Effect of Pregnancy-Induced Diabetes Mellitus on Oral Health Status of Bareilly Sub-Population: An Observational Study

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Abstract

Objective: This observational study aims to evaluate the effect of pregnancy-induced diabetes mellitus (gestational diabetes mellitus, GDM) on the oral health status of a sub-population in Bareilly. Specifically, the study explores the relationship between GDM and periodontal disease in pregnant women. **Methods:** The study involved 90 pregnant women (45 with GDM and 45 controls), recruited from the outpatient department of the Institute of Dental Sciences, Bareilly. A comprehensive dental examination was performed, assessing clinical parameters such as clinical attachment loss (CAL), probing depth (PD), bleeding on probing (BOP), and gingival recession. Participants were also evaluated for oral hygiene status using the Simplified Oral Hygiene Index (OHI-S). Demographic data and clinical information, including body mass index (BMI), family history of diabetes, and oral hygiene habits, were collected via interviews. **Results:** The study found significant differences between the GDM and non-GDM groups in oral hygiene practices and periodontal health indicators. The GDM group showed higher levels of bleeding on probing (BOP), with a greater number of patients exhibiting BOP in more than three teeth (P = 0.030). Mild periodontal disease was more prevalent in the non-GDM group, while severe periodontal disease was observed in both groups at similar rates. GDM patients reported poorer oral hygiene, with fewer achieving a "good" OHI-S score compared to the control group (P = 0.050). However, the overall prevalence of periodontal disease did not differ significantly between the two groups (77% in GDM vs. 70% in non-GDM, P = 0.535). **Conclusion:** While women with GDM tended to exhibit poorer oral hygiene and more periodontal disease indicators, no definitive statistical association between GDM and periodontal disease was found in this study. These findings suggest the need for further research to establish a clearer link between GDM and oral health, particularly to explore the long-term effects of pregnancy-induced diabetes on oral health.

Keywords: Pregnancy-induced diabetes mellitus, Gestational diabetes mellitus (GDM), Oral health status, Periodontal health, Dental caries, Oral hygiene status, Pregnancy and oral health

Introduction

Pregnancy marks a significant phase in a woman's life, bringing with it a complex interplay between oral health and overall pregnancy outcomes. On one hand, pregnancy can exacerbate existing oral health issues, while on the other, poor oral hygiene can negatively influence pregnancy outcomes. Pregnant women are especially susceptible to prevalent oral conditions such as dental caries and periodontal diseases. Without proper dental care during this period, these issues may have lasting consequences for maternal health.[1]

The link between hormonal fluctuations during pregnancy and periodontal inflammation has long been recognized. As early as 1778, Vermeeren described tooth pain experienced by pregnant women. Similarly, Pitcairn observed gingival swelling and inflammation, and in 1877, Pinard documented a case of pregnancy-induced gingivitis.[2]

Periodontal disease encompasses two primary conditions: gingivitis and periodontitis. Gingivitis involves inflammation of the gum tissues and is both preventable and reversible with appropriate oral hygiene practices. In contrast, periodontitis is more severe, characterized by progressive inflammation that leads to irreversible damage to supporting dental structures, including alveolar bone loss. One of the major contributors to the development and progression of periodontitis is diabetes. Studies suggest that individuals with diabetes are approximately three times more likely to develop periodontitis than those without the condition.[3]

Gestational Diabetes Mellitus and Its Implications

Gestational diabetes mellitus (GDM) is a form of glucose intolerance that arises during pregnancy. This diagnosis stands regardless of whether the condition resolves after childbirth or requires management through diet or insulin therapy.[4] Women who develop GDM are at an increased risk of progressing to type 2 diabetes later in life.[5] GDM affects around 7% of pregnancies annually, translating to over 200,000 cases each year.[4]

If left untreated, GDM can have adverse outcomes for both mother and child. Complications may include preeclampsia, stillbirth, cesarean delivery, preterm birth, and macrosomia an abnormally large infant size. Macrosomia is associated with delivery complications, respiratory issues, and neonatal hypoglycemia. Moreover, children born to mothers with GDM face heightened risks of developing obesity and type 2 diabetes as they grow.[6]

Despite the known consequences of both periodontal disease and GDM, limited research has explored their direct association. This gap in the literature has sparked interest in examining the potential link between these two conditions. As such, the current study was undertaken to evaluate the correlation between periodontal disease and GDM within our population.

Materials and Methods

Study population

The study included a total of 90 participants, comprising 45 cases diagnosed with gestational diabetes mellitus (GDM) and 45 control subjects. All participants were selected from those visiting the outpatient department of the Institute of Dental Sciences, Bareilly. Pregnant women previously diagnosed with pregnancy-induced diabetes mellitus were enrolled for the study. To assess carbohydrate intolerance, all participants underwent a random blood glucose test as part of the screening process.

• Women with glucose level >135 mg/dl were diagnosed with GDM and were considered as cases

• Women who glucose levels <135 mg/dl were considered as controls.

Inclusion and exclusion criteria

Inclusion criteria

- Patient at the gestational age between 24th and 30th weeks
- Patients who have undergone complete GDM screening
- Patients above 18 years of age
- Patients who consent to participate.

Exclusion criteria

- Patients with history of presentational diabetes
- Patients having any heart disorders
- Patients suffering from HIV
- Patients who had undergone any oral prophylaxis or periodontal treatment within last 3 months.

Definitions and periodontal disease measurements

Prior to conducting the dental examination, each participant underwent a personal interview to gather demographic and clinical information, including age, gestational age, level of education, occupation, body mass index (BMI), history of gestational diabetes mellitus (GDM), previous treatment for periodontal conditions, family history of diabetes, frequency of dental visits, and oral hygiene practices such as tooth brushing.

A comprehensive periodontal examination was carried out for all participants, with assessments taken at six sites per tooth. The clinical parameters evaluated included probing depth (PD) fig 1, clinical attachment loss (CAL) fig2, bleeding on probing (BOP) and gingival recession.
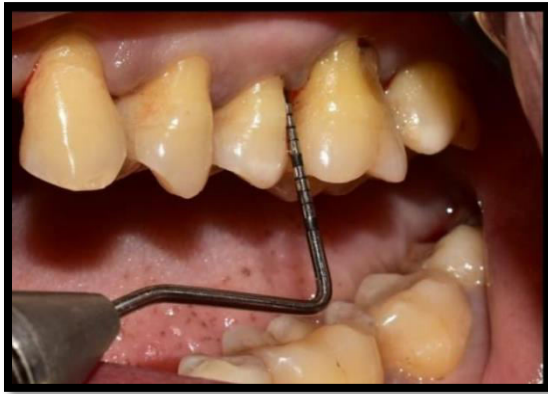
Fig 1 Recording PD   **Fig 2 Recording CAL**

Bleeding on probing was assessed by gently probing to the base of the sulcus on six surfaces of each tooth and was recorded as the percentage of sites showing bleeding relative to the total number of surfaces examined.

Gingival recession was measured as the distance in millimeters from the cement enamel junction to the gingival margin.

To evaluate oral hygiene status, the Simplified Oral Hygiene Index (OHI-S) was used for both cases and controls. This involved assessing six preselected teeth for debris and calculus. The scoring criteria followed the guidelines established by Green and Vermillion (JADA, 1964).

All periodontal evaluations were conducted by a single examiner to avoid inter-examiner variability. Consistent with earlier research on the relationship between periodontal disease and pregnancy outcomes, periodontal disease was identified based on PD and CAL values of ≥4 mm. Additionally, classification criteria from Offenbacher et al. were applied: mild periodontal disease was defined as any site with PD ≥4 mm and CAL ≥3 mm, while severe periodontal disease was characterized by at least four sites with PD ≥5 mm and CAL ≥3 mm.[7]

Statistical analysis

The collected data were organized and entered into Microsoft Excel 2013 and subsequently analyzed using IBM SPSS Statistics version 22 for Windows (New York, USA). Statistical tests, including the Chi-square test, were employed to assess proportions and associations between variables. To further validate the findings, multivariate logistic regression analysis was conducted.

Results

A total of 90 pregnant women participated in the study, which aimed to examine the association between periodontal disease and gestational diabetes mellitus (GDM). Among them, 45 women with a history of GDM were designated as the case group, while the remaining 45 without GDM served as controls. The average age of the case group was 27.83±4.60 years, whereas the control group had a mean age of 30.48±4.95 years. The mean body mass index (BMI) was 26.63±1.35 for the GDM group and

24.92±0.88 for the non-GDM group [Table 1]. Table 2 provides a comparative analysis of periodontal health indicators between the two groups. Notable differences were identified in oral hygiene practices, family history of diabetes, and periodontal status. A greater proportion of GDM patients reported brushing twice daily, while once-daily brushing was more prevalent in the non-GDM group. A positive family history of diabetes was significantly more common among GDM participants. Employment status also varied, with a higher rate of unemployment observed among non-GDM individuals.

In terms of periodontal health, the GDM group showed higher scores for bleeding on probing (BOP), with a larger number of patients presenting BOP in more than three teeth. Although generalized gingival recession was more frequently observed in the GDM group, this difference did not reach statistical significance. Both groups had a similar prevalence of severe periodontal disease; however, mild periodontal disease was more frequently recorded in the non-GDM group. Oral hygiene, as evaluated using the Simplified Oral Hygiene Index (OHI-S), was generally poorer among GDM patients, with fewer achieving a "good" OHI-S score compared to the control group.

Despite these trends, the overall prevalence of periodontal disease was 77% in the GDM group and 70% in the non-GDM group. This difference was not statistically significant (P = 0.535), as illustrated in Figure 1. These findings indicate that while women with GDM tend to exhibit poorer periodontal health and oral hygiene behaviors, a definitive association between GDM and periodontal disease could not be established based on this study.

Table 1: Characteristics of Study Subjects

Parameter	GDM (Mean ± SD)	Non-GDM (Mean ± SD)
Mean age (years)	27.83 ± 4.60	30.48 ± 4.95
Mean gestational age	27.46 ± 1.83	27.90 ± 1.52
Mean BMI (kg/m²)	26.63 ± 1.35	24.92 ± 0.88

Note: BMI = Body Mass Index; GDM = Gestational Diabetes Mellitus

Table 2: Periodontal Disease Measurements

Condition	GDM (n=45) (%)	Non-GDM (n=45) (%)	p
Brushing			
Once daily	27 (60.0)	34 (75.5)	0.002*
Twice daily	18 (40.0)	11 (24.5)	0.004*
Last dental visit			
Within 6 months	3 (6.7)	4 (8.9)	0.700
6–12 months	42 (93.3)	41 (91.1)	0.750
Family history of diabetes			
Present	34 (75.0)	10 (22.2)	0.001*
Education			
Educated	36 (80.0)	32 (71.1)	0.300
Uneducated	9 (20.0)	13 (28.9)	0.290

Employment			
Employed	30 (66.7)	22 (48.9)	0.050
Unemployed	15 (33.3)	23 (51.1)	0.040
BOP (Bleeding on Probing)			
Mean ± SD			0.002*
No BOP	7 (15.6)	13 (28.9)	0.500
BOP in 1–2 teeth	12 (26.7)	18 (40.0)	0.040*
BOP in >3 teeth	26 (57.8)	13 (28.8)	0.030*
Generalized recession			
Present	20 (44.4)	16 (35.6)	0.150
Periodontal disease			
No periodontal disease	10 (22.2)	13 (28.9)	0.100
Mild periodontal disease	15 (33.3)	22 (44.4)	0.300
Severe periodontal disease	18 (40.0)	18 (40.0)	1.000
OHI-S score (Simplified Oral Hygiene Index)			
Good	12 (26.7)	20 (44.4)	0.050
Fair	18 (40.0)	15 (33.3)	0.500
poor	15 (33.3)	10(22.2)	0.200

*Statistically significant. Percentage mentioned under heading "family history of diabetes" and "generalized recession" may not add up to 100% because only positive finding had been reported. OHI-S=Simplified oral hygiene index, GDM=Gestational diabetes mellitus
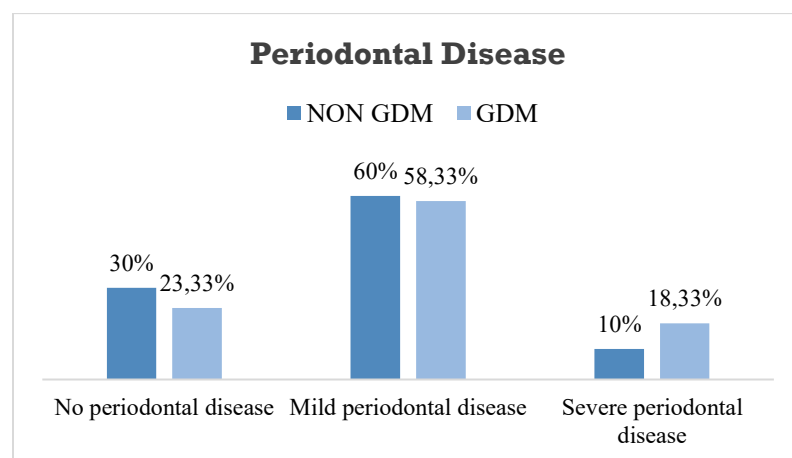

Figure 1: Comparisons of periodontal disease in gestational diabetes mellitus and non-gestational diabetes mellitus patients

Discussion

This study aimed to investigate the relationship between periodontal disease and gestational diabetes mellitus (GDM) in our population. A total of ninety pregnant women participated, with thirty women in the case group (GDM) and sixty women in the control group. The gestational age of participants ranged from 24 to 30 weeks. The findings of the study suggest a significant association between periodontal disease and GDM. Mishra et al. (2014) conducted a study that did not reveal any significant correlation between GDM and periodontal disease in cases of generalized chronic

periodontitis (P=0.475) and localized chronic periodontitis (P=0.538).[8] In contrast, Dasanayake et al. observed a higher risk of periodontal disease in women with GDM compared to those without, although this result did not reach statistical significance.[9]

In the present study, bleeding on probing (BOP) was significantly higher in GDM patients, with a P-value of 0.045. This finding aligns with a study by Xiong et al., which involved 53 cases and 106 controls at the Woman's Hospital, Baton Rouge, USA. Their research reported a higher prevalence of BOP, a measure of gingivitis, in GDM patients compared to controls, further supporting the hypothesis that gingivitis is associated with GDM.[10]

The presence of periodontal pockets increases the likelihood of harboring pathogenic microorganisms, which can trigger a host inflammatory response, potentially leading to systemic effects.[11] Periodontal treatment can help reduce local inflammation and lower the levels of inflammatory mediators, such as C-reactive protein and interleukin-6, which play a role in glycemic control.[12] Additionally, periodontal pockets have been linked to elevated levels of low-density lipoprotein (LDL) cholesterol and total cholesterol. Knopp et al. reported higher triglyceride levels and lower high-density lipoprotein (HDL) concentrations in women with GDM, while Koukkou et al. observed increased triglycerides and lower LDL cholesterol levels.[13,14]

The study population in this research may appear to have more severe periodontal disease than other populations studied for similar associations with adverse pregnancy outcomes. This could be due to the educational and socioeconomic factors of the participants. In our study, 63% of women with GDM had some level of education, while 58.33% of women without GDM were educated, suggesting that education might play a role in better oral health. Moreover, previous studies often included participants from lower socioeconomic backgrounds. In our study, a positive correlation was observed between family history of diabetes and oral hygiene index scores among women with GDM.

Periodontal disease is both preventable and treatable. If future studies confirm its role as a risk factor for GDM, this could open up opportunities for intervention studies. Improving oral health and treating periodontal disease before or during pregnancy could reduce maternal and infant morbidity related to GDM and help prevent the future risk of type 2 diabetes.

Conclusion

Periodontal diseases are distributed worldwide representing a major oral health concern. Diabetes has been proved as a major risk factor for periodontitis. The physician and dentist should make a combined effort to encourage periodic assessment of the oral hygiene status and to educate the patients regarding the implications of poor oral health status on preterm deliveries and low birth weight deliveries even before pregnancy. Further, prospective controlled trials with a larger number of patients are warranted to establish these relationships; their etiology and

the results that treating periodontal disease can positively reduce the burden of diabetes-related complications in life.

References

1. Karunachandra NN, Perera IR, Fernando G (2012). Oral health status during pregnancy: Rural-urban comparisons of oral disease burden among antenatal women in Sri Lanka. Rural Remote Health;12:1902.

2. Yaghobee S. (2010) Evaluation of the oral health status and needs for periodontal treatment in pregnant women. DJH; 2:53-8.

3. Preshaw PM, Alba AL, Herrera D, Jepsen S, Makrilakis K, Taylor R (2012). Periodontitis and diabetes: A two-way relationship. Diabetologia;55:21-31.

4. American Diabetes Association (2004). Gestational diabetes mellitus. Diabetes Care ;27 (Suppl 1):S88-90.

5. Matthews DC (2002). The relationship between diabetes and periodontal disease. J Can Dent Assoc;68:161-4.

6. Meek CL, Lewis HB, Patient C, Murphy HR, Simmons D (2015). Diagnosis of gestational diabetes mellitus: Falling through the net. Diabetologia;58:2003-12.

7. Offenbacher S, Lieff S, Boggess KA, Murtha AP, Madianos PN, Champagne CM, et al (2001). Maternal periodontitis and prematurity. Part I: Obstetric outcome of prematurity and growth restriction. Ann Periodontol;6:164-74.

8. Mishra P, Gita B, Chandrasekaran SC (2014). Assessment of periodontal status in association with gestational diabetes mellitus: A case-control study. J Diabetes Metab ;5:467.

9. Dasanayake AP, Chhun N, Tanner AC, Craig RG, Lee MJ, Moore AF, et al (2008).Periodontal pathogens and gestational diabetes mellitus. J Dent Res; 87:328-33.

10. Xiong X, Elkind-Hirsch KE, Vastardis S, Delarosa RL, Pridjian G, Buekens P (2009). Periodontal disease is associated with gestational diabetes mellitus: A case-control study. J Periodontol ;80:1742-9.

11. Habib FA (2009). Evaluation of periodontal status among Saudi females with gestational diabetes and its relation to glucose and lipid homeostasis in Ohud hospital, Al-Madina Al-Munawarah. Int J Health Sci (Qassim) ;3:143-54.

12. Díaz-Romero RM, Ovadía R (2007). Diabetes and periodontal disease: A bidirectional relationship. Med Biol ; 14:6-9.

13. Knopp RH, Chapman M, Bergelin R, Wahl PW, Warth MR, Irvine S (1980). Relationships of lipoprotein lipids to mild fasting hyperglycemia and diabetes in pregnancy. Diabetes Care; 3:416-20.

14. Koukkou E, Watts GF, Lowy C (1996). Serum lipid, lipoprotein and apolipoprotein changes in gestational diabetes mellitus: A cross-sectional and prospective study. J Clin Pathol ; 49: 634-7.