Periodontal disease and preterm low birth weight: a case control study

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Abstract

Introduction: The influence of subject-based and environmental factors on the balance between the subgingival microbial challenge and the host response in periodontal diseases illustrates the intimate link between oral and systemic health. From this stems the hypothesis that the persistent gram-negative challenge and associated inflammatory sequelae in periodontal disease may have consequences extending beyond the periodontal tissues themselves. This article addresses the design of a case-control study to examine the relationship between preterm low birth weight and maternal periodontal disease.

Materials and Method: A case control study design was chosen including postpartum women between the age group of 18- 35 years of age. Cases were mothers delivering an infant weighing < 2,500g before 37 weeks' gestation and controls as mothers delivering an infant > 2,500g after 37 weeks. A full mouth periodontal examination was performed and corroborated by one examiner. The clinical parameters measured included plaque index, gingival index, pocket probing depth and clinical attachment level. Data was analyzed with Chi-square test, Fisher's exact test, Student t-test and Mann Whitney U test.

Results: There was statistically no significant difference in the mean age between the case group and the control group. There was a strong association between the socioeconomic status, gingival status, plaque levels, pocket probing depth, clinical attachment level and the incidence of preterm low birth weight.

Conclusion: The data from the present study, thus, shows an association between maternal periodontal disease and the risk of pre-term low birth weight infant.

Keywords: Periodontal Disease, Preterm Low Birth Weight, Clinical Attachment Level, Pocket Probing Depth, Socio-economic Status, Gingival Status

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Introduction

Preterm low birth weight is a major medical, social, and economic problem accounting for a large proportion of maternal and especially neonatal mortality, acute morbidity and long term sequelae. It is associated with mortality in the first year of life with developing problems in childhood like acute and chronic infections, cerebral palsy, respiratory conditions, epilepsy, severe learning problems and the risk for adult-onset diseases, such as hypertension and type 2 diabetes.[1] India contributes to 8 million (40%) LBW babies every year.[2]

The etiology of preterm birth is clearly multifactorial, and a host of individual, environmental and genetic factors affect risk.[3] Potential risk factors include parity (number of previous births), short cervical length, short maternal stature, low maternal weight, low socioeconomic status and education, poor maternal nutrition and genito-urinary infections.[4,5] Out of these known risk factors periodontal inflammation is a significant new risk factor that may have as large an impact on the rate of obstetric complications as smoking, alcohol or genito-urinary tract infections.[6]

The role of maternal periodontitis as a potential maternal fetal stressor that has detrimental effects on the pregnancy outcome is a relatively new field of investigation.[7] Early work[8] with pregnant rodent models, including a model with *Porphyromonas gingivalis* and also a model of experimental periodontitis demonstrated that low grade challenges with oral micro-organisms during pregnancy resulted in impaired fetal growth as measured by amniotic fluid prostaglandin E2 (PGE_2), tumor necrosis factor – α (TNF- α) and attendant fetal growth restriction.

The hypothesis linking subclinical infection and preterm birth states that microbes themselves or microbial toxins such as endotoxins (lipopolysaccharide) enter the uterine cavity during pregnancy, which in case of periodontal disease interacts, most likely in the decidua or possibly in its membranes leading to prostaglandin production or directly to uterine muscle contraction.[8]

This interaction is mediated through a cytokine cascade including Interleukin-6 (IL-6), TNF- α which have been shown to be locally elevated as a part of host response to the microbial challenge in periodontal disease. In turn, there is cervical dilation, entry of more microbes into the uterus and continuation of the "vicious cycle" resulting in premature birth.[9] Thus periodontal

disease may influence preterm delivery directly by seeding the genital tract with pathogens or indirectly through endotoxins and release of prostaglandins and cytokines implicated in both periodontal disease and preterm birth thereby representing an additional pathway of infectious/inflammatory exposure to the maternal – fetal unit.[8]

This study was thus undertaken to elucidate the relationship between periodontal disease in women and the risk of preterm low birth weight infant. The objectives of the study were to assess the relationship between clinical attachment level, plaque scores, gingival health, pocket probing depth, socioeconomic status and the incidence of preterm low birth weight infant.

Materials & Method

The present study was designed in the Department of Periodontology and Oral Implantology, I.T.S-CDSR, Muradnagar, Ghaziabad and conducted in the department of Paediatrics, Kalavati Saran (Lady Harding Medical College), New Delhi.

A case control study design was chosen, including 100 postpartum women, between the age group of 18- 35 years of age. The study population was grouped as follows:

Controls (n= 50): Defined as mothers who delivered infants after 37 weeks of gestation and infants weighing more than or equal to 2500 grams at birth.

Cases (n= 50): Defined as mothers who delivered infants before 37 weeks of gestation and infants weighing less than 2500 grams at birth.

Study participants having Body Mass Index (BMI) ranging between 19kg/m^2 and 25kg/m^2 were included as cases. All mothers suffering from severe anaemia, diabetes, urinary tract infections, and environmental factors including use of tobacco, alcohol, were excluded from the study. Women presenting with an obstetric history of severe polyhydramnios, severe oligohydramnios, umblical cord coiling and pre-eclampsia were also excluded from the study. All the data was collected within 48 hours after delivery. Mother's height and weight were determined in order to evaluate the nutritional status.

Socio-economic status of the mother was assessed using Kuppuswamy's Socio-economic Status Scale.[9] This scale takes into account education, occupation and income of the family to classify study groups into high, middle and low socio-economic status.

A full mouth periodontal examination was performed. The oral examination was carried out with the help of artificial light source, mouth mirror and William's graduated periodontal probe.

Clinical parameters measured included:

1. Plaque Index: Tureskey –Gilmore Glickman Modification of the Quigley –Hein Plaque Index[10]
2. Gingival Index (GI) by Loe H and Silness J[11]
3. Pocket Probing Depth (PPD) in mm
4. Clinical Attachment Level (CAL) in mm

Birth weight was obtained within the 1st hour of life by placing the naked infant on a precise scale and calibrated in grams. Gestational age of the infant was determined using Ballard's (Modified) gestational age assessment chart[12] which is based on physical and neurological examination to determine maturity.

The data obtained was tabulated and then subjected to statistical analysis. Continuous data were expressed as mean± SD. Difference between two proportions was expressed by Chi-Square test. Fischer's exact test was carried out to determine the distribution of the study population according to the pocket probing depth. Difference between means for two independent groups was expressed by student t-test.

Results

Study results were presented for each of the following variables; maternal age, socio economic status, gingival condition, periodontal condition, infant birth weight, gestational age and BMI of the mother.

The majority of women in the case group (n=33, 66%) belonged to the upper lower class, as compared to the controls (n=19, 38%) with a statistically very highly significant difference between the groups (Table 1).

Table 1: Distribution of the study population according to the socioeconomic status

SE-Class	Cases (%)	Controls (%)	Total
I	0	0	0
(Upper)	0%	0%	0%
II	0	10	10
(Upper Middle)	0%	20%	10%
III	4	18	22
(Lower Middle)	8%	36%	22%
IV	33	19	52
(Upper Lower)	66%	38%	52%
V	13	3	16
(Lower)	26%	6%	16%
Total	50	50	100
	100%	100%	100%

The age of the mother ranged from 19-32 years in the case group and 18-31 years in the controls, with a mean age of 23.76±2.911 years and 24.84±3.203 years respectively. Statistically no significant difference was observed between the cases and the controls ($p > 0.05$) (Table 2).

Table 2: Comparison of age, BMI, gestational age, weight of the infant between the cases and the controls

Groups	Mean±S.D	Minimum	Maximum	p value
Age				0.081
Cases	23.76±2.911	19	32	
Controls	24.84±3.203	18	31	
BMI				.97
Cases	22.02±1.612	19.56	25	
Controls	22.00±1.882	17.35	24.57	
Gestational age				0.000
Cases	29.92±2.019	27	35	
Controls	39.20±1.325	38	42	
Weight of infant				0.000
Cases	1.66±0.525	0.734	2.400	
Control	2.80±0.187	2.600	3.300	

When the BMI was compared, it ranged from 19.56 kg/m^2 to 25 kg/m^2 in the cases with a mean BMI of 22.02±1.612 kg/m^2. In the controls, the BMI ranged from 17.35kg/m^2 to 24.57 kg/m^2 with a mean BMI of 22.00±1.582 kg/m^2. Statistically no significant difference was obtained between the two groups ($p>0.05$) (Table 2).

In the cases group, mean plaque scores were 1.78±0.49, whereas, the mean plaque scores were 0.97±0.47 in the control group. Statistically a very highly significant difference was observed between the groups ($p\leq 0.0001$) (Table 3).

Table 3: Comparison of PlI (Q), GI, PPD, CAL between the cases and the controls

Variables	Mean±S.D	T value	p- value
PlI(Q)			<0.0001
Cases	1.78±0.49	8.4357	
Controls	0.97±0.47		
GI			<0.0001
Cases	1.62±0.45	10.1447	
Controls	0.775±0.38		
PPD			<0.0001
Cases	2.21±0.62	6.9467	
Controls	1.52±0.33		
CAL			<0.0001
Cases	2.28±0.74	9.1499	
Controls	1.014±0.64		

The mean gingival score in the cases was 1.62±0.45 and was 0.775±0.38 for the controls. Statistically a very high significant difference was observed between the two groups ($p\leq 0.0001$) (Table 3).

The PPD in the cases ranged from 1.43 mm to 4.09 mm and the mean depth was 2.21±0.62 mm. In the controls, the PPD ranged from 1.18 mm to 2.78 mm with a mean depth of 1.52±0.33 mm. Statistically a highly significant difference was observed between the two groups ($p\leq 0.0001$) (Table 3).

The CAL in the cases ranged from 1.43 mm to 4.56 mm with a mean value of 2.28±0.74 mm. In the controls, the values ranged from 0.12 mm to 3.00 mm with a mean level of 1.014±0.64 mm. Statistically, a very highly significant difference were observed between the two groups ($p\leq 0.0001$). (Table 3).

Discussion

Preterm low birth weight is a major medical, social, and economic problem accounting for a large proportion of maternal and especially neonatal mortality, acute morbidity, and long term sequelae.

A landmark study by Offenbacher et al.[12] was the first to demonstrate an association between maternal periodontal infection and adverse pregnancy outcome in humans, suggesting that maternal periodontal disease could lead to a seven fold increased risk of preterm low birth weight infant.

In the present study selection bias was avoided by excluding all the traditional risk factors and confounding variables were controlled, as the study sample was obtained from a well-defined population. Women aged 18-35 years were selected because maternal age less than 18 years and greater than 35 years has been found to be a risk factor for preterm low birth weight.

The majority of women were between 20-29 years of age, with statistically no significant difference between the groups. This is in agreement with the results obtained by Radnai et al.[13] and Davenport et al.[14]

With respect to the socio-economic status, majority of women in the case group, (66%) belonged to the upper lower class as compared to the controls (38%) with a statistically very highly significant difference between the groups ($p<0.001$). This correlates well with the results of Dasanayake AP[15] which lends further credibility to the validity of the study. According to Radnai et al[16] the difference was insignificant, which is in contrast to the present study.

When the mean gingival scores were compared there was a statistically very highly significant difference between the two groups ($p<0.001$). These results correlate well with the results obtained by Marakoglu et al[17] and Rajapaske et al.[18]

The mean plaque scores were higher in the cases (1.78±0.49) as compared to the controls (0.97±0.47). The results of the present study are in agreement with the observations of Rajapaske et al.[18] These findings are, however, in contrast to the results observed by Radnai et al[16] where no significant difference was obtained between the cases and the controls. A possible reason for the more healthy periodontal status of the Hungarian subjects included in their study, could be due to the ethnic homogeneity of the sample, contrary to the present study, where the subjects included, belonged to the lower socio-economic strata, who have more negative attitude towards dental care, worse dental health and are less likely to receive preventive dental care.

The mean PPD was comparatively greater in the case group (2.21±0.62 mm) as compared to the controls (1.52± 0.33 mm) with a statistically very highly significant difference between the two groups ($p<0.001$). This correlation is further strengthened by the

observations of Jeffcoat et al[19] and Marakoglu et al.[17] However, the conclusion drawn from the present study are in contrast to studies conducted by Radnai et al[16] and Davenport et al.[20]

The mean CAL was comparatively higher in the cases (2.28±0.74 mm) as compared to the controls (1.014±0.64 mm) with a statistically very highly significant difference between the two groups ($p<0.001$). These observations are in conformity with the results obtained by Santos-Pereira et al[21] and Jeffcoat et al.[19] On the contrary, Davenport et al[20] observed no statistically significant difference between the cases and the controls. Again, this may be due to a different definition used to describe the extent of CAL, in comparison to the present study.

Local inflammation may be the price paid for preventing the spread of dental plaque bacteria to other parts of the body. If the host's local defenses are compromised as a consequence of the microbial challenge or host-based factors, then continued or renewed inflammation will lead to continued destruction. Therefore, it follows that an improved understanding of the influence of systemic, environmental, and host genetic factors on the balance between the microbial challenge and the host response represents a significant goal in periodontal research, with opportunities for the development of novel diagnostic, preventive, and treatment strategies.

Conclusion

With respect to the age of the subject population, there was statistically no significant difference in the mean age between the cases and the controls. There was a strong association between the socioeconomic status, gingival status, plaque levels, pocket probing depth, clinical attachment level and the incidence of preterm low birth weight. The data from the present study thus shows an association between maternal periodontal disease and the risk of pre-term low birth weight infant.

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