**ORIGINAL ARTICLE**

**Evaluation of Relationship between Maternal Periodontal Status and Preeclampsia: A Case-Control Study**

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**ABSTRACT**

**BACKGROUND:** The aim of the present case control study was to evaluate the association between maternal periodontitis and preeclampsia. **Objectives:** To evaluate following periodontal parameters in women with preeclampsia & to compare them with non-preeclamptic women. 1. Bleeding on probing, 2. Probing depth, 3. Clinical attachment level **MATERIAL AND METHODS:** Initially 310 women were included in the study and their periodontal parameters were assessed followed by retrieval of their demographic and medical data from the medical records. The women were divided into a control group (280 non preeclamptic women who gave birth to infants with adequate gestational age) and a case group (30 preeclamptic women). Further 30 preeclamptic women were matched according to primiparity to 30 non preeclamptic women randomly selected from the control group. Maternal periodontitis was defined as PD ≥ 4mm and CAL ≥ 3mm at the same site in at least four teeth.

**RESULTS:** Maternal periodontitis (odds ratio 13.5) was associated with preeclampsia. Maternal periodontitis also remained associated with preeclampsia after matching for primiparity (odds ratio 9.33). **CONCLUSION:** Maternal periodontitis is a risk factor associated with preeclampsia, emphasizing the importance of periodontal care in prenatal programs.

**Key words:** Infection; inflammation; periodontal disease; preeclampsia; pregnancy; risk factors.

**INTRODUCTION**

Periodontal diseases are a group of infectious diseases caused by predominantly Gram-negative, anaerobic and aerobic bacteria that colonize the subgingival area. Inflamed periodontal tissues produce significant amounts of pro-inflammatory cytokines, mainly interleukin 1 beta (IL-1β), IL-6, prostaglandin E₂ and tumor necrosis factor alpha (TNF-α) which may have systemic effects on the host. The concept that the periodontal disease might influence systemic health is not new. Focal infection therapy suggested that “microorganisms or their waste products obtain entrance to parts of the body adjacent to or remote from the mouth”. Epidemiological, microbiological and immunological studies have lent credence to the concept that periodontal disease may be a separate risk factor for cardiovascular disease, cerebrovascular disease, respiratory disease and adverse pregnancy outcome such as preterm delivery of low birth weight infants and preeclampsia.¹² Gingivitis and periodontitis are two periodontal conditions of significance during pregnancy. Gingivitis is an infectious and inflammatory condition of the superficial gingival tissues, with prevalence rate during pregnancy ranging from 30-100%. Periodontitis is a more severe condition affecting 5-20% of pregnant women.³ Preeclampsia is a multisystem disorder of unclear etiology that is exclusive to human pregnancy. Preeclampsia is a multifactor disease specific to pregnancy and is characterized by hypertension and proteinuria after week 20 of gestation in a previously normotensive woman. Preeclampsia is also associated with short and long term abnormal cytokine responses in the mother and the fetus, related to high circulating levels of TNF-α, IL -10 and IL -6 resulting in an inflammatory vascular damage. Altered vascular related conditions have been proposed as the main pathologic mechanisms leading to placental endothelial damage.⁴ Periodontal diseases as well as preeclampsia, both are of multifactorial
nature. Systemic inflammation is one possible link between periodontal disease and preeclampsia. Periodontal pathogens were suggested to play a role in systemic diseases either through a direct pro-inflammatory effect or through indirect or host mediated effects triggered by periodontal infection. Considering possible similarities between the pathophysiology of atherosclerosis and preeclampsia, it was hypothesized that periodontal diseases may increase the risk of preeclampsia. Based on the current uncertainty of a relationship between periodontal infection and preeclampsia, this case-control study is planned in order to evaluate the association between maternal periodontal status and preeclampsia.

**MATERIALS AND METHODS**

The present study was conducted by Department of Periodontology and Implantology, Karnavati School of Dentistry and approved by the Karnavati School of Dentistry Ethical Committee. The study included the participants reporting to the Department of Gynecology and Obstetrics, B. J. Medical College, Civil Hospital, Ahmedabad. Participants were informed about the aim of the study and written informed consent was taken. An eligible sample was selected based on the accessibility and availability of women in the postpartum period within 48 hours of delivery. Periodontal examination was first performed for assessment of bleeding on probing, probing pocket depth and clinical attachment level. Information such as maternal age, educational level, marital status, chronic hypertension, diabetes mellitus, parity, alcohol and drug consumption during pregnancy, previous abortion, previous preterm birth, number of prenatal visits, genitourinary infection and preeclampsia were obtained from medical records. Women were diagnosed with preeclampsia if they had

I. Blood pressure ≥ 140/90 mm Hg on two separate occasions after week 20 of gestation. Blood pressure was assessed by a trained medical group from the hospital unit.

II. Proteinuria was defined as protein concentration ≥ 0.30 g/dl. The preeclamptic patients were healthy before the onset of preeclampsia.

**Inclusion criteria**

Women 18 – 35 years of age who gave birth to live infants in the hospital unit.

**Exclusion criteria**

I. Who did not have a legal guardian

II. Who had multiple gestations

III. Who had suffered a spontaneous abortion

IV. Who had undergone in vitro fertilization

V. Who were diagnosed with diabetes mellitus, genitourinary infections

VI. Diagnosed with pregestational diabetes, heart and renal diseases, placental, cervical, and/or uterine abnormalities, human immunodeficiency virus infection

VII. Any medical condition requiring antibiotic prophylaxis for dental treatment

VIII. Who were smokers and alcoholics

**Study design**

During the two year study period 330 eligible women were selected for case-control study on preeclampsia and maternal periodontitis. Based upon the inclusion and exclusion criteria followed for the study 20 patients were excluded from the analysis. The final sample was composed of 310 women with same ethnicity. After assessment of the medical records and randomization for primiparity the women were divided as follows:

- **Group A**: A case group consisting of 30 preeclamptic women.
- **Group B**: 30 non-preeclamptic women selected from the control group in a proportion of 1:1 (case / controls) matched for primiparity.
- **Group C**: A control group consisting of 280 non-preeclamptic women who gave birth to live term infants.

**Periodontal assessment**

Within forty eight hours of delivery, the patients were assessed for their periodontal status. Periodontal examination was performed before assessment of medical records to avoid the occurrence of bias. Intraoral examination was done with help of artificial light source, mouth mirror, Williams Periodontal Probe and cotton pliers. The hospital bed was adjusted to the
sitting position and teeth were cleaned with sterile cotton for adequate assessment when necessary. The following clinical parameters were used to evaluate for clinical signs of inflammation and periodontal tissue destruction:

1. Gingival bleeding index (Ainamo and Bay) \(^6\)
2. Probing pocket depth
3. Clinical attachment level

**Gingival Bleeding Index** (Ainamo and Bay 1975) \(^6\)

The presence or absence of gingival bleeding is determined by gentle probing of the gingival crevice with a Williams periodontal probe. The appearance of bleeding within 10 seconds indicates a positive score, which is expressed as a percentage of the total number of gingival margins examined.

**Probing Pocket Depth:**

It is the distance between the base of the pocket and gingival margin. This distance is calculated with a Williams periodontal probe held parallel to the vertical axis of the tooth and walked circumferentially around each surface of the tooth. The pocket is measured at six sites (mesiobuccal, midbuccal, distobuccal, distolingual/palatal, midlingual/palatal, mesiolingual/palatal) of each tooth and the deepest/highest penetration was recorded for each individual tooth.

**Clinical Attachment Level:**

When the gingival margin is located on the anatomic crown, the level of attachment is determined by subtracting from the depth of the pocket the distance from the gingival margin to the cemento-enamel junction. If both are the same, the loss of attachment is ‘0’. When the gingival margin coincides with the cemento-enamel junction, the loss of attachment equals the pocket depth. When the gingival margin is located apical to the cemento-enamel junction, the loss of attachment will be greater than the pocket depth and therefore the distance between the cemento-enamel junction and the gingival margin should be added to the pocket depth.

The clinical attachment level was recorded for all teeth including the third molars. For the purpose of analysis, maternal periodontitis was defined as probing depth \(\geq 4\)mm and clinical attachment loss \(\geq 3\)mm at the same site in at least four teeth.

**Medical Data**

Demographic data, medical history and detailed information on events during pregnancy and delivery were obtained from medical records. Medical data were reviewed by an obstetrician to confirm inclusion and exclusion criteria.

**Statistical Analysis**

Mean and standard deviation were estimated from the sample for each study group. Mean values were compared between different study groups by using Independent Sample T-Test. Univariate and multivariate logistic regression analysis was done to identify the risk factors for the development of preeclampsia. In the present study, \(p < 0.05\) was considered as the level of significance.

**RESULTS**

The aim of the present study was to evaluate the association between maternal periodontal status and preeclampsia. The present study was conducted by Department of Periodontology and Implantology, Karnavati School of Dentistry and approved by the Karnavati School of Dentistry Ethical Committee. The study included the participants reporting to the Department of Gynecology and Obstetrics, B. J. Medical College, Civil Hospital, Ahmedabad. A total of 310 patients were screened for periodontal parameters such as BOP, PPD and CAL. Demographic parameters such as maternal age and number of prenatal visits was obtained. Medical data regarding primiparity, chronic hypertension, previous preterm birth and preeclampsia was gathered from medical records. After the periodontal parameters were assessed the patients were divided into three groups based on their medical records.

Group A were preeclamptic patients (n=30).

Group B were normotensive patients matched for primiparity (n=30).

Group C were normotensive patients (n=280).
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**Table: 1 Mean and Standard Deviation of percentage of Bleeding on probing (BOP) sites in the study groups**

<table>
<thead>
<tr>
<th>GROUP</th>
<th>BOP (% OF SITES) Mean ± S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preeclamptic (Group A)</td>
<td>84.49 ± 13.95</td>
</tr>
<tr>
<td>Non–Preeclamptic (Primiparity) (Group B)</td>
<td>16.86 ± 8.25</td>
</tr>
<tr>
<td>Non–Preeclamptic (Group C)</td>
<td>15.88 ± 4.91</td>
</tr>
</tbody>
</table>

**Inference**

In Group A the mean percentage of sites with Bleeding on Probing was found to be 84.49 ± 13.95%, in Group B it was found to be 16.86 ± 8.25% and in Group C it was found to be 15.88 ± 4.91%. On comparing the mean Percentage of BOP sites between Group A and Group C the difference was statistically significant. (p-value<0.0001). On comparing the mean percentage of BOP sites between Group A and Group B the difference was statistically significant. (p-value <0.0001).

**Table: 2 Mean and Standard Deviation of Probing Pocket Depth (PPD) and Clinical Attachment Level (CAL) in the study groups**

<table>
<thead>
<tr>
<th>GROUP</th>
<th>PPD</th>
<th>CAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preeclamptic (Group A)</td>
<td>3.96 ± 0.80</td>
<td>4.05 ± 0.83</td>
</tr>
<tr>
<td>Non–Preeclamptic (Parity) (Group B)</td>
<td>2.38 ± 0.37</td>
<td>2.41 ± 0.37</td>
</tr>
<tr>
<td>Non–Preeclamptic (Group C)</td>
<td>2.20 ± 0.36</td>
<td>2.26 ± 0.36</td>
</tr>
</tbody>
</table>

**Inference**

In Group A the mean Probing Pocket Depth was found to be 3.96 ± 0.80mm, in Group B it was found to be 2.38 ± 0.37mm and in Group C it was found to be 2.20 ± 0.36mm. On comparing the mean PPD between Group A and Group C the difference was statistically significant. (p-value<0.0001). On comparing the mean PPD between Group A and Group B the difference was statistically significant. (p-value<0.0001).

In Group A the mean Clinical Attachment Level was found to be 4.05 ± 0.83mm, in Group B it was found to be 2.41 ± 0.37mm and in Group C it was found to be 2.26 ± 0.36mm. On comparing the mean CAL between Group A and Group C the difference was statistically significant. (p-value<0.0001). On comparing the mean CAL between Group A and Group B the difference was statistically significant. (p-value<0.0001).

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**Table: 3 Logistic Regression Multivariate Analysis for Preeclampsia: Unconditional (Group A; Group C)**

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Group A</th>
<th>Group C</th>
<th>Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal periodontitis</td>
<td>24</td>
<td>64</td>
<td>p=0.0001</td>
</tr>
<tr>
<td>Primiparity</td>
<td>25</td>
<td>143</td>
<td>p=0.00001</td>
</tr>
<tr>
<td>Maternal Age ≥30</td>
<td>2</td>
<td>37</td>
<td>p=0.0047</td>
</tr>
<tr>
<td>Chronic Hypertension</td>
<td>2</td>
<td>27</td>
<td>p=0.151</td>
</tr>
<tr>
<td>Prenatal visits ≥ 6</td>
<td>25</td>
<td>188</td>
<td>p=0.648</td>
</tr>
<tr>
<td>Previous preterm birth</td>
<td>1</td>
<td>4</td>
<td>p=0.431</td>
</tr>
</tbody>
</table>

*Statistically significant

**Inference**

Comparison of Maternal Periodontitis between Group A and Group C for Preeclampsia was found to be statistically significant. (p-value<0.0001), (Odds Ratio 13.50).

Comparison of Primiparity between Group A and Group C for Preeclampsia was found to be statistically significant. (p-value<0.0001), (Odds Ratio 4.79).

Comparison of Maternal Age, chronic hypertension, prenatal visits ≥ 6 and previous preterm birth between Group A and Group C for Preeclampsia were found to be statistically not significant.

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**Table: 4 Logistic Regression Analysis for Preeclampsia: after matching for Primiparity between Group A and Group B**

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Group A</th>
<th>Group B</th>
<th>Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal periodontitis</td>
<td>24</td>
<td>9</td>
<td>p=0.0001</td>
</tr>
</tbody>
</table>

*Statistically significant

**Inference**

Comparison of Maternal Periodontitis between Group A and Group B for Preeclampsia was found to be statistically significant. (p-value<0.0001), (Odds Ratio 9.33).

**DISCUSSION**

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with active periodontal disease during pregnancy may have transient translocation of oral bacteria to the fetal-placental unit, inciting placental inflammation or oxidative stress early in pregnancy, which ultimately produces placental damage and the clinical manifestations of preeclampsia. Von DP and Magee LA (2002) suggested that infection may be an important trigger of the inflammatory response that characterized preeclampsia and may also initiate the preeclamptic process by increasing the risk for acute uteroplacental atherosis. Increasing evidence links periodontal disease and cardiovascular disease due to vascular endothelial dysfunction and atheroma formation. It is possible that similar mechanism may also play a role in the pathogenesis of preeclampsia. Oral cavity and systemic diseases are a two way street i.e. both entities can affect each other. Periodontitis is associated with various systemic diseases like cardiovascular diseases, respiratory diseases, adverse pregnancy outcomes such as Preterm Low Birth Weight and Preeclampsia. Various studies are done on Preterm Low Birth Weight but the focus has shifted to Preeclampsia recently.

The aim of the present study was to assess the association between Maternal Periodontitis and Preeclampsia. The present study included the participants reporting to the Department of Gynecology and Obstetrics, B. J. Medical College, Civil Hospital, Ahmedabad. Of a total 330 women eligible, 310 were selected were selected based upon their demographic, obstetric and medical history from the medical records under a standardized protocol to eliminate any possibility of a bias. Patients with multiple gestation, spontaneous abortion, with in vitro fertilization, diagnosed with diabetes mellitus, genitourinary infections, pregestational diabetes, heart and renal diseases, placental, cervical, and/or uterine abnormalities, human immunodeficiency virus infection, or any medical condition requiring antibiotic prophylaxis for dental treatment were excluded from the study. Considering their potential effects for preeclampsia, they were determined to be confounders and risk factors in studies done by Bdolah Y et al 2005, Riche EL et al 2002, Boggess KA et al 2003, Khader YS et al 2006 and were excluded from the present study. In addition to the above mentioned parameters this study was based on women of the same ethnic group who did not smoke or drink. Such characteristics were found to be associated with preeclampsia in a study done by Roberts JM 2003.

Clinical signs of inflammation and periodontal tissue destruction were assessed using BOP, PPD and CAL based upon the criteria proposed by Lopez et al (2002). After the periodontal parameters were assessed the patients were divided into three groups based on their medical records. Group A were preeclamptic patients (n=30), Group B were normotensive patients matched for primiparity (n=30) and Group C were normotensive patients (n=280). In Group A the mean percentage of sites with Bleeding on Probing was 84.49 ± 13.95%, in Group B it was 16.86 ± 8.25% and in Group C it was 15.88 ± 4.91 %. On comparing, the mean percentage of BOP sites was statistically significant between Group A and Group B (p-value<0.0001) and also between Group A and Group C (p-value<0.0001). In Group A the mean Probing Pocket Depth was 3.96±0.80 mm, in Group B it was 2.38±0.37 mm and in Group C it was 2.20 ±0.36 mm. On comparing, the mean PPD was statistically significant between Group A and Group B (p-value<0.0001) and also between Group A and Group C (p-value <0.0001). In Group A the mean Clinical Attachment Level was 4.05±0.83 mm, in Group B it was 2.41±0.37 mm and in Group C it was 2.26±0.36 mm. On comparing, the mean CAL was statistically significant between Group A and Group B (p-value <0.0001) and also between Group A and Group C (p-value <0.0001).

Findings from the present study showed a significant risk association between maternal periodontitis and preeclampsia considering other variables analysed. The adjusted OR for preeclampsia was 13.5 (95% CI 5.289-34.459; p-value <0.0001).
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The result of the present study was in correlation with the studies done by Kunnen et al (OR, 7.9)\textsuperscript{18}, Shetty M et al (OR, 20.15)\textsuperscript{19}. After matching for primiparity, maternal periodontitis still remained as a significant factor in pre-eclamptic group with OR of 9.333. Studies done by Siqueira FM et al 2008 (OR, 1.52)\textsuperscript{21} and Canakci V et al (OR, 3.47)\textsuperscript{22} also showed similar significant association.

In the present study there was also significant association between primiparity(OR, 4.790) and preeclampsia when the preeclamptic and normotensive groups were compared. The result of the present study was in co-relation with the studies done by Cota LOM et al (OR, 2.4)\textsuperscript{20} and Siqueira et al (OR, 2.3).\textsuperscript{21}

Comparison of preeclamptic group and normotensive group showed no significant risk association between maternal age, chronic hypertension, previous preterm birth, number of prenatal visits and preeclampsia. The result of the present study was in accordance with the study done by Canakci V et al 2004\textsuperscript{22} however in contrast to the study done by Cota LOM et al 2006\textsuperscript{20} found significant relation of maternal age and chronic hypertension with pre-eclampsia.

The biological plausibility for such an association is supported by the hypothesis that chronic periodontitis infection increases the risk of developing preeclampsia in pregnant women. The nature of periodontitis and preeclampsia is multifactorial and caution should be exercised when implicating periodontal disease in causation of preeclampsia. In case of a causal link between periodontal disease and preeclampsia, periodontal treatment is expected to reduce the risk of preeclampsia, like periodontal treatment reduces the risk of pre-term birth. Furthermore longitudinal and interventional studies are necessary to better address the association between periodontitis and preeclampsia as well as the benefits of periodontal treatment on the prevention of adverse pregnancy outcomes.

CONCLUSION

In the present case-control study, maternal periodontitis was associated with an elevated risk for preeclampsia. Caution should be exercised when interpreting these data, as the aetiology of both periodontal disease and preeclampsia is likely to be multifactorial. Maternal periodontitis may also represent a surrogate for another maternal factor that predisposes to the development of preeclampsia.

REFERENCES


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