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RESEARCH ARTICLE

The Relationship between Gestational Diabetes Mellitus and Periodontal Health: A Case-Control Study

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ABSTRACT

Introduction: Gestational diabetes mellitus (GDM) is carbohydrate intolerance of various degrees occurring or being observed during pregnancy for the first time. The aim of the present study is to investigate the relationship between periodontal health and GDM, which is one of the most important medical complications of pregnancy.

Materials and methods: One hundred and sixty-five pregnant women, 80 healthy and 85 with gestational diabetes, between the ages of 18 and 30, with a mean age of 25.85 ± 2.96 were included in the study. It was first pregnancy of all individuals and none of them received periodontal treatment 6 months prior to the study.

Clinical evaluations were made by using plaque index (PI), gingival index (GI), probing pocket depth, bleeding on probing (BOP) index.

Results: The results of our study revealed that, compared to healthy pregnant women, the values of body mass index, weight, GI and BOP were significantly higher for women with GDM.

Keywords: Gestational diabetes mellitus, Oral glucose tolerance test, Periodontal health, Pregnancy, Diabetes mellitus.

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INTRODUCTION

Periodontal disease is one of the most common chronic disorders of infectious origin known in humans and refers to an inflammatory condition of the soft tissues surrounding the teeth, (i.e. gingivitis) and the destruction of the supporting structures of the teeth, including the periodontal ligament, bone, cement and soft tissues, (i.e. periodontitis).[1-4] The primary etiology of the disease is microorganisms in the microbial flora of dental plaque. However, certain individuals are more prone to periodontal disease due to specific risk factors, thereby suggesting that there are a host of various factors that are involved in the etiology of periodontal disease.[5] It was reported that systemic conditions, such as cardiovascular diseases, diabetes mellitus (DM) and adverse pregnancy outcomes, increase the risk for periodontal disease.[6,7]

Gestational diabetes mellitus (GDM) refers to various degrees of carbohydrate intolerance with the onset or first detection during pregnancy. The onset of glucose intolerance either before or during pregnancy cannot be distinguished. GDM is the most common medical complication and metabolic disorder observed during pregnancy. Its prevalence varies between 1 and 14% depending on the diagnostic criteria and the population.[8-10] GDM is associated with significantly increased risks of maternal and infant morbidity, including macrosomia, pre-eclampsia, preterm birth, shoulder dystocia, birth injury and need for a cesarean section.[11-13] Women with GDM are at a significantly higher risk of developing type 2 diabetes later in life.[14] Studies[15] have found that type 1 or 2 diabetes increases the risk of developing periodontal disease, and periodontal disease may also increase the risk for type 2 diabetes. However, few studies[6,16] have examined the relationship between periodontal disease and GDM.

The objective of this study was to determine whether GDM constitutes an increased risk for periodontal disease.

MATERIALS AND METHODS

Study Population

We conducted a case-control study at Etlik State Maternity Hospital and the Zekai Tahir Burak Women's Health Education and Research Hospital in Ankara, Turkey. We estimated that, a total of 85 cases of GDM and 80 controls were recruited at the obstetric clinic at Woman's Hospitals between January 2004 and February 2005.

Definition of Cases and Controls

At Woman's Hospitals, all pregnant women undergo a laboratory screening test for GDM between 24 and ≥28 weeks of gestation based on the recommendation of the American College of Obstetricians and Gynecologists.[11] Women were first screened for carbohydrate intolerance by performing a standard 1 hour, 50 gm oral glucose tolerance test (OGTT). If the plasma glucose level is ≥140 mg/dl at 1 hour after the 50 gm oral glucose load, a 3-hour 100 gm OGTT is administered after a maximum 14 hours overnight fast. Women whose glucose levels (when fasting and at 1, 2 and 3 hours) exceeded two or more threshold values on the OGTT were diagnosed as having GDM, i.e. cases.[17] Controls were defined as women who passed the GCT at 24 to 28 weeks and did not have any other types of diabetes.

Pregnant women were asked to participate if they met all of the following criteria: (1) completed a GDM screening at gestational age between 24 and 28 weeks; (2) were

between 18 and 30 years of age; (3) their first pregnancy and (4) agreed to sign a consent form. These individuals were also nonsmokers. Exclusion criteria included: known pregestational type 1 or 2 diabetes; having <20 teeth; contraindication to probing in a dental examination, such as heart disorders; having prosthetic restorations or teeth crowding, which could affect the etiology of periodontal disease, and having received any periodontal treatment within the last 6 months.

All eligible pregnant women who were diagnosed with GDM (cases) and without GDM (controls) were invited to take part in the study. All participants gave written informed consent. After consenting, the research staff conducted an in-person, structured questionnaire interview and scheduled another date for a dental examination at Woman's Hospital. The metabolic status of the individuals was diagnosed by the affiliated hospital. Personal information and medical histories were obtained from the individuals' registered hospital files, including: family history, gestational age, maternal weight/height and body mass index (BMI).

Periodontal Disease Measurements and Definitions

A full-mouth periodontal examination was performed on all study participants, and measurements were taken at four sites per tooth (mesial, distal, buccal, lingual), using a Williams periodontal probe. The clinical measures of periodontal conditions included plaque index (PI), gingival index (GI), probing pocket depth (PPD) and bleeding on probing (BOP) index. PD was defined as the distance in millimeters from the gingival margin to the apical part of the pocket. BOP was assessed when probing to the base of the sulcus, four surfaces per tooth, and was expressed as the percentage of bleeding sites over the total tooth surfaces. Third molars were not included in the analysis.

To eliminate interexaminer variability; all measurements were performed by one specialist in periodontics clinician in an indoor environment using daylight. The examination of each individual took approximately 35 to 40 minutes. To ensure metabolic control, the examinations of women with GDM were performed prior to treatment, and all individuals were examined in one session.

In addition to the dental examination, other information was obtained from a personal interview of the participants before the dental examination, including: oral hygiene and habits, (e.g. frequency of dental care visit, dental cleaning, brushing teeth and flossing teeth) and dental insurance coverage.

STATISTICAL ANALYSIS

The measurements were analyzed using the SPSS 9.05 for Windows statistical program. Analysis was performed to compare the different periodontal disease measurements and characteristics of the study population between cases and controls. The adjusted Chi-squared test for clustered data and the adjusted independent t-test for clustered data were used for the analysis of periodontal parameters.

RESULTS

A total of 165 pregnant women participated in our study, which was designed to examine the relationship between GDM and periodontal health during pregnancy. Of these women, 85 were diagnosed with GDM and constituted the case group of our study. The remaining 80 pregnant women without GDM or other systemic diseases were included in the control group of the study. The ages of participants varied between 19 and 30 years, and the mean age was 25.85 ± 2.96 years. Their gestational ages varied between 24 and 30 weeks. Necessary measures were taken to ensure similar ages and gestational weeks in the case and control groups. Table 1 presents that the average heights were not significantly different between the healthy and GDM groups ($p > 0.05$). However, the differences in average weights were statistically significant: the average weight of the case group was higher ($p < 0.001$). Accordingly, the BMI calculated for each individual, and the average BMI was 28.67 ± 4.15 for the case group and 26.28 ± 3.17 for the control group. This difference was statistically significant ($p < 0.001$). The plasma glucose values obtained using the OGTT test were significantly higher ($p < 0.001$) in the case group.

In terms of oral hygiene habits, the majority of the individuals (97 of 165 participants; 58.8%) claimed that they regularly brushed their teeth at least once per day. The number of participants who brushed irregularly was 45 (27.3%), whereas 23 (13.9%) participants did not brush their teeth. However, no significant difference was found between the groups ($p > 0.05$) in terms of their brushing habits.

The means of all parameters were calculated to evaluate the differences between the control and case groups with respect to periodontal parameters. Based on this evaluation, all periodontal parameters were found to be higher in the women with GDM group. However, only the differences in GI and BOP values were statistically significant ($p < 0.01$, $p < 0.001$). Although the mean values of PI and PPD were higher in subjects in the case group, the differences were not statistically significant (Table 2).

DISCUSSION

Our study indicated that the presence of GDM in pregnant women correspond to an increased extent of gingival inflammation. Accordingly, the presence of GDM constitutes an increased risk for severe periodontal disease.

Table 1: A comparison of the age, gestational week, plasma glucose level, height, weight and BMI for the case and control groups

Parameter	*Controls (n = 80)*	*Cases (n = 85)*	*p-value*
Age	25.91 ± 2.91 (min 20 max 30)	25.80 ± 3.02 (min 19 max 30)	NS
Gestation week	27.45 ± 1.68 (min 24 max 30)	27.47 ± 3.53 (min 24 max 30)	NS
Plasma glucose level	109.81 ± 14.09 (min 71 max 137)	197.84 ± 32.23 (min 149 max 297)	*
Height	157.63 ± 5.51 (min 146 max 170)	158.56 ± 5.25 (min 145 max 175)	NS
Weight	65.22 ± 7.82 (min 45 max 90)	72.03 ± 10.58 (min 53 max 98)	*
BMI	26.28 ± 3.17 (min 18.66 max 37.46)	28.67 ± 4.15 (min 21.48 max 38.22)	*

*p < 0.001; NS: not significant

Table 2: The comparison of the healthy and GDM groups in terms of periodontal parameters

Parameter	*Controls (n = 80)*	*Cases (n = 85)*	*p-value*
Plaque index (prevalence %)	0.661	0.668	NS
Gingival index (prevalence %)	0.197	0.272	*
Bleeding on probing (prevalence %)	0.233	0.321	**
Pocket depth (mean millimeter)	1.99	2.12	NS

*p < 0.01, **p < 0.001; NS: not significant

Several studies conducted on this subject support our findings. Dasanayake et al compared women who did and did not develop GDM and found that all clinical periodontal parameters were higher in women who developed GDM. However, these results were not statistically significant.[18] Xu Xiong et al studied 159 pregnant women, including 53 women with GDM, and, in accordance with our study, reported that the BOP parameter increased in individuals with GDM. PD and clinical attachment loss measurements of women with GDM were significantly higher when compared to those of healthy pregnant individuals.[19]

Pregnancy requires additional attention to periodontal disease. Hormonal changes during this period may have an effect on periodontal tissues. A number of studies have demonstrated a relationship between periodontal disease and pregnancy, and this relationship has been attributed to an increased reaction to the microbial dental plaque.[20] Therefore, due to the possibility of periodontal health deterioration with an increasing number of pregnancies, we only enrolled women with first pregnancy in our study. Machuca et al argued that the previous number of pregnancies had no effect on the development of periodontal disease.[21] However, Taani et al examined the relationship between demographic factors and periodontal status in 400 women, including 200 pregnant women, and reported that women with two or more pregnancies had a statistically significant increase in the PPD and GI parameters when compared to women with only 1 pregnancy.[22]

DM is known to be a risk factor for periodontal disease Bacic et al reported that the extent of tooth loss increased in diabetic subjects. In addition, they stated that the prevalence and severity of deep periodontal pockets were higher in diabetic subjects relative to healthy controls. Shlossman et al assessed individuals in terms of their periodontal status, loss of attachment and radiographic bone loss and reported that there was a significant increase in attachment loss and bone loss in diabetic patients compared to healthy controls. Emrich et al reported that the development of destructive periodontal disease was three-fold higher in patients with type 2 DM relative to healthy subjects. Attachment loss and interproximal bone loss were significantly increased in the diabetic subjects.[23-25]

The reduced insulin resistance associated with hyperglycemia, vascular changes, altered microbial flora and abnormal collagen metabolism increase the susceptibility to periodontal disease.[15] Similarly, DM as well as GDM characterized by hyperglycemia may show similar effects on periodontal health. However, when comparing DM and GDM, it should be noted that GDM may be considered as an early stage of glucose intolerance. GDM associated with hyperglycemia may have an effect on the periodontal tissues even though it is mild and short-term. This situation implies that increased periodontal disease during pregnancy is a result of GDM.[26]

To determine the status of periodontal disease in this study, the PI, GI, PPD and BOP indices of the participants were measured. The PI was used to determine the oral hygiene and healthcare of the participants. GI, considered as a sign of gum disease, provided information on the gum health of these women. The PPD measurement provided a clinical approximation of the periodontal pocket depth. It is possible to assess the status of periodontal disease based on pocket depth measurements. In our study, the clinical attachment level was not measured due to the short-term occurrence of GDM. In general, clinical attachment level measurements are used as an assessment tool in studies on

the treatment and progression of periodontitis.[27] However, Xu Xiong et al stated that the levels of pocket depth and clinical attachment loss in individuals with GDM were significantly higher than those in healthy pregnant subjects.[19]

The BOP index was used as an indicator of inflammation in our study. Inflammation and PPD were observed to decrease as a result of periodontal treatment. In light of this information and to identify the presence of periodontal inflammation, BOP was used as an important parameter for our study.

When comparing the height, weight and BMI between groups, the difference in mean heights was statistically significant. In contrast, the means of the weight and BMI values of the GDM group were significantly higher than in the control group. Our findings are consistent with the ADIPS report showing that obesity is a risk factor of GDM in women.

All clinical measurements used to evaluate the periodontal health (PI, GI, PPD and BOP) increased in the pregnant subjects with GDM. However, only the changes in the GI and BOP values were statistically significant. Lopez et al studied the presence of gingivitis and reported that there was no significant difference between individuals with GDM and healthy pregnant individuals. In our study, the GI and BOP values were significantly higher in women with GDM. Lopez et al did not include the PD and BOP indices in their study, which may contribute to the differences between these results.[28] In addition, Xu Xiong et al reported that BOP was increased in subjects with GDM, which was in accordance with our study. Furthermore, they showed that the PD values and the clinical attachment loss in individuals with GDM were significantly higher than those of healthy pregnant individuals.[19]

Finally, the parameters that were significantly different between the two study groups, namely the BMI, GI and BOP values, were assessed by regression analysis to analyze whether they were related to the OGTT value. Although GI values were found to significantly increase in the GDM group, these values were not correlated with the OGTT levels. In addition, the independent variables of BMI and BOP explained 66.7% of the glucose level change. The relationship between high BMI and GDM is known, and obesity has been reported to be a risk factor for GDM. In contrast, the majority of glucose level changes are associated with an increase in BOP. In accordance with our findings, another study showed that decreased glucose levels as a result of treatment in diabetic patients resulted in a decreased incidence of periodontal disease.[29]

Based on the data obtained in our study and using BOP as a marker of periodontal inflammation, a relationship between periodontal disease and GDM was determined. The oral cavity works as a continuous source of infectious agents, and its condition often reflects the progression of systemic pathologies.[30] Further prospective studies are needed to examine the role of GDM in the etiology of periodontal disease.

REFERENCES

1. Pihlstrom BL, Michalowicz BS, Johnson NW. Periodontal diseases. Lancet 2005;366:1809-1820.
2. Offenbacher S. Periodontal diseases: pathogenesis. Ann Periodontal 1996;1:821-878.
3. Albandar JM, Rams TE. Global epidemiology of periodontal diseases: an overview. Periodontol 2000, 2002;29:7-10.
4. Kinane DF. Causation and pathogenesis of periodontal disease. Periodontol 2000, 2001;25:8-20.
5. Genco RJ. Current view of risk factors for periodontal diseases. J Periodontol 1996; Oct;67(10 Suppl):1041-1049.
6. Xiong X, Buekens P, Fraser W, Beck J, Offenbacher S. Periodontal disease and adverse pregnancy outcomes: a systematic review. BJOG 2006;113:135-143.
7. Garcia RI, Henshaw MM, Krall EA. Relationship between periodontal disease and systemic health. Periodontol 2000;25: 21-36.
8. Metzger BE, Coustan DR. Summary and recommendations of the fourth international workshop-conference on gestational diabetes mellitus. Diabetes Care 1998;21:16-17.
9. Rey E. Screening for gestational diabetes mellitus. BMJ 1999;319:798-799.
10. Metzger BE. Organizing Committee: summary and recommendations of the third international workshop-conference on gestational diabetes mellitus. Diabetes Care 1991;40(Suppl 2): 197-201.
11. American College of Obstetricians and Gynecologists Committee on Practice Bulletins-Obstetrics. ACOG Practice Bulletin. Clinical management guidelines for obstetrician-gynecologists. Number 30, September 2001 (replaces Technical Bulletin Number 200, December 1994). Gestational diabetes. Obstet Gynecol 2001;98:525-538.
12. Engelgau MM, Herman WH, Smith PJ, German RR, Aubert RE. The epidemiology of diabetes and pregnancy in the US, 1988. Diabetes Care 1995;18:1029-1033.
13. Xiong X, Saunders LD, Wang FL, Demianczuk NN. Gestational diabetes mellitus: prevalence, risk factors, maternal and infant outcomes. Int J Gynaecol Obstet 2001;75:221-228.
14. Kim C, Newton KM, Knopp RH. Gestational diabetes and the incidence of type 2 diabetes: a systematic review. Diabetes Care 2002;25:1862-1868.
15. Soskolne WA, Klinger A. The relationship between periodontal diseases and diabetes: an overview. Ann Periodontol 2001;6: 91-98.
16. Xiong X, Buekens P, Vastardis S, Yu SM. Periodontal disease and pregnancy outcomes: state-of-the-science. Obstet Gynecol Surv 2007;62:605-615.
17. Carpenter MW, Coustan DR. Criteria for screening tests for gestational diabetes. Am J Obstet Gynecol 1982;144:768-773.
18. Dasanayake AP, Chhun N, Tanner AC. Periodontal pathogens and gestational diabetes mellitus. J Dent Res 2008;87:328-333.
19. Xiong X, Elkind-Hirsch KE, Vastardis S, Delarosa RL, Pridjian G, Buekens P. Periodontal disease is associated with gestational diabetes mellitus: a case-control study. J Periodontol 2009 Nov;80(11):1742-1749.

20. Loe H, Silness J. Periodontal disease in pregnancy. I. Prevalence and severity. Acta Odontol Scand 1963 Dec;21:533-551.
21. Machuca G, Khoshfeiz JRL, Machuca C, Bullon P. The influence of general health and socio-cultural variables on the periodontal condition of pregnant women. J Periodontol 1999; 70:779-785.
22. Taani DQ, Habashneh R, Hammad MM, Batieha A. The periodontal status of pregnant women and its relationship with socio-demographic and clinical variables. J Oral Rehabil 2003 Apr;30(4):440-445.
23. Bacic M, Plancak D, Granic M. CPITN assessment of periodontal disease in diabetic patients. J Periodontol 1988 Dec:59(12): 816-822.
24. Shlossman M, Knowler WC, Pettitt DJ, Genco RJ. Type 2 diabetes mellitus and periodontal disease. J Am Dent Assoc 1990 Oct;121(4):532-536.
25. Emrich LJ, Shlossman M, Genco RJ. Periodontal disease in non-insulin dependent diabetes mellitus. J Periodontol 1991 Feb; 62(2):123-131.
26. Xiong X, Buekens P, Vastardis S, Pridjian G. Periodontal disease and gestational diabetes mellitus. Am J Obstet Gynecol 2006; 195:1086-1089.
27. Armitage GC. Periodontal diseases: diagnosis. Ann Periodontal 1996;1:37-215.
28. Lopez-Perez R, Diaz-Romero RM, Barranco-Jaubert A, Borges-Yanez A, Avila-Rosas H. Prevalence of dental caries, gingivitis and periodontal disease in pregnant diabetic women. Salud Publica Mex (Abst) 1996 Mar-Apr;38(2):101-109.
29. Kiran M, Arpak N, Unsal E, Erdogan MF. The effect of improved periodontal health on metabolic control in type 2 diabetes mellitus. J Clin Periodontol 2005 Mar;32(3):266-272.
30. Saini R. Dental air force home dental cleaning system. A revolutionary oral hygiene device to prevent systemic diseases caused by periodontal infection. Int J Med Res Health Sci 2013; 2(3):431-438.

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