Original Article
DOI: https://doi.org/10.70749/ijbr.v3i4.1009

INDUS JOURNAL OF BIOSCIENCE RESEARCH
https://induspublishers.com/IJBR
ISSN: 2960-2793/ 2960-2807

Sleep Patterns and Long-Lasting Risk of Diabetes Mellitus Type 2 in Females with a History of Gestational Diabetes Mellitus

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ARTICLE INFO

Keywords

Sleep Pattern, Gestational Diabetes, Diabetes Mellitus, HbA1c.

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Declaration

Authors' Contribution: All authors equally contributed to the study and approved the final manuscript.

Conflict of Interest: No conflict of interest.

Funding: No funding received by the authors.

Article History

Received: 06-03-2025, Revised: 28-03-2025
Accepted: 07-04-2025, Published: 14-04-2005

ABSTRACT

Background: Gestational diabetes mellitus is a type of hyperglycemia that occurs or is diagnosed during pregnancy. The state of sleep is becoming a crucial public health concern globally. **Methodology:** It was a prospective cohort study. 38 women having a history of gestational diabetes mellitus participated in the study. The study was carried out at Capital Hospital, Islamabad, for six months from September 2024 to February 2025. Patients who responded to sleep characteristics were also included in the study. Data was analyzed by IBM SPSS version 25. Based on previous literature, a sample of 38 participants was included in the study. The chi-square test was applied to find the association between T2D and sleep quality, and an independent sample t-test was applied to analyze the comparison between health variables and participants with and without T2D. **Results:** The average age is 37.45 years with SD=5.674, with a range of 30 to 45 years. Most participants, 71.1%, did not have T2D, whereas 28.9% had T2D. Diabetic patients had a substantially higher BMI (M=30.66, SD=1.39) than non-diabetics (M=24.45, SD=1.22; t(36)=13.65, 95% CI (5.29,7.14). Compared to the non-diabetic group (M=91.73, SD=5.74), the diabetic group had higher fasting blood glucose levels (M=121.98, SD=6.74), t(36)=14.01, 95% CI [25.87, 34.63]. None of the 11 participants with T2D had good sleep quality, while 27 without type 2 diabetes reported good sleep. **Conclusion:** The results show a strong association between T2D and various health factors. Participants with T2D had higher BMI, fasting glucose level, and HbA1c values, along with shorter sleep duration and less physical activity. Poor sleep quality suggests a significant association between sleep quality and type 2 diabetes mellitus (T2D).

INTRODUCTION

The pattern of sleep is growing as an important public health concern worldwide. (1) In the year 2020, the CDC stated that 1/3rd of people in the United States consistently slept less than seven hours of recommended sleep every day (2). The previous studies on sleep quality as well as its effects on a variety of health findings, infections, cancers, Alzheimer's disease, and heart disease, have increased over the past few decades(3,4). There is mounting evidence associating a common person who snores frequently with less sleep and a higher risk of diabetes mellitus type 2 (5,6). Circadian patterns are the behavioral and physiological modifications regulated by the circadian clock, which maintains synchronized adjustment with the natural light-dark cycles. (7).

The standard definition of gestational diabetes is hyperglycemia that occurs or is detected during pregnancy. Gestational diabetes is frequently categorized into two classes such as A1GDM, which is diet-controlled gestational diabetes, and class A2GDM, which is defined as gestational diabetes that requires pharmacologic therapy for hyperglycemia. About 7 percent of gestations in America were complicated by diabetic mellitus of some type, with gestational diabetes accounting for diabetic Mellitus 86% of those cases(8). In Europe, the predicted incidence of gestational diabetes is about 10% (9). In Pakistani research, it was reported prevalence rate of gestational diabetes ranged from 4.41 percent to 57.90 percent (10).

Women with gestational diabetic mellitus were almost 10 times more likely to acquire T2D in the future than women without previous episodes of gestational diabetes (11). Changeable risk factors such as diet, exercise, and weight are associated with a lower risk of gestational diabetes in women with previous episodes of the disease (12). These underlying metabolic processes frequently cause females with GD to acquire T2D years before the general population (13).

Our research goals are to evaluate the association among sleep quality of women, their sleep patterns, as well as the diagnosis of diabetes in women who were suffering from gestational diabetes.

METHODOLOGY

This prospective cohort research initially enrolled 57 female patients aged between 30 and 49, including those with GD. This study was conducted at CDA Hospital Islamabad, Pakistan. The study duration was 6 months from September 2024 to February 2025. Patients who had a gestational diabetes history were included. Patients who responded to sleep characteristics were also included in the study. Women with a history of diabetes mellitus type 1, several gestational pregnancies, and missing birth dates were excluded from the study. Diagnosis of type 2 diabetes, missing data on sleep-related factors, and participants who did not report gestational diabetes were excluded. Data was analyzed by IBM SPSS version 25. Based on previous literature, a sample of 38 participants was included in the study. To adjust the sample size for a 6-month duration, 917 participants were included in a previous study. However, if the 917 participants were for a study conducted between 2007-2018 (144 months) (14), we estimated the proportional sample size for a 6-month study using a simple ratio.

New sample size = Original sample size × new Study Duration (months)/Original study duration (Months)
=917 ×6/144
=38

Age, past medical history, gestational diabetes diagnosis, and parents' history of type 2 diabetes were among the demographic data that were computed. Hemoglobin A1c and fasting glucose levels were assessed. Health factors were compared between women with and without diabetes with type 2 using an independent sample t-test. The association between the diagnosis of T2D and sleep quality variables was evaluated using the tests of chi-square. A probability value of 0.05 was taken as a significant value.

RESULTS

The descriptive statistics of crucial health-related variables for a sample of 38 participants. The average age is 37.45 with SD=5.674, with a range of 30 to 45 years. The average BMI is 26.247(SD=3.1206), with a range of 22.2 to 32.8. The mean amount of sleep is 7.11 hours with a wide range of 4.1 to 9.0 hours.

Table 1

Variables	Frequency	Min ± Max	Mean values	SD
Age	38	30 ± 45.0	37.45	5.674
BMI	38	22.2 ± 32.8	26.247	3.1206
Sleep Duration	38	4.1 ± 9.0	7.1105	1.676
Insulin Resistance	38	1.57 ± 5.49	3.0211	1.20836
Fasting Blood Glucose	38	81.1 ±1 29.0	100.4895	15.123
Hb1Ac	38	4.5 ± 7.3	5.603	0.8713
Physical Activity	38	542 ± 2970	2081.34	774.885
Diet Quality Score	38	30 ± 89	69.08	19.59

Table 2 shows the distribution of 38 participants' type 2 diabetes diagnosis and sleep quality. Most participants, 71.1%, did not have T2D, whereas 28.9% had T2D. 71.1 percent said they had a good quality of sleep, compared to 28.9 percent who reported they did not have a good quality of sleep. These results show that while the percentage of people with T2D is still significant, there is a higher prevalence of good quality in the sample.

Table 2

Type 2 Diabetes Diagnosis and Sleep Quality

Type 2 Diabetes Diagnosis	Frequency	Percent
Yes	11	28.9%
No	27	71.1%
Total	38	100.0%
Sleep Quality		
High	27	71.1%
Low	11	28.9%
Total	38	100%

Using independent t-tests, Table 3 compares health factors statistically between people with and without T2D. All the variables that were examined showed significant differences with a p-value of 0.001. With a significant effect size (t (36) =-13.41, 95% confidence interval (-3.83, -2.83), the diabetic group's sleep duration was significantly shorter (Mean= 4.75, SD=0.51) as compared to the non-diabetic group (Mean=8.07, Standard Deviation=0.75). Diabetic patients had a substantially higher BMI (M=30.66, SD=1.39) than non-diabetics (M=24.45, SD=1.22; t (36) =13.65, 95% CI (5.29,7.14). Compared to the non-diabetic group (Mean=91.73, SD=5.74), the diabetic group had higher fasting blood glucose levels (Mean=121.98, Standard Deviation = 6.74), t(36)=14.01, 95% CI [25.87, 34.63]. Similarly, people with DM had substantially higher HbA1c values (M=6.85, SD=0.34) than people without diabetes (M=5.10, SD=0.34; t (36) =14.36, 95% CI [1.50, 2.00]. Diabetes patients had significantly less physical activity (M=994.00 SD=357.07) than people without the disease (M=2524.33, SD=318.50); t(36)=-12.98, 95% CI [-1769.49, -1291.18].

Table 3
Comparison of Health Variables among Participants with and without T2D

Variable	Diagnosis of Diabetes	N	Mean	SD	t-value	df	P-value-value	Confidence Interval (95%)
Sleep Duration	Yes	11	4.75	0.51	-13.41	36	0.00	-3.83 to -2.83
	No	27	8.07	0.75				
BMI	Yes	11	30.66	1.39	13.65	36	0.00	5.29 to 7.14
	No	27	24.45	1.22				
Fasting Blood Glucose	Yes	11	121.98	6.74	14.01	36	0.00	25.87 to 34.63
	No	27	91.73	5.74				
HbA1c	Yes	11	6.85	0.34	14.36	36	0.00	1.50 to 2.00
	No	27	5.1	0.34				
Physical Activity	Yes	11	994.0	357.07	-12.98	36	0.00	-1769.49 to -1291.18
	No	27	2524.33	318.5				
Sleep Quality	Yes (Low)	11	-	-	-	-	-	-
	No (High)	27	-	-	-	-	-	-

The diagnosis of T2D and sleep quality are strongly associated, according to Table 4. None of the 11 participants who were diagnosed with T2D had great sleep quality, whereas all of them reported poor sleep quality. On the other hand, 27 participants who did not have T2D reported having good sleep. Association is statistically significant (p-value = 0.00), indicating that there is very little possibility that it happened by chance, which shows there is a strong association between the higher risk of diagnosis of diabetes and quality of sleep.

Table 4
Association between Type 2 Diabetes Diagnosis and Sleep Quality

T2Diabetes Diagnosis	High Sleep Quality	Low Sleep Quality	P-value
Yes	0 (0.0%)	11 (100.0%)	0.00
No	27 (100.0%)	0 (0.0%)	
Total	27 (71.1%)	11 (28.9%)	

DISCUSSION

A higher probability of GD is associated with short sleep duration as well as long sleep duration in the second trimester; the effects are influenced by sleeping frequency and pre-pregnancy obesity. (15) In American women of reproductive age, the length and quality of sleep had no significant association with the risk of diabetes mellitus type 2. (16) Our research revealed that all people with T2D had poor sleep quality, indicating a significant association between the two conditions. According to this statistically substantial association, getting too little sleep may increase the chance of getting the disease. Enhancing the quality of one's sleep may help prevent and manage diabetes association between the duration, quality, and change of sleep and risk of T2D was shown in another study. (17)

Women with a history of pregnancy-related diabetes are significantly more probably to develop type 2 diabetes than women who are in good health (18). The current consensus, evaluated from the EASD and American Diabetes Association, stated that sleep is equally important for maintaining Type 2 diabetes as more traditional aspects of lifestyle, such as food and exercise. (19) Data regarding the association between sleep and the occurrence of T2D in women with GDM is, however, lacking. Although associations have been observed in the second group, the underlying diabetes status in females differs significantly from that in people of all ages. (20), possibly having an impact on the relationship between sleep quality and the occurrence of type-2 diabetes mellitus in the high-risk group. Between 35 and 60 % of women with gestational diabetes within 10 years after receiving a diagnosis, making them more likely than the general population to develop the disease sooner. (13) According to our research, those with diabetes slept noticeably less than people without the disease. The significant difference between the two groups is highlighted by the huge effect size, suggesting that those with diabetes often have significantly lower sleep quality. This strong association implies that less sleep time could play a substantial role in diabetes hazard assessment and management. According to previous studies, it was stated that less sleep time is correlated with a higher chance of the onset of T2D (21,22).

The results of our study show that while a smaller percentage of individuals reported low sleep quality, a larger percentage reported good sleep quality. Similarly, while a considerable proportion of people were diagnosed with T2D, most were not. This implies that although T2D is still significantly prevalent in groups, better sleep quality is more prevalent. There seems to be some interest in the association between sleep quality and the risk of T2D, which emphasizes the need for more studies to examine any possible associations. In individuals with T2D, poor sleep quality is associated with a reduced health-related quality of life. (23)

In each group we tested, we discovered substantial variations between the diabetes and non-diabetic groups. While the diabetic group's Body Mass Index, fasting glucose levels, and HbA1c levels were high, suggesting worse metabolic health, their sleep duration and physical activity were lower. Although no quantitative analysis was presented, sleep quality was classified as low for

people with diabetes and high for people without the disease.

CONCLUSION

The results point to a strong association between T2D and several health-related factors. Compared to people without T2D, individuals with the disease had higher BMI, higher fasting blood glucose, higher HbA1c values, and noticeably less sleep duration. The group with diabetes also engaged in much less physical activity. Furthermore, all participants with T2D reported having poor sleep quality, indicating a substantial and statistically significant association between the two conditions. These findings call for more research into the function of sleep and lifestyle factors in diabetes management and prevention, since they show a strong association between women with poor quality of sleep, negative health metrics, and a greater risk of T2D.

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