapolating these results to other populations.

Conclusions

The transition to motherhood, especially during the first year, represents a critical period marked by substantial disruptions in sleep. This study confirms that sleep quality in mothers significantly declines postpartum and remains below pre-motherhood levels even two years later. Key determinants include the frequency of nighttime awakenings, maternal stress, and the level of support from partners or family.

Importantly, mothers whose children experience sleep disturbances are disproportionately affected, suggesting that infant sleep interventions could yield dual benefits for both child and maternal health. The absence of significant associations with infant feeding method and maternal illness further highlights the primary role of sleep-related behavioral and psychosocial factors.

Recommendations

These findings call for public health policies and family-centered programs that prioritize maternal sleep health. Strategies might include parental education on infant and parents' sleep hygiene, cognitive-behavioral interventions for insomnia (CBT-I), and the promotion of shared caregiving responsibilities.

Future research should continue to explore long-term trajectories of maternal sleep and the effectiveness of targeted interventions, particularly in under-researched populations such as North Macedonia.

Author Contributions

All authors contributed to the study's conception and design. Data collection and writing of the manuscript were performed by Sanja Gjorgjeva. Marija Topuzovska Latkovikj performed the computations. All authors read and approved of the final manuscript.

References

- Bhaskar S, Hemavathy D, Prasad S. Prevalence of chronic insomnia in adult patients and its correlation with medical comorbidities. *J Family Med Prim Care*. 2016 Oct-Dec;5(4):780-784. <https://doi.org/10.4103/2249-4863.201153> PMID:28348990 PMCID:PMC5353813
- Torsvik S, Bjorvatn B, Eliassen KE, Forthun I. Prevalence of insomnia and hypnotic use in Norwegian patients visiting their general practitioner. *Fam Pract*. 2023 Mar 28;40(2):352-359. <https://doi.org/10.1093/fampra/cmab103> PMID:36124938 PMCID:PMC10047630
- Jahrami H, BaHammam, AS, AlGahtani H, et al. The examination of sleep quality and insomnia in the general population during the COVID-19 pandemic: A systematic review and meta-analysis. *Sleep & Breathing*, 2021;25(1):339-350. <https://doi.org/10.5664/jcsm.8930> PMID:33108269 PMCID:PMC7853219
- Zhang B, Wing YK. Sex differences in insomnia: A meta-analysis. *Sleep*, 2006 29(1): 85-93. <https://doi.org/10.1093/sleep/29.1.85> PMID:16453985
- Crowley, K. Sleep and sleep disorders in older adults. *Neuropsychology Review*. 2011; 21(1):41-53. <https://doi.org/10.1007/s11065-010-9154-6> PMID:21225347
- Baglioni C, Battagliese G, Feige B, Spiegelhalder, K, et al. Insomnia as a predictor of depression: A meta-analytic evaluation of longitudinal epidemiological studies. *Journal of Affective Disorders*. 2011; 135(1-3):10-19. <https://doi.org/10.1016/j.jad.2011.01.011> PMID:21300408
- Spiegel K, Leproult R, Van Cauter, E. Impact of sleep debt on metabolic and endocrine function. *The Lancet*. 1999; 354(9188):1435-1439. 1999. [https://doi.org/10.1016/S0140-6736\(99\)01376-8](https://doi.org/10.1016/S0140-6736(99)01376-8) PMID:10543671
- Rand Europe. Why sleep matters-the economic costs of insufficient sleep: A cross-country comparative analysis. Rand Corporation. 2016 https://www.rand.org/pubs/research_reports/RR1791.html Last access 05.07.2025
- Grandner MA. Sleep, health disparities, and social determinants: A wake-up call for the field of sleep medicine. *Sleep Health*. 2020; 6(4):365-367. <https://doi.org/10.1016/j.sleh.2020.05.004> PMID:32601040 PMCID:PMC8186947
- Gay CL, Lee KA, Lee SY. Sleep patterns and fatigue in new mothers and fathers. *Biological Research for Nursing*. 2004; 5(4):311-318. <https://doi.org/10.1177/1099800403262142> PMID:15068660 PMCID:PMC1307172
- Montgomery-Downs HE, Insana SP, Clegg-Kraynok MM. Normative longitudinal maternal sleep: The first 4 postpartum months. *American Journal of Obstetrics and Gynecology*. 2010; 203(5):465.e1-465.e7. <https://doi.org/10.1016/j.ajog.2010.06.057> PMID:20719289 PMCID:PMC2975741
- Posmontier B. Sleep quality in women with and without postpartum depression. *Journal of Obstetric, Gynecologic & Neonatal Nursing*. 2008; 37(6):722-735. <https://doi.org/10.1111/j.1552-6909.2008.00298.x> PMID:19012723 PMCID:PMC2597421
- Hunter LP, Rychnovsky JD, Yount SM. A selective review of maternal sleep characteristics in the postpartum period. *Journal of Obstetric, Gynecologic & Neonatal Nursing*. 2009; 38(1):60-68. <https://doi.org/10.1111/j.1552-6909.2008.00309.x> PMID:19208049
- Dorheim SK, Bondevik GT, Eberhard-Gran M, Bjorvatn B. Sleep and depression in postpartum women: A population-based study. *Sleep*. 2009; 32(7):847-855. <https://doi.org/10.1093/sleep/32.7.847> PMID:19639747 PMCID:PMC2704916
- Sivertsen B, Hysing M, Dørheim S.K. et al. Trajectories of maternal sleep problems before and after childbirth: a longitudinal population-based study. *BMC Pregnancy and Childbirth*. 2015;15:129. <https://doi.org/10.1186/s12884-015-0577-1> PMID:26031504 PMCID:PMC4458335
- Medic G, Wille M, Hemels MEH. Short- and long-term health consequences of sleep disruption. *Nature and Science of Sleep*. 2017; 9: 151-161. <https://doi.org/10.2147/NSS.S134864> PMID:28579842 PMCID:PMC5449130
- Tikotzky L. Postpartum maternal sleep, maternal depressive symptoms and self-perceived mother-infant emotional relationship. *Behavioral Sleep Medicine*. 2016; 14(1): 5-22. <https://doi.org/10.1080/15402002.2014.940111> PMID:25127316
- Dennis CL, Ross L. Relationships among infant sleep patterns, maternal fatigue, and development of depressive symptomatology.

- Birth. 2005 Sep;32(3):187-93. <https://doi.org/10.1111/j.0730-7659.2005.00368.x> PMID:16128972
19. Okun ML, Schetter CD, Glynn LM. Poor sleep quality is associated with preterm birth. *Sleep*. 2011; 34(11):1493-1498. <https://doi.org/10.5665/sleep.1384> PMID:22043120
PMCID:PMC3198204
20. Mancevska S, Pislevski M, Pluncevic Gligoroska J. Assessment of sleep quality during the winter semester in undergraduate medical students enrolled at UKIM, Faculty of Medicine, Skopje, Republic of North Macedonia. *Journal of Morphological Sciences*. 2024;7(1):7-24. <https://doi.org/10.55302/JMS2471017m>
21. Hall WA, Moynihan M, Bhagat R, et al. Relationships between parental sleep quality, fatigue, cognitions about infant sleep, and parental depression pre and post-intervention for infant behavioral sleep problems. *BMC Pregnancy Childbirth*. 2017;17:104. <https://doi.org/10.1186/s12884-017-1284-x> PMID:28376726
PMCID:PMC5379718
22. Cai T, Sutter C, Donovan SM, Fiese BH. The relationship between maternal and infant sleep duration across the first two years. *Journal of Developmental & Behavioral Pediatrics*. 2023; 44(6): e421-e428. <https://doi.org/10.1097/DBP.0000000000001195> PMID:37276363
PMCID:PMC10524561
23. Salvatore P, Insana, Kayla B, Williams, Hawley E, Montgomery-Downs. Sleep Disturbance and Neurobehavioral Performance among Postpartum Women, *Sleep*. 2013;36(1): 73-81. <https://doi.org/10.5665/sleep.2304> PMID:23288973
PMCID:PMC3524545
24. Goyal D, Gay C, Lee K. Fragmented maternal sleep is more strongly correlated with depressive symptoms than infant temperament at three months postpartum. *Arch Womens Ment Health*. 2009;12: 229-237. <https://doi.org/10.1007/s00737-009-0070-9> PMID:19396527
PMCID:PMC2700868
25. Okun ML. Sleep and postpartum depression. *Current Opinion in Psychiatry*. 2015;28(6):p 490-496. <https://doi.org/10.1097/YCO.0000000000000206> PMID:26382160
26. Richter D, Krämer MD, Tang NKY, Montgomery-Downs HE, Lemola S. Long-term effects of pregnancy and childbirth on sleep satisfaction and duration of first-time and experienced mothers and fathers. *Sleep*. 2019;42(4):zsz015. <https://doi.org/10.1093/sleep/zsz015> PMID:30649536
27. Astbury et al. Does breastfeeding influence sleep? A longitudinal study across the first two postpartum years, BIRTH. 2022;49(3):540-548. <https://doi.org/10.1111/birt.12625> PMID:35191089
PMCID:PMC9546104
28. Qi W, Liu Y, Lv H, et al. Effects of family relationship and social support on the mental health of Chinese postpartum women. *BMC Pregnancy Childbirth*. 2022; 22: 65. <https://doi.org/10.1186/s12884-022-04392-w> PMID:35078423
PMCID:PMC8787939