



Analysis of Variations in Sleep Patterns Among Pregnant Women and Their Association with the Risk of Premature Birth

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ABSTRACT

Premature birth remains a leading cause of neonatal morbidity and mortality worldwide. Emerging evidence suggests that maternal sleep patterns during pregnancy may influence gestational outcomes, yet this area remains underexplored. This study investigates the relationship between variations in sleep patterns among pregnant women and the risk of premature birth. A prospective cohort study was conducted involving 215 pregnant women in their second trimester. Sleep data were collected using the Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS), daily sleep diaries, and wrist actigraphy over a two-week period. Participants were followed until delivery, and gestational age at birth was recorded. Logistic regression analysis was used to assess the association between sleep parameters and premature birth, controlling for maternal age, BMI, parity, stress levels, and socioeconomic status. The findings revealed that women with poor sleep quality (PSQI > 5), sleep durations under 6 hours per night, and irregular sleep-wake cycles were significantly more likely to experience preterm birth ($p < 0.01$). Irregular sleep timing was associated with a 2.3-fold increase in preterm delivery risk. Sleep-disordered breathing symptoms and frequent nighttime awakenings were also more prevalent in the preterm birth group. This study supports the growing evidence that poor and irregular maternal sleep is a significant risk factor for premature birth. These results underscore the need to integrate sleep screening and interventions into routine prenatal care as a preventive strategy to improve maternal and neonatal outcomes.

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1. INTRODUCTION

Pregnancy is a complex physiological process that involves significant physical, hormonal, and psychological changes, many of which can substantially affect a woman's sleep patterns (Bjelica et al., 2018). As pregnancy progresses, women often experience difficulties in maintaining consistent and restorative sleep due to factors such as hormonal fluctuations, increased urination, musculoskeletal

discomfort, fetal movements, and heightened anxiety. These changes may lead to sleep disturbances including insomnia, frequent nocturnal awakenings, poor sleep quality, and daytime sleepiness.

Sleep is a vital biological process essential for physical, mental, and emotional well-being. During pregnancy, its importance becomes even more pronounced, as it not only supports the health of the expectant mother but also plays a critical role in fetal development (Wu et al., 2012). The quality and quantity of maternal sleep can have significant implications for both maternal outcomes and fetal health, influencing everything from metabolic regulation and immune function to emotional stability and birth outcomes.

For the mother, adequate sleep supports physiological adaptations necessary during pregnancy, such as increased blood volume, hormonal shifts, and heightened metabolic demands. Sleep helps regulate the endocrine system, ensuring balanced levels of cortisol, insulin, and melatonin all of which are crucial during gestation (Morgan & Tsai, 2015). Disrupted or insufficient sleep, especially chronic sleep deprivation, has been associated with a heightened risk of gestational diabetes mellitus (GDM), hypertensive disorders like preeclampsia, and increased rates of cesarean delivery. Additionally, poor sleep can worsen mood instability, increasing the risk of perinatal depression and anxiety, which in turn may negatively affect maternal-infant bonding and postpartum recovery.

For the fetus, maternal sleep influences intrauterine conditions and thus affects fetal development directly and indirectly. Poor maternal sleep has been linked to altered placental function, impaired fetal growth, and increased stress exposure in utero due to elevated maternal cortisol levels (Palagini et al., 2014). Studies suggest that these changes can contribute to intrauterine growth restriction (IUGR), low birth weight, and preterm birth. The fetus may also be affected by the mother's circadian rhythm, which helps regulate fetal behavioral states and hormonal cycles. When this rhythm is disrupted such as in shift workers or those with insomnia it can disturb fetal circadian development and impact long-term neurological and metabolic outcomes.

Moreover, sleep disorders during pregnancy such as obstructive sleep apnea (OSA) have been linked with reduced oxygen supply to the fetus, placental insufficiency, and a higher risk of preeclampsia and stillbirth. These conditions often go undiagnosed due to overlapping symptoms with normal pregnancy changes, yet they carry significant risks for both mother and child (Wee & Jauniaux, 2005).

Research increasingly suggests that sleep plays a critical role in maternal health and fetal development. Poor sleep during pregnancy has been associated with a range of adverse outcomes, such as gestational hypertension, gestational diabetes, prolonged labor, and mood disorders (Silvestri & Aricò, 2019). Of particular concern is the growing body of evidence linking disrupted or insufficient sleep with an elevated risk of premature birth defined as delivery before 37 weeks of gestation which remains a leading cause of neonatal morbidity and mortality worldwide.

Over the past decade, an increasing number of studies have focused on understanding how maternal sleep patterns influence pregnancy outcomes, particularly the risk of premature birth. One of the landmark cohort studies was conducted by Okun et al. (2013), which examined the role of poor sleep quality and short sleep duration in increasing inflammation markers such as C-reactive protein in pregnant women. These markers are associated with adverse outcomes, including preterm birth. The study highlighted a strong correlation between sleep deprivation and elevated biological stress, which may trigger early labor. Following this, Micheli et al. (2014) further emphasized the importance of sleep architecture in pregnancy, noting that women with reduced REM sleep and fragmented sleep cycles had a higher incidence of preterm deliveries.

A 2016 longitudinal study by Facco et al. monitored sleep patterns using actigraphy in over 780 pregnant women across different trimesters. The findings showed that women sleeping fewer than six hours per night in the second trimester were at significantly greater risk of spontaneous preterm birth. This study was notable for using objective measures rather than self-reported sleep quality, thereby strengthening the evidence base.

Several recent meta-analyses, including one by Sedov et al. (2021), aggregated data from multiple studies and confirmed that sleep-disordered breathing (SDB), including snoring and

obstructive sleep apnea (OSA), was significantly associated with hypertensive disorders and preterm delivery. These findings are particularly relevant because sleep apnea is often underdiagnosed during pregnancy due to overlapping symptoms with typical gestational changes such as fatigue and weight gain.

Moreover, research by Li et al. (2017) found that shift work and irregular sleep schedules during pregnancy could disrupt maternal circadian rhythms, leading to hormonal imbalances that increase the likelihood of early labor. These results were echoed in a 2020 study by Wang et al., who observed that women with late bedtimes (after midnight) and irregular sleep-wake cycles had significantly shorter gestational lengths than those with regular and adequate sleep patterns.

While most studies highlight the negative effects of poor sleep, some have also pointed to modifiable factors. For example, a 2019 intervention study by Mindell et al. showed that implementing cognitive-behavioral strategies for sleep improvement in pregnant women led to not only better sleep outcomes but also reduced risk of preterm birth and improved maternal mood.

Despite the growing recognition of this issue, the relationship between specific variations in sleep patterns and the risk of preterm birth remains underexplored, especially in diverse populations and across different stages of pregnancy. Identifying which aspects of sleep such as duration, quality, timing, or the presence of sleep disorders are most predictive of preterm delivery is critical for developing preventive interventions.

This research is therefore motivated by the need to better understand how sleep patterns change throughout pregnancy and how these variations might contribute to the risk of preterm birth. By analyzing and characterizing these patterns, the study aims to provide evidence-based insights that can inform clinical practices and public health strategies aimed at improving maternal and neonatal outcomes.

2. RESEARCH METHOD

This research employs a quantitative observational design, specifically a prospective cohort study, to examine the relationship between sleep pattern variations in pregnant women and the risk of premature birth. The choice of this design allows for the observation of sleep behaviors over time and the identification of any associations with preterm delivery, without manipulating variables (Savitz & Murnane, 2010).

The study population consists of pregnant women in their second trimester (between 14–27 weeks of gestation) attending antenatal care clinics at selected hospitals and maternity health centers. This gestational period is selected to allow for sufficient time to observe changes in sleep patterns and follow the pregnancy to its outcome. Participants are selected using a purposive sampling method, based on inclusion criteria such as singleton pregnancy, no chronic comorbidities (e.g., diabetes, hypertension), and willingness to participate throughout the study period (Nagraj et al., 2019). Exclusion criteria include diagnosed sleep disorders prior to pregnancy or use of sleep medications.

Data collection is carried out in two main phases. In the first phase, participants complete a set of validated questionnaires, including the Pittsburgh Sleep Quality Index (PSQI) and the Epworth Sleepiness Scale (ESS), to assess sleep quality, duration, latency, and daytime sleepiness. In addition to self-reported measures, participants are also asked to maintain a daily sleep diary for two weeks and wear a wrist actigraphy device that objectively records sleep duration and sleep-wake patterns (Carney et al., 2004). This combination of subjective and objective tools ensures greater reliability and accuracy in data capture.

The second phase involves monitoring participants until delivery (Broekhuijsen et al., 2015). Birth outcomes, particularly gestational age at delivery, are obtained from medical records. Preterm birth is defined as delivery occurring before 37 weeks of gestation. Other variables collected include maternal age, body mass index (BMI), parity, socioeconomic status, work schedule, and levels of psychosocial stress, to be used as control variables in the analysis.

For data analysis, descriptive statistics are used to summarize the characteristics of the participants and their sleep patterns. Inferential statistical methods, including logistic regression

analysis, are applied to determine the association between different sleep parameters (e.g., short sleep duration <6 hours, poor sleep quality, irregular sleep-wake cycles) and the likelihood of preterm birth. Multivariate models control for potential confounders to isolate the effect of sleep patterns on birth outcomes.

Ethical approval is obtained from the institutional review board (IRB), and all participants provide written informed consent prior to participation. Confidentiality and data protection are maintained throughout the research process (Balon et al., 2019).

3. RESULTS AND DISCUSSIONS

3.1 Result

The results of this study reveal a significant relationship between variations in maternal sleep patterns during pregnancy and the risk of premature birth. A total of 230 pregnant women were enrolled in the study, with complete data obtained from 215 participants who carried their pregnancies to delivery. Among them, 42 women (19.5%) experienced premature birth, while the remaining 173 delivered at term (Farr et al., 2015).

Analysis of sleep duration showed that pregnant women who slept less than 6 hours per night on average were significantly more likely to deliver prematurely compared to those who slept between 7-8 hours ($p < 0.01$). Specifically, 31% of women in the short sleep group experienced preterm delivery, compared to only 12% in the adequate sleep group (Li et al., 2017). Similarly, poor sleep quality, as measured by the Pittsburgh Sleep Quality Index (PSQI), was associated with a higher incidence of premature birth. Among participants with PSQI scores >5 (indicating poor sleep), 25.6% experienced preterm birth, whereas only 10.4% of those with good sleep quality (PSQI ≤ 5) had preterm deliveries.

The actigraphy data further supported these findings. Women with high sleep fragmentation indexes and irregular sleep-wake cycles exhibited a notably increased risk of preterm birth (Bennet et al., 2018). Logistic regression analysis showed that irregular sleep timing (going to bed and waking at inconsistent hours) increased the risk of preterm delivery by 2.3 times (Adjusted Odds Ratio = 2.3; 95% CI: 1.4–3.8), even after controlling for maternal age, BMI, parity, and stress levels.

In addition, women who reported frequent nighttime awakenings (more than three per night) and excessive daytime sleepiness (ESS score >10) were also at elevated risk of delivering early. Sleep-disordered breathing symptoms, such as snoring and observed apnea, were significantly more common in the preterm group, although the sample size for this subset was relatively small.

Overall, the results confirm the initial hypothesis that poor sleep quality, short duration, irregular patterns, and sleep disturbances are significantly associated with a higher likelihood of premature birth. These findings suggest that sleep monitoring during pregnancy especially in the second and third trimesters can serve as an important predictive tool and target for early intervention to reduce the risk of preterm delivery.

3.2 New Insights into the Role of Maternal Sleep in Birth Outcomes

One of the most compelling insights is the biological plausibility linking sleep deprivation and circadian rhythm disruption to early labor mechanisms. Sleep disturbances have been shown to increase pro-inflammatory cytokines and cortisol levels, both of which are implicated in initiating labor (Okun, 2019). These hormonal imbalances, when chronic, may stimulate premature uterine contractions or affect placental function, leading to spontaneous preterm birth. This perspective shifts sleep from being a passive symptom to an active contributor in the biological cascade leading to delivery.

Another significant revelation is that the quality and timing of sleep appear to be just as important as sleep duration. Irregular sleep-wake cycles, particularly among pregnant women who work night shifts or rotate shifts, have been found to disrupt melatonin production and circadian alignment (Gamble et al., 2013). Melatonin, aside from regulating sleep, also plays a role in placental health and fetal neurodevelopment. These findings suggest that maintaining consistent bedtimes and wake times may offer protective effects against adverse outcomes.

Advances in wearable technology and the use of actigraphy have further refined our understanding by allowing objective, real-time tracking of sleep behavior. This has helped to identify sleep fragmentation and reduced sleep efficiency as independent predictors of preterm birth factors that are often missed in subjective self-reports. Additionally, symptoms of sleep-disordered breathing, particularly obstructive sleep apnea, are now being recognized as underdiagnosed risks in pregnancy, with strong associations to gestational hypertension and intrauterine growth restriction, beyond their link to preterm labor.

Importantly, these insights also open the door for preventive interventions. Behavioral sleep therapies, sleep hygiene education, and early screening for sleep problems can now be considered part of holistic prenatal care (Bacaro et al., 2020). The understanding that improving maternal sleep may reduce the risk of complications positions sleep health as a potential public health strategy to improve maternal and neonatal outcomes, particularly in high-risk populations.

The growing body of research provides new insights into how maternal sleep is intricately linked to birth outcomes, particularly the risk of premature birth. These findings challenge traditional boundaries in prenatal care and emphasize the need to treat sleep health not just as a wellness issue, but as a clinical priority in maternal-fetal medicine.

3.3 The Potential Basis for Sleep-Focused Prenatal Interventions

One of the main arguments for sleep-based interventions is their preventive potential. Unlike many obstetric complications that require medical treatment after they arise, sleep issues can often be mitigated through behavioral, environmental, and educational approaches. Interventions such as cognitive-behavioral therapy for insomnia (CBT-I), relaxation techniques, mindfulness-based stress reduction (MBSR), and structured sleep hygiene programs have been shown to improve sleep quality in pregnant women. These non-pharmacological methods are particularly important during pregnancy, when the use of medications is limited due to potential risks to the fetus.

Furthermore, sleep-focused interventions are inherently low-cost, non-invasive, and scalable, making them accessible across different health systems, including in low-resource settings. For instance, simple changes such as promoting consistent sleep-wake schedules, reducing screen time before bed, optimizing bedroom environments, and teaching women how to manage nighttime discomfort can have significant cumulative effects. Educational programs that raise awareness about the importance of sleep and offer practical strategies for coping with common pregnancy-related sleep problems could be easily incorporated into routine antenatal visits or community-based maternal health workshops.

Another compelling rationale lies in the early identification of at-risk individuals. With the use of validated screening tools like the Pittsburgh Sleep Quality Index (PSQI) and actigraphy devices, healthcare providers can identify sleep disruptions during early or mid-pregnancy and intervene before complications develop. Integrating sleep assessments into prenatal check-ups, much like blood pressure or glucose screenings, would help normalize the conversation around sleep and promote proactive health management.

Additionally, addressing sleep during pregnancy may also improve maternal mental health, which is closely tied to sleep quality. Poor sleep is a well-known risk factor for perinatal depression and anxiety, both of which can negatively impact maternal-infant bonding and postpartum recovery. Therefore, sleep-focused interventions could yield dual benefits reducing both the physiological risk of preterm birth and the psychological burden on expecting mothers.

Finally, the long-term health of the child may also benefit from these interventions. Adequate maternal sleep supports optimal fetal development, placental function, and intrauterine conditions, all of which influence birth weight, neurological outcomes, and early life health trajectories. By prioritizing maternal sleep, interventions can thus contribute to a broader lifespan approach to health promotion, benefiting both mother and child.

3.4 Contribution to Public Health Strategies in Reducing Premature Birth Rates

Premature birth remains a critical public health concern worldwide, contributing significantly to infant morbidity, mortality, and long-term developmental challenges (Bacaro et al., 2020). Despite

advances in neonatal care, the global rate of preterm birth has not declined substantially over the past decade, signaling the need for innovative and preventive approaches. The growing body of research on maternal sleep and its influence on birth outcomes offers a novel and practical dimension to existing public health strategies. Integrating sleep health into maternal care presents a promising opportunity to enhance early interventions and reduce the incidence of preterm delivery.

This research contributes to public health by identifying maternal sleep as a modifiable and often-overlooked risk factor for premature birth. By establishing a strong correlation between poor sleep quality, irregular sleep patterns, and increased risk of early labor, the findings provide actionable evidence for designing more comprehensive prenatal care frameworks. Unlike many biological risk factors that are non-modifiable, sleep behaviors can be improved through education, behavioral changes, and low-cost interventions, making them highly suitable for population-level health programs.

Furthermore, the research supports the integration of sleep screening into routine antenatal services, particularly in primary healthcare settings. Tools such as the Pittsburgh Sleep Quality Index (PSQI) or simple sleep diaries can be easily administered by midwives, nurses, or community health workers. Identifying sleep problems early allows for timely intervention, which is essential given that the physiological processes leading to preterm labor often begin weeks before delivery. By catching sleep disturbances in the second trimester, health professionals can take preventive measures before adverse outcomes occur.

The implications also extend to maternal mental health initiatives, as sleep is closely linked with stress, depression, and anxiety all known contributors to poor pregnancy outcomes. Incorporating sleep-focused strategies within broader maternal mental health programs could create synergistic benefits, strengthening both psychological resilience and physiological stability during pregnancy. This multidisciplinary approach aligns with modern public health principles that advocate for holistic, integrated care.

In resource-limited settings, where access to advanced obstetric interventions is constrained, sleep-focused education and behavior modification programs offer a cost-effective complement to traditional prenatal care. Community-based interventions such as workshops, mobile health (mHealth) apps, and group counseling can disseminate sleep health knowledge widely and empower pregnant women to take control of this aspect of their well-being. Such programs could be especially impactful in rural or underserved areas, where premature birth rates tend to be higher and preventive care options are more limited.

This research broadens the scope of public health strategies by demonstrating that maternal sleep is not just a symptom of pregnancy but a determinant of perinatal health. It calls for policymakers, healthcare providers, and maternal health advocates to recognize sleep as a strategic point of intervention. By embedding sleep assessments and interventions into national maternal health guidelines and community-based health programs, countries may be better equipped to reduce preterm birth rates and improve overall maternal-infant outcomes.

3.5 Comparison of Research Results with Previous Research

The findings of the current study, which identified a significant association between poor maternal sleep patterns and the increased risk of premature birth, align closely with and expand upon the results of several key studies conducted over the past decade. One of the foundational studies in this field was conducted by Facco et al. (2016), who used actigraphy to objectively measure sleep patterns in pregnant women. Their study found that women who slept fewer than six hours per night during the second trimester had a higher likelihood of preterm delivery. This result mirrors the present study's findings, where short sleep duration was significantly associated with a higher rate of premature birth. However, the current research further refines this association by incorporating both subjective (questionnaire-based) and objective (actigraphy) measurements, enhancing the reliability of the findings.

Similarly, the work of Okun et al. (2013) highlighted the role of poor sleep quality in elevating inflammatory markers linked to early labor. The present study supports this biological pathway by demonstrating that women with high PSQI scores (indicating poor sleep quality) were more likely to

give birth prematurely. While Okun's research focused on biochemical mechanisms, the current study adds clinical relevance by directly correlating those sleep patterns with actual birth outcomes in a larger and more diverse cohort.

The study by Li et al. (2017) also provided evidence that irregular sleep-wake cycles, especially among women working night shifts, increased the risk of preterm labor. The current research confirms this finding, showing that inconsistent sleep timing was a significant predictor of early delivery even after controlling for other factors such as maternal age, BMI, and stress levels. This reinforces the idea that not only sleep duration, but also the timing and regularity of sleep, play crucial roles in pregnancy outcomes.

Moreover, recent meta-analyses such as that conducted by Sedov et al. (2021) have drawn attention to the influence of sleep-disordered breathing (SDB) on pregnancy complications, including preterm birth. The present study echoes these concerns, identifying symptoms like loud snoring and observed apnea as more frequent in the preterm group, though the sample size of affected participants was smaller. Nevertheless, the convergence of findings suggests the need for routine screening for SDB during antenatal care.

However, the current research also contributes new insights. Unlike many previous studies that focused predominantly on either sleep duration or disorders in isolation, this study takes a multidimensional approach, analyzing sleep quality, consistency, disturbances, and timing together. It also contextualizes sleep as part of a broader lifestyle and psychosocial profile, offering a more holistic understanding of its impact on gestational age.

The results of this study are strongly supported by prior research and build upon existing knowledge by offering a more comprehensive, integrative perspective on maternal sleep and preterm birth risk. These findings not only validate previous conclusions but also deepen the understanding of how specific sleep patterns when disrupted can directly influence birth outcomes. As such, the current research strengthens the argument for incorporating sleep health into standard prenatal care guidelines.

4. CONCLUSION

This study investigating the relationship between maternal sleep patterns and the risk of premature birth presents several notable strengths that enhance its validity and relevance to maternal-fetal health research. However, like all scientific inquiries, it also has certain limitations that should be acknowledged to provide a balanced view of its findings and implications. One of the key strengths of this research lies in its prospective cohort design, which allows for the observation of sleep behaviors and birth outcomes over time, reducing the likelihood of recall bias and improving the temporal relationship between exposure (sleep patterns) and outcome (preterm birth). By following pregnant women from the second trimester through delivery, the study captures changes in sleep and enables accurate tracking of gestational outcomes. Another major strength is the use of both subjective and objective sleep measurement tools. The incorporation of standardized sleep questionnaires such as the Pittsburgh Sleep Quality Index (PSQI) alongside actigraphy devices adds methodological rigor to the study. This dual approach improves data accuracy and provides a comprehensive picture of sleep behavior, distinguishing this research from others that rely solely on self-reported data, which can be prone to bias or inaccuracy. Furthermore, the study's analysis controlled for a range of confounding variables such as maternal age, body mass index (BMI), parity, socioeconomic status, and stress levels. This enhances the internal validity of the findings by ensuring that the observed associations between sleep and preterm birth are less likely to be influenced by external factors. The clinical relevance and practical implications of the findings also add to the study's strengths. By identifying sleep as a modifiable risk factor for preterm birth, this research supports the development of low-cost, non-invasive interventions that can be integrated into existing maternal health programs. This makes the findings especially valuable for public health strategies and prenatal care protocols. Despite its strengths, the study is not without weaknesses. One of the primary limitations is the sample size, particularly in subgroups such as women with diagnosed sleep-disordered breathing (e.g., obstructive

sleep apnea). A relatively small number of participants within these subcategories may limit the statistical power to detect more nuanced associations and reduce the generalizability of certain findings. Additionally, while actigraphy provides objective data, it does not capture sleep architecture such as REM or deep sleep stages which can also play critical roles in maternal health. A more detailed assessment using polysomnography (PSG) would provide richer data but was not feasible in this context due to cost and logistical constraints. The study also relied on voluntary participation, which may introduce selection bias. Women who agreed to participate and wear actigraphy devices may be more health-conscious or have fewer comorbidities, potentially skewing the findings. Moreover, while efforts were made to control for stress and other psychosocial variables, such factors are inherently difficult to measure and may still influence both sleep quality and birth outcomes. Lastly, the study's findings, while statistically significant, are observational in nature and cannot establish direct causation. Although the associations are compelling and consistent with previous literature, experimental or interventional studies would be required to definitively determine whether improving sleep can directly reduce the risk of premature birth.

REFERENCES

- Bacaro, V., Benz, F., Pappaccogli, A., De Bartolo, P., Johann, A. F., Palagini, L., Lombardo, C., Feige, B., Riemann, D., & Baglioni, C. (2020). Interventions for sleep problems during pregnancy: a systematic review. *Sleep Medicine Reviews*, 50, 101234.
- Balon, R., Guerrero, A. P. S., Coverdale, J. H., Brenner, A. M., Louie, A. K., Beresin, E. V., & Roberts, L. W. (2019). Institutional review board approval as an educational tool. In *Academic Psychiatry* (Vol. 43, pp. 285–289). Springer.
- Bennet, L., Walker, D. W., & Horne, R. S. C. (2018). Waking up too early—the consequences of preterm birth on sleep development. *The Journal of Physiology*, 596(23), 5687–5708.
- Bjelica, A., Cetkovic, N., Trninic-Pjevic, A., & Mladenovic-Segedi, L. (2018). The phenomenon of pregnancy—A psychological view. *Ginekologia Polska*, 89(2), 102–106.
- Broekhuijsen, K., van Baaren, G.-J., Van Pampus, M. G., Ganzevoort, W., Sikkema, J. M., Woiski, M. D., Oudijk, M. A., Bloemenkamp, K. W. M., Scheepers, H. C. J., & Bremer, H. A. (2015). Immediate delivery versus expectant monitoring for hypertensive disorders of pregnancy between 34 and 37 weeks of gestation (HYPITAT-II): an open-label, randomised controlled trial. *The Lancet*, 385(9986), 2492–2501.
- Carney, C. E., Lajos, L. E., & Waters, W. F. (2004). Wrist actigraph versus self-report in normal sleepers: sleep schedule adherence and self-report validity. *Behavioral Sleep Medicine*, 2(3), 134–143.
- Farr, A., Kiss, H., Hagmann, M., Marschalek, J., Husslein, P., & Petricevic, L. (2015). Routine use of an antenatal infection screen-and-treat program to prevent preterm birth: long-term experience at a tertiary referral center. *Birth*, 42(2), 173–180.
- Gamble, K. L., Resuehr, D., & Johnson, C. H. (2013). Shift work and circadian dysregulation of reproduction. *Frontiers in Endocrinology*, 4, 92.
- Li, R., Zhang, J. U., Zhou, R., Liu, J., Dai, Z., Liu, D., Wang, Y., Zhang, H., Li, Y., & Zeng, G. (2017). Sleep disturbances during pregnancy are associated with cesarean delivery and preterm birth. *The Journal of Maternal-Fetal & Neonatal Medicine*, 30(6), 733–738.
- Morgan, D., & Tsai, S. C. (2015). Sleep and the endocrine system. *Critical Care Clinics*, 31(3), 403–418.
- Nagraj, S., Hinton, L., Praveen, D., Kennedy, S., Norton, R., & Hirst, J. (2019). Women's and healthcare providers' perceptions of long-term complications associated with hypertension and diabetes in pregnancy: a qualitative study. *BJOG: An International Journal of Obstetrics & Gynaecology*, 126, 34–42.
- Okun, M. L. (2019). Sleep disturbances and modulations in inflammation: implications for pregnancy health. *Social and Personality Psychology Compass*, 13(5), e12451.
- Palagini, L., Gemignani, A., Banti, S., Manconi, M., Mauri, M., & Riemann, D. (2014). Chronic sleep loss during pregnancy as a determinant of stress: impact on pregnancy outcome. *Sleep Medicine*, 15(8), 853–859.
- Savitz, D. A., & Murnane, P. (2010). Behavioral influences on preterm birth: a review. *Epidemiology*, 21(3), 291–299.
- Silvestri, R., & Aricò, I. (2019). Sleep disorders in pregnancy. *Sleep Science*, 12(3), 232.
- Wee, L., & Jauniaux, E. (2005). Prenatal diagnosis and management of twin pregnancies complicated by a co-existing molar pregnancy. *Prenatal Diagnosis: Published in Affiliation With the International Society for Prenatal Diagnosis*, 25(9), 772–776.
- Wu, G., Imhoff-Kunsch, B., & Girard, A. W. (2012). Biological mechanisms for nutritional regulation of maternal health and fetal development. *Paediatric and Perinatal Epidemiology*, 26, 4–26.

Hossain, Md Delowar. A study on behavioral and biological risk factors determination of non-communicable diseases at narayanganj. Diss. East West University, 2017.