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Original Research Article

Sleep Disturbances in Pregnancy and Their Association with Gestational Diabetes Mellitus

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Abstract:

Background: Sleep quality and duration have been proposed as modifiable factors influencing the risk of gestational diabetes mellitus (GDM), but existing evidence remains inconsistent. Understanding these associations is particularly important in early pregnancy when preventive strategies are most effective. This study examined whether sleep quality or duration is associated with the development of GDM in pregnant women.

Methods: A prospective longitudinal study was conducted among 194 pregnant women recruited before 14 weeks of gestation from a tertiary care hospital. Sleep quality was assessed using the Pittsburgh Sleep Quality Index, and physical activity using the Baecke questionnaire. GDM was diagnosed at 24–28 weeks using the 75-g OGTT based on standard criteria. Logistic regression models were used to evaluate associations between sleep parameters and GDM.

Results: Baseline characteristics were comparable between groups except for higher age, BMI, and prior GDM history in women who developed GDM. Sleep quality components and total PSQI scores did not differ significantly between GDM and non-GDM groups. Short night sleep (<7 h) was more common among women with GDM and showed a twofold increased risk in univariate analysis. However, no sleep parameter, including short or long sleep duration, remained significantly associated with GDM after adjustment.

Conclusion: Sleep quality and duration were not independently associated with GDM, although short sleep showed a modest unadjusted risk.

Keywords: Gestational diabetes mellitus; Sleep quality; Sleep duration; PSQI; Pregnancy; Risk factors.

Introduction

Sleep is a vital physiological process necessary for both mental and physical well-being [1]. Beyond providing rest for daily activities, sleep plays a critical role in tissue repair and metabolic regulation. During wakefulness, free radicals accumulate, and the non-REM phase of sleep facilitates repair of free radical-induced tissue damage [2,3]. Sleep also influences hormonal secretion, particularly cortisol and growth hormone, and modulates sympathetic nervous system activity, all of which are essential for maintaining metabolic homeostasis. [4,5].

Epidemiological evidence indicates a strong link between sleep quality and metabolic health. Individuals with poor sleep tend to exhibit higher visceral adiposity, increased insulin resistance, and a greater risk of developing type 2 diabetes compared with good sleepers. [6,7]. Both excessively short and prolonged sleep durations have also been associated with impaired glucose regulation and an elevated risk of metabolic syndrome and diabetes. [8-10].

Pregnancy introduces unique physiological changes, including increased insulin resistance driven by placental hormone secretion, predisposing susceptible women to gestational diabetes mellitus (GDM) [11]. At the same time, pregnancy frequently disrupts sleep, causing poor sleep quality, insomnia, and altered sleep duration, particularly shortened sleep in the first trimester [12]. While traditional risk factors such as obesity and a history of GDM are well-established [13] the contribution of sleep disturbances to GDM remains unclear and under-researched [13–17]. Previous studies have been limited by cross-sectional designs, nonstandardized sleep assessments, and inadequate adjustment for confounders [18–21]. To address these gaps, the present prospective longitudinal study evaluates the relationship between sleep quality and nocturnal sleep duration in the first

trimester and the subsequent development of GDM at 24–28 weeks of gestation.

Materials and Methods

Study Design and Setting: This prospective longitudinal study was conducted over one year in a tertiary care hospital, among women attending antenatal clinics.

Participants and Eligibility Criteria: Pregnant women aged ≥20 years with a gestational age of ≤14 weeks (confirmed by last menstrual period or ultrasound) were recruited at their first prenatal visit. Women with pre-existing diabetes mellitus were excluded. A total of 194 eligible participants were included.

Sampling Procedure: Participants were recruited using a convenience sampling method from all eligible women attending the clinics during the study period.

Measures and Outcomes: Data were collected at three time points: (1) first prenatal visit (≤14 weeks), (2) gestational weeks 22–28, and (3) within six weeks postpartum. Demographic information, medical and obstetric history, and medication use were collected by trained interviewers.

Sleep quality over the previous month was evaluated using the Pittsburgh Sleep Quality Index (PSQI), which measures seven components: sleep latency, sleep disturbances, habitual sleep efficiency, subjective sleep quality, sleep duration, use of sleep medications, and daytime dysfunction. Each component is scored 0–3, and a total PSQI score >5 indicates poor sleep quality [24]. Physical activity over the past year was assessed using the Baecke questionnaire, which includes occupational, sport, and recreational activity domains; total scores reflect overall physical activity level [25].

Gestational diabetes mellitus (GDM) was diagnosed using a 75-g oral glucose tolerance test (OGTT) at 24–28 weeks of gestation. A fasting glucose ≥92 mg/dL, 1-h glucose ≥180 mg/dL, or 2-h glucose ≥153 mg/dL defined GDM [26].

Ethical Considerations: The study was approved by the Ethics Committee of the University, and all participants provided written informed consent.

Statistical Analysis: Associations between sleep parameters and GDM were evaluated using multivariate logistic regression, adjusting for relevant confounders. $P < 0.05$ was considered statistically significant.

Results

The baseline demographic and clinical characteristics of the 194 participants showed that women with GDM were slightly older than those without GDM (31.3±4.8 vs. 29.3±4.5 years, P<0.001). While most participants were aged 26–40 years, there were no significant differences in age groups, employment status, education, smoking status, gravidity, gestational age, depression scores, or physical activity. Prepregnancy BMI was higher in the GDM group (26.3±3.9 vs. 25.0±4.0 kg/m², P=0.002), and a greater proportion of women with GDM had a history of GDM (21.0% vs. 5.6%, P<0.001) (Table 1).

Table 1: Baseline Demographic and Clinical Characteristics of Participants (n=194)

Variable	GDM (n=104)	Non-GDM (n=90)	P
Age (years)	31.3±4.8	29.3±4.5	<0.001
Age groups (years), n (%)			
≤25	13 (12.5)	19 (21.1)	0.058
26–40	89 (85.6)	70 (77.8)	
>40	2 (1.9)	1 (1.1)	
Employment status (employed), n (%)	29 (27.9)	20 (22.2)	0.360
Education, n (%)			0.630
High school/diploma	36 (34.6)	29 (32.2)	
University	68 (65.4)	61 (67.8)	
Smoking, n (%)	1 (0.9)	1 (1.1)	0.950
Gravidity	2.0±1.1	1.7±0.9	0.055
Gestational age (weeks)	8.9±2.3	8.8±2.4	0.673
Prepregnancy BMI (kg/m²)	26.3±3.9	25.0±4.0	0.002
Prepregnancy BMI groups, n (%)			0.015
Normal	43 (41.3)	50 (55.6)	
Overweight	44 (42.3)	29 (32.2)	
Obese	17 (16.4)	11 (12.2)	
History of GDM, n (%)	13 (21.0)	5 (5.6)	<0.001
Depression score	8.5±5.7	8.7±5.3	0.529
Physical activity	6.5±1.2	6.6±1.0	0.091

Sleep quality and duration parameters were generally comparable between groups. The mean total PSQI scores were similar (5.7±2.8 vs. 5.5±2.4, P=0.448), and the proportion of participants with poor sleep quality did not differ significantly (57.7% vs. 61.1%, P=0.503). Nighttime sleep duration was slightly shorter in the GDM group, with significantly more participants sleeping <7 hours (14.4% vs. 7.8%, P=0.028), while other components of sleep quality and longer sleep durations showed no significant differences (Table 2).

Table 2: Sleep Quality and Duration in Participants

Variable	GDM (n=104)	Non-GDM (n=90)	P
PSQI components (mean±SD)			
Subjective sleep quality	1.0±0.5	0.9±0.5	0.271
Sleep latency	1.1±0.9	1.1±0.9	0.433
Sleep duration	0.5±0.8	0.4±0.8	0.354
Habitual sleep efficiency	0.3±0.7	0.3±0.6	0.159
Sleep disturbances	1.2±0.5	1.2±0.4	0.210
Use of sleep medications	0.05±0.31	0.03±0.27	0.499
Daytime dysfunction	1.3±0.9	1.4±0.9	0.324
Total PSQI score	5.7±2.8	5.5±2.4	0.448
Poor sleep quality (PSQI>5), n (%)	60 (57.7)	55 (61.1)	0.503
Night sleep duration (h)	8.4±1.5	8.7±1.4	0.055
Night sleep <7 h, n (%)	15 (14.4)	7 (7.8)	0.028
Night sleep >9 h, n (%)	30 (28.8)	30 (33.3)	0.312

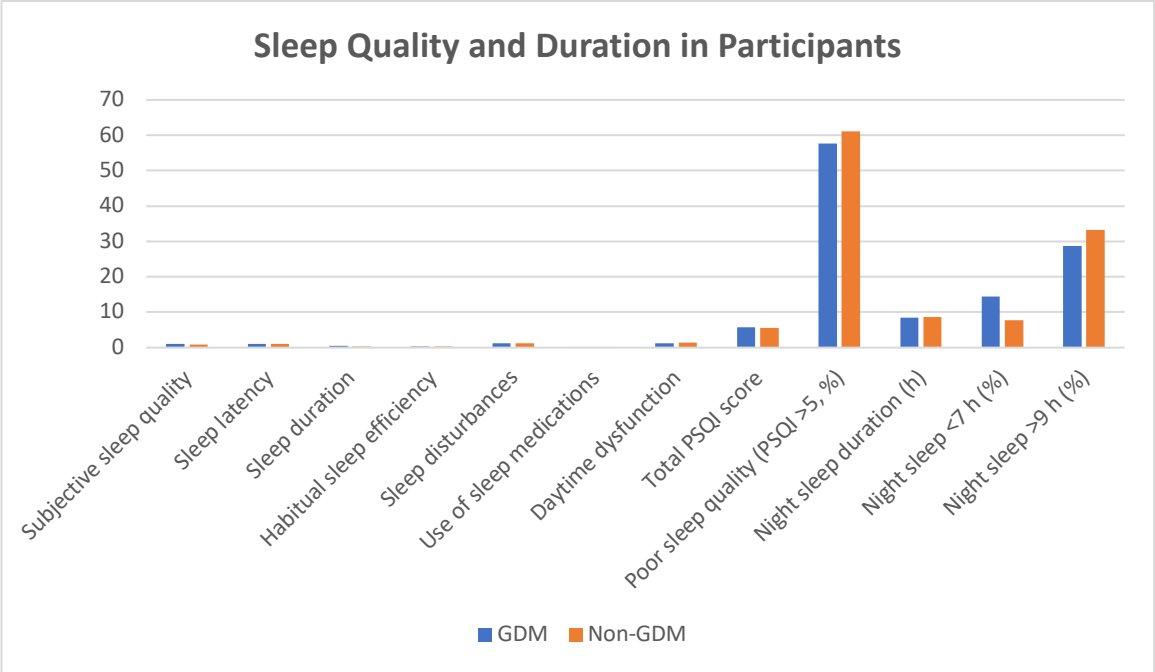

Figure 1: Sleep Quality and Duration in Participants

Cross-tabulation of sleep categories with GDM prevalence indicated no significant association between poor versus good sleep quality and GDM (52.2% vs. 55.7%, P=0.503). However, a higher proportion of participants with night sleep <7 hours had GDM (68.2% vs. 31.8%, P=0.028), whereas sleep durations of 7–9 hours or >9 hours showed no significant differences in GDM prevalence (Table 3).

Table 3: Sleep Categories and GDM Prevalence (Cross-tabulation)

Sleep Category	Total (n)	GDM, n (%)	Non-GDM, n (%)	P
Poor sleep quality	115	60 (52.2)	55 (47.8)	0.503
Good sleep quality	79	44 (55.7)	35 (44.3)	
Night sleep <7 h	22	15 (68.2)	7 (31.8)	0.028
Night sleep 7–9 h	112	59 (52.7)	53 (47.3)	
Night sleep >9 h	60	30 (50.0)	30 (50.0)	0.312

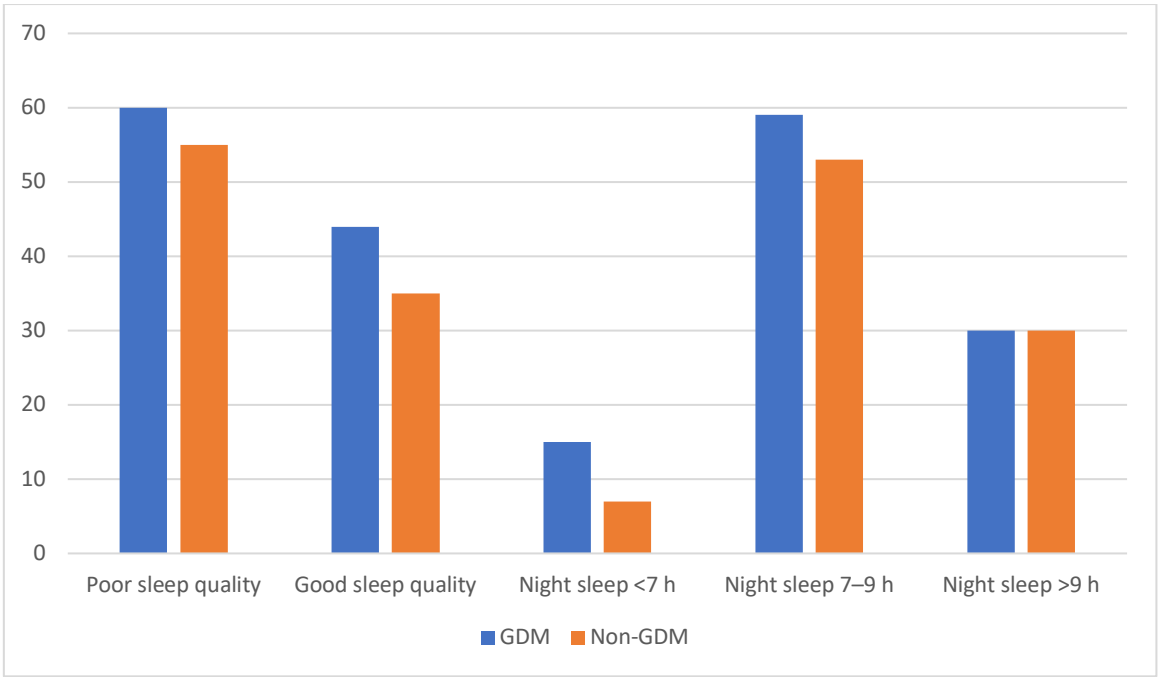

Figure 2: Sleep Categories and GDM Prevalence

Univariate logistic regression analysis demonstrated that short night sleep (<7 hours) was associated with a twofold increased odds of GDM (OR=2.0, 95% CI: 1.1–3.8, P=0.031). Poor sleep quality and long night sleep (>9 hours) were not significantly associated with GDM (OR=0.9, P=0.503; OR=0.9, P=0.752, respectively) (Table 4).

Table 4. Univariate Association of Sleep Parameters with GDM (OR)

Sleep Parameter	OR (95% CI)	P
Poor sleep quality	0.9 (0.6–1.3)	0.503
Night sleep <7 h	2.0 (1.1–3.8)	0.031
Night sleep >9 h	0.9 (0.5–1.2)	0.752

ORs calculated using univariate logistic regression

Discussion

In this prospective longitudinal study of 194 pregnant women, we did not find any significant association between individual components of sleep quality or the total PSQI score and the occurrence of GDM. Although night sleep duration of less than 7 hours was associated with a twofold higher risk of GDM in unadjusted analyses, this association was no longer significant in adjusted models that accounted for other risk factors. Similarly, other measures of night sleep duration, including mean or long sleep duration, showed no significant association with GDM. Given the study design and covariate adjustments, it is unlikely that the nonsignificant results in the adjusted models were due to concealment of relationships by other variables.

Evidence regarding the impact of sleep quality on GDM remains inconsistent. Cai et al., in a cohort study of Asian pregnant women, reported that poor sleep quality increased the risk of GDM by 1.75 times, suggesting that poor sleep may predispose this population to GDM [22]. In contrast, Bisson et al., using both objective (polysomnography) and subjective (PSQI) assessments, found no association between sleep quality and GDM [15]. Ahmed et al. assessed sleep quality at the 22nd and 32nd gestational weeks and observed a worsening of sleep quality in later pregnancy, but no relationship was found between poor sleep and maternal serum glucose [16]. Sharma et al. and Reutrakul et al. also reported no association between sleep quality and GDM [14,17]. Although the meta-analysis by Zhu et al. suggested poor sleep quality as a significant risk factor for GDM (pooled OR = 1.43, 95% CI: 1.16–1.77, P = 0.001) [21], three large-weighted studies included in the analysis used nonstandard sleep assessment tools, which limits the reliability of the pooled estimate [18–20].

The reported association between sleep duration and GDM is similarly mixed. Cai et al. and Reutrakul et al. identified short nocturnal sleep (<6 h and <7 h, respectively) as a risk factor for GDM, with Reutrakul et al. noting a 4% increase in 1-hour post-glucose blood glucose for each hour of sleep lost [14,22]. Conversely, Wang et al. reported a J-shaped relationship, with sleep durations ≥9 h associated with an approximately 20% higher GDM risk [19]. Ahmed et al. and Bisson et al. found no relationship

between sleep duration and GDM [15,16]. In our study, while unadjusted analyses suggested that <7 h of sleep increased GDM risk, this association disappeared after adjustment for other GDM risk factors, indicating that short sleep alone may not be an independent predictor.

These inconsistencies across studies suggest that socioeconomic or psychological factors may modulate the relationship between sleep and metabolic outcomes. In our previous research on metabolic syndrome, poor sleep quality was independently associated with a threefold higher risk in workers, but not in employees [23]. Similarly, Jennings et al. found that the association between sleep quality and metabolic syndrome became nonsignificant after adjusting for depression [24]. Nguyen-Rodriguez et al. also reported that high sleep latency increased the risk of emotional eating, but anxiety traits were the key determinant in multivariate models [25]. These findings highlight the potential influence of contextual factors on the link between sleep and GDM, emphasizing the need to consider psychosocial and behavioral mediators in future studies.

Conclusion

In this prospective study of 194 pregnant women, sleep quality and most sleep duration measures were not independently associated with the development of gestational diabetes mellitus. Although short night sleep (<7 hours) showed a twofold increased risk of GDM in univariate analysis, this association disappeared after adjusting for established risk factors, suggesting that short sleep alone may not be a significant predictor of GDM. Other sleep parameters, including total PSQI score, individual sleep components, and long sleep duration (>9 hours), showed no meaningful relationship with GDM. Overall, the findings indicate that neither sleep quality nor sleep duration independently contributes to GDM risk in this population.

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