Association between Sleep Duration and Quality with Risk of Gestational Diabetes Mellitus

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Abstract

Background: Several studies have been conducted on the relationship between sleep disorders and gestational diabetes. In this study, the relationship between the quality and quantity of sleep and the incidence of gestational diabetes in pregnant women was assessed.

Methods: In this case-control study, the quality and quantity of sleep in pregnant women attended to the Perinatology clinic at Yas Hospital, Tehran, Iran between June 2016 to September 2017 and its relationship with gestational diabetes mellitus was assessed. In this research, 3000 pregnant women at 24 to 28 weeks of pregnancy were enrolled. Gestational diabetes screening test was initially performed on Glucose Challenge Test (GCT) with administration of 50 *gr* of glucose. For abnormal cases, Oral Glucose Tolerance Test (OGTT) with administration of 100 *gr* of glucose after an overnight fasting (8-10 hours) was requested. According to the Gestational Diabetes Mellitus (GDM) diagnosis criteria based on the American Diabetes Association (ADA), women were divided into two groups of case and control (290 diabetic cases and 2710 non-diabetic cases). The Pittsburgh Sleep Quality Index (PSQI) and the participants' demographic information were collected.

Results: Ultimately, 290 of 3,000 women in the study, based on the ADA criteria were diabetic and non-diabetic patients were 2710 women. Sleep quality in the diabetic mothers was significantly worse than non-diabetic mothers and the duration of sleep of them was higher than non-diabetic mothers ($p<0.05$).

Conclusion: Quality and quantity of sleep can be associated with the incidence of gestational diabetes and diabetic mothers have worse sleep quality and longer sleep times than non-diabetic mothers.

Keywords: Gestational diabetes mellitus, Pregnancy, Sleep disorder

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Introduction

Gestational Diabetes Mellitus (GDM) that has shown an increasing trend worldwide is accompanied with adverse short-term and long-term outcomes for both mother and fetus including cardiovascular disorders, diabetes mellitus type II, childhood obesity, *etc* (1,2). GDM is multi-factorial and recognition of contributing factors would help better programming in decreasing the incidence rate of disease and possible outcomes (2). Sleep disorders especially elongated sleep, poor-quality sleep, and breathing disorders during sleep are common in pregnancy with possible etiological role of hormonal alterations, anxiety, and somatic problems (3,4). In previous studies, the association between sleep disorders and gestational adverse outcomes such as preeclampsia, elongated labor duration, increased cesarean rate, Intra Uterine Growth Retardation (IUGR), and preterm labor has been demonstrated (3-5).

Also, some studies were conducted on the association between sleep disorders in non-pregnant women and risk of glucose metabolism disorders, insulin resistance, and diabetes type II (6-8). Sleep is an important human requirement and the sleep quality in high-risk pregnant women with mild pre-eclampsia and GDM decreases (8,9). The association between sleep-related respiratory disorders and risk of diabetes mellitus has been shown (9) but the association with GDM and also the role of duration and quality of sleep is not yet clear. Clarifying such association may help to determine the role of contributing factors in GDM which are useful in decreasing its incidence rate (10-15). Hence, in this study, the association between GDM with duration and quality of sleep was assessed.

Materials and Methods

In this case-control study, 3040 pregnant women at 24 to 28 gestational weeks were assessed who were seeking obstetric cares from perinatology clinic of Yas Hospital, Tehran, Iran from June 2016 to September 2017. The study was approved by local ethical committee with recorded code of 9311290021. This study was performed in accordance with Helsinki Declaration and the informed consent was signed by all participants.

The pregnant women with the history of type 1, 2 diabetes mellitus, history of respiratory syndrome, history of chronic heart or renal disease (n=40) were excluded, then Glucose Challenge Test (GCT) (blood glucose 1 hour post-50-*gr* glucose) was measured for 3000 pregnant women. All tests were done in a single lab of Yas Hospital. In the cases with abnormal blood glucose levels (GCT ≥135), OGTT with 100 *gr* glucose after 8-10 hours of overnight fasting was requested and blood glucose levels were measured before and 1, 2 and 3 hours after administration of 100 *gr* of glucose. The GDM was diagnosed according to American Diabetes Association (ADA) criteria (when two or more venous plasma glucose concentrations are met or exceeded for positive diagnosis and these include: Fasting Blood Sugar (FBS)≥ 95 *mg*/*dl*, BS 1 hour after 100 *gr* glucose ≥180 *mg*/*dl*, BS 2 hours after 100 *gr* glucose≥ 155 *mg*/*dl*, BS 3 hours after 100 *gr* glucose ≥ 140 *mg*/*dl*). The cases with GDM were considered as case group and the women without GDM were enrolled as control group. The required data (demographic, family history, self-gestational history, anthropometric and personal habits) was recorded by trained clinical staff and collected in checklists; also, all women completed the Pittsburgh Sleep Quality Index (PSQI). The PSQI score <5 was defined as poor sleep (16).

Data analysis among 3000 women (290 cases and 2710 controls) was done by SPSS version 25.0 software. The utilized tests for comparisons across the groups were chi-square and independent samples t-test and the p values less than 0.05 were considered statistically significant. Ultimately for elimination of distorting effect of different variables, the logistic regression was used for detecting the association of sleep quality and quantity in case and control groups.

Results

Demographic data of two groups is shown in table 1. As shown in figures 1 and 2, the gravid and parity status significantly differed across the groups (p=0.0001). As shown in figure 3, the monthly income was the same across the groups (p=0.055). As shown in figure 4, there was significant difference between quality of life in case and control groups (p=0.0001).

Different sleep quality subscales are shown in table 2 with significant difference for majority of items. As shown in table 3, the sleep duration subscales did not differ for the time of going to bed and the

Table 1. Demographic data across the groups

Variables	GDM group	Non diabetic group	p value
Mean age (years)	31.9	29.5	0.0001
Family history of diabetes	91 (31.4%)	803 (29.6%)	0.536
Personal history of GDM	44 (15.2%)	136 (5.0%)	0.0001
Smoking	10 (3.4%)	24 (0.9%)	0.001
Undergraduate level literacy	40 (13.8%)	390 (14.4%)	0.0001
Non-Iranian patients	10 (3.4%)	10 (0.4%)	0.0001
Mean BMI (kg/m^2)	27.9 ± 5.8	28.2 ± 4.4	0.413
History of hypertension	42 (15.1%)	108 (4.0%)	0.0001

p- value ≥ 0.05 showed significant difference across two groups

Table 2. Sleep quality subscales across the groups

Item	GDM	Never	Once	Twice	Thrice	p value
Inability to sleep	No	860 (31.7%)	550 (20.3%)	680 (25.1%)	620 (22.9%)	0.0001
	Yes	80 (27.6%)	30 (10.3%)	80 (27.6%)	100 (34.5%)	
Waking up for the need to bathe	No	2410 (88.9%)	210 (7.7%)	80 (3.0%)	10 (0.4%)	0.671
	Yes	260 (89.7%)	20 (6.9%)	10 (3.4%)	---	
Waking up for inability to breathe	No	1910 (70.5%)	360 (13.3%)	260 (9.6%)	180 (6.6%)	0.0001
	Yes	170 (58.6%)	50 (17.2%)	20 (6.9%)	50 (17.2%)	
Waking up for coughing/snoring	No	2090 (77.1%)	400 (14.8%)	150 (5.5%)	70 (2.6%)	0.0001
	Yes	200 (69.0%)	70 (24.1%)	10 (3.4%)	10 (3.4%)	
Waking up for cold sensation	No	2150 (79.3%)	400 (14.8%)	150 (5.5%)	10 (0.4%)	0.0001
	Yes	190 (65.5%)	70 (24.1%)	30 (10.3%)	---	
Waking up for warm sensation	No	1070 (39.5%)	680 (25.1%)	560 (20.7%)	400 (14.8%)	0.0001
	Yes	110 (37.9%)	30 (10.3%)	60 (20.7%)	90 (31.0%)	
Waking up for nightmare	No	1960 (72.3%)	490 (18.1%)	210 (7.7%)	50 (1.8%)	0.002
	Yes	180 (62.1%)	70 (24.1%)	30 (10.3%)	10 (3.4%)	
Waking up for pain	No	1030 (38.0%)	670 (24.7%)	520 (19.2%)	490 (18.1%)	0.0001
	Yes	80 (27.6%)	60 (20.7%)	40 (13.8%)	110 (37.9%)	
Sedative use	No	2660 (98.2%)	20 (0.7%)	10 (0.4%)	20 (0.7%)	0.0001
	Yes	240 (82.8%)	40 (13.8%)	---	10 (3.4%)	
Somnolence	No	2020 (74.5%)	500 (18.5%)	100 (3.7%)	90 (3.3%)	0.0001
	Yes	180 (62.1%)	60 (20.7%)	30 (10.3%)	20 (6.9%)	
Difficulty in doing routine activities	No	1110 (41.0%)	780 (28.8%)	580 (21.4%)	240 (8.9%)	0.0001
	Yes	100 (34.5%)	60 (20.7%)	70 (24.1%)	60 (20.7%)	

Table 3. Sleep duration subscales across the groups

Item	GDM	Mean	Standard deviation	p value
Time of going to bed	No	8.05	10.35	0.831
	Yes	8.13	10.37	
Time of going to sleep	No	5.5	9.00	0.075
	Yes	4.54	8.22	
Wake-up time	No	8.23	1.49	0.002
	Yes	8.42	1.38	
Sleep duration	No	7.68	1.64	0.009
	Yes	8.21	1.48	

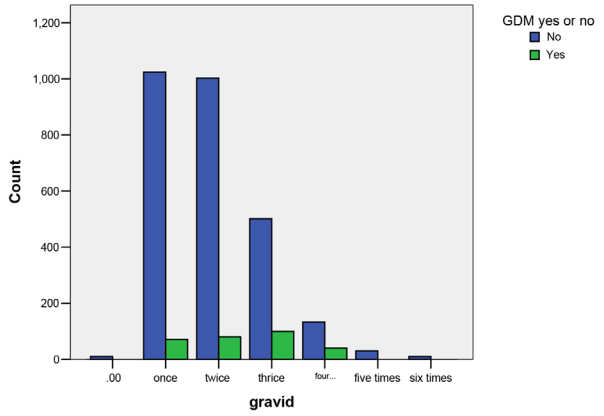

Figure 1. Gravid status across the groups

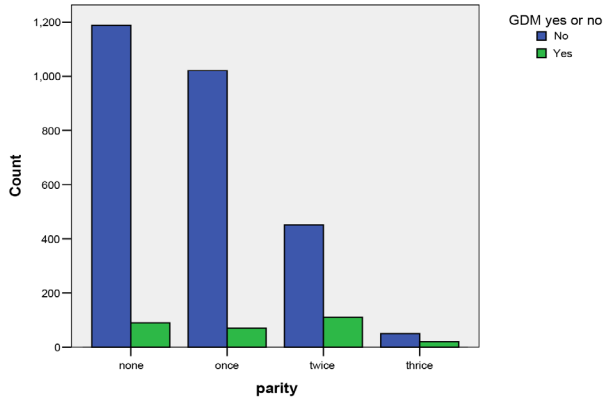

Figure 2. Parity status across the groups

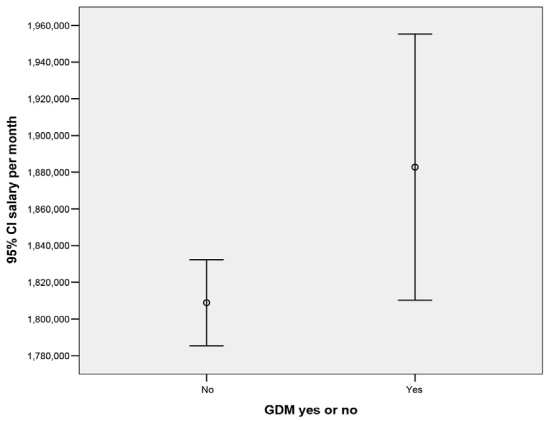

Figure 3. Monthly income across the groups

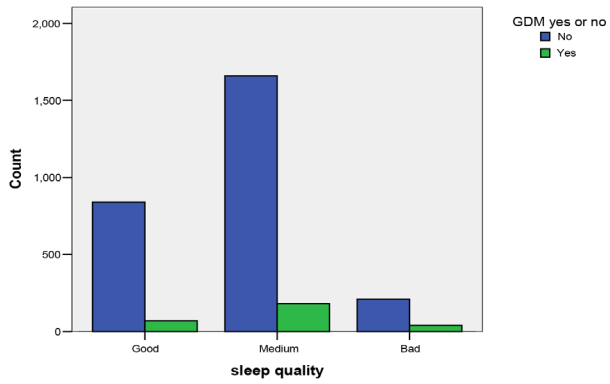

Figure 4. Sleep quality across the groups

time of sleeping (p>0.05); but there was significant difference for wake-up time (p=0.002) and sleep duration (p=0.009) across the groups. The mean Pittsburgh point was 2.31.5± and 6.21.8± in control and cases group, respectively (p=0.0001).

The logistic regression was predictive up to 90% (p=0.0001) with a range of prediction between 30.1 to 64.1% (mean of 94.1%). Significant factors include previous GDM (p=0.006), literacy (p=0.0001), hypertension (p=0.032), age (p=0.020), and Pittsburgh score (p=0.0001).

Discussion

The results demonstrated that both quality and quantity of sleep may be related with GDM. The quality of sleep in GDM cases was worse and duration of sleep was longer. Prevalence rate of GDM is increasing worldwide with some variation according to age, ethnicity, race, body composition, and diagnostic and screening tests characteristics. There are multiple short-term and long-term complications affecting both maternal and neonatal health. Women with GDM are at increased risk for diabetes mellitus type II and cardiovascular disorders. Children of diabetic mothers will have increased risk for childhood obesity, abnormal glucose level, and early-onset cardiovascular diseases. GDM is a carbohydrate intolerance status during pregnancy either treated with or without insulin. More than half of GDM cases would develop overt diabetes mellitus till the next 20 years. Hence, recognition of related factors would help in better prevention of GDM. Sleep disorders especially elongated sleep, poor-quality sleep, and sleep-breathing disorders are common during pregnancy which may be connected with hormonal changes, anxiety, and somatic problems.

In non-pregnant population, it has been shown by Chaput *et al* (7) that increased and decreased night-time sleep would increase the incidence rate of diabetes mellitus. Wang *et al* (10) reported that poor-quality sleep and sleep duration longer than nine hours versus 7 to 9 hours are accompanied with higher incidence rate of GDM. Similarly, in our study, the sleep quality was worse in mothers with GDM and also the longer duration was related to GDM. In some studies, the economic and social status, income levels, and literacy were separately related to sleep

disorders and occurrence of GDM (16,17).

The study by Saadati *et al* (18) reported that poor-sleep quality was related to mild preeclampsia and GDM. Other studies (19-22) showed that short duration of sleep was related to GDM. In this study, there was no significant difference between family history among healthy and GDM mothers. It is recommended that in future studies, the second-degree relatives be evaluated as well.

Sleeping difficulties, difficulty breathing or shortness of breath, coughing or snoring, nightmare, and pain are more common among diabetic cases. Also, the use of sedatives was more common among GDM mothers. The mean Pittsburgh score was 6.2 that showed poor sleep quality similar to other studies (18,19,23). Regarding the obtained association between quality and quantity of sleep with GDM, some training courses and guidance would result in improved sleep pattern and subsequent decrease in GDM incidence rate.

Totally, according to the obtained results, it may be concluded that quality and quantity of sleep is associated with the incidence of gestational diabetes and diabetic mothers have worse sleep quality and longer sleep times than non-diabetic mothers. However, further studies with larger sample size are required to attain more definite results.

Conclusion

This study showed significant association between quality and quantity of sleep and GDM in pregnancy, although studies with larger sample size are required and the priority of sleep disorders in occurrence of GDM needs to be more investigated. That may result in early detection of GDM in these patients or can lead to decrease of GDM prevalence by treating sleep disorders during pregnancy.

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