

A Study to Evaluate Periodontal Diseases of the Pregnant Women as a Risk Factor for Pre-Term Birth and Low Weight Infants

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Abstract

Pre term (PTB) and low birth (LBW) are the leading perinatal problems worldwide as they are closely related to perinatal mortality and morbidity. Multiple factors have been associated with PLBW. Recently maternal periodontal disease has been reported as a cause of preterm low birth weight (PTLBW) babies. The aim of this study was to establish a correlation between periodontal disease of pregnant women as a risk factor for PTLBW infants and at the same time role of other factors as a cause of PTLBW infants in these cases.

This study indicated a 4.66-fold increase in PTLBW in cases of moderate to severe periodontal infection with CPI score 3 in comparison to periodontal infection with CPI score 1 or 2. Illiteracy of the mother was observed to be an important factor in causation of periodontal disease and PTLBW.

INTRODUCTION

Preterm birth (PTB) and low birth weight (LBW) are the leading perinatal problems worldwide and are closely related to perinatal mortality and morbidity.¹ Multiple factors, some of which are preventable, have been associated with PTB and/or LBW e.g., alcohol, smoking or drug use during pregnancy, high or low maternal age, low socioeconomic status, inadequate prenatal care, low maternal body mass index (BMI), hypertension (HT), generalized infections, genitourinary tract infections, cervical

incompetence, diabetes, nutritional status, stress, multiple pregnancies etc.^{2,3,4}. It has been proposed that one important factor contributing to the continuing prevalence of infants with preterm low birth weight (PTLBW) is the effect of maternal infection.⁵ In this context, new research suggests a new risk factor -periodontal disease.

In recent years, many workers have observed a significant correlation between periodontal infections in mother and PT/LBW babies.^{6,7,8,9,10}

Periodontal diseases are a group of infectious diseases resulting in inflammation of gingival and periodontal tissues caused by an overgrowth of putative periodontal pathogens in the subgingival plaque followed by an immuno-inflammatory response in a susceptible host. Cytokines such as TNF- α , IL-1, IL-6 produced by the infected periodontium, appear in systemic circulation may target the placenta. The changes in the level of the hormones during pregnancy affect many organs of the body and periodontium also.

The possibility of maternal periodontal infections, which may adversely influence the birth outcome was raised for the first time in the late 1980s.^{11,12}

Tobacco chewing/smoking/ oral use of smokeless tobacco (tobacco toothpaste & tooth powder- *lal dant manjan*) is known factor for PTLBW babies.^{13,14,15}

Further it was also reported that at present, however, there is no compelling evidence to indicate that treatment of periodontitis can improve birth outcome.^{15,16,17,18,19,20}

Therefore, there is an urgent need to definitely establish the true role of periodontal disease as one of the causative factor in the etiology of PTLBW, hence a study was designed to establish the cause effect relationship between periodontal disease in mother and PTLBW babies

AIMS AND OBJECTIVES

The present study will be conducted with the following aims and objectives:

1. To correlate the association of periodontal disease of pregnant women as a risk factor for preterm low birth weight (PTLBW) infants delivering at Mahila Chikitsalya of S.M.S. Medical College & Attached Hospital, Jaipur between May, 2007 to July, 2008.
2. To correlate the association of hypertension, history of tobacco use, smoking, alcohol intake, socio-economic (family income) and educational status of the mother as risk factor for PTLBW infants.

MATERIALS & METHODS

The study was conducted in the Department of Periodontology and Oral Implantology, Government Dental College and Hospital, Jaipur in

association with the Department of Obstetrics and Gynaecology, Mahila Chikitsalya, S.M.S. Medical College & Attached Hospital, Jaipur.

SELECTION OF PATIENTS

A case control study design was chosen including 100 pregnant mothers delivered at Department of Obstetrics and Gynaecology, Mahila Chikitsalya, Jaipur between May, 2007 to July, 2008.

PATIENT GROUP

Two groups were prepared as under:

Case group

50 pregnant mothers with CPI score 3.

Control group

50 pregnant mother with CPI score 1 or 2.

INCLUSION CRITERIA

- Mothers with age group of 18 to 35 years.
- Mothers who had delivered live infant weighing normal (more than 2500g) or PTLBW (less than 2500g and one or more of the following: gestational age <37 weeks, preterm labor (PTL), or premature rupture of membranes (PROM),⁶
- CPI score of mothers in the scale of 1 to 3.
- Associated Risk Factor (RF): hypertension (HT), history of smoking, smokeless tobacco use, alcohol intake, socio-economic and educational status of the mother.

EXCLUSION CRITERIA

- Case with history of abortion, systemic disease such as coronary heart disease, medications or medical problem that may affect study outcome was excluded.

METHODS

A case control study design was chosen involving total 100 pregnant mothers, 50 mothers with presence of periodontal disease with CPI score 3 in the case group and 50 mothers with CPI score 1 or 2 in the control group.

STUDY PROTOCOL

- All mothers were thoroughly briefed about the nature of the study and an informed consent was obtained.
- Each mother included in the study was interviewed directly at the bed side. Information was collected about her educational level, age, family income per

month¹⁰¹ and details about her husband's education & occupation. Adverse habits such as smoking, smokeless tobacco use, alcohol consumption were also recorded. For smoking and tobacco chew / paste, the type and form in which it was consumed was also noted.

- The mother's data were obtained from medical file. Information on the outcome of the current pregnancy was gathered from mother's medical record. The birth weight of the infant was also noted from the available infant & maternal record. The history of hypertension was noted from gynecologist's record.
- Periodontal clinical examination was carried out upto 48 hours after delivery which included the following recordings:

- 1) COMMUNITY PERIODONTAL INDEX (CPI Score)
- 2) CLINICAL ATTACHMENT LOSS (CAL Score)

ASSOCIATED RISK FACTOR		
HYPERTENSION Hypertension history was noted from hospital record		Yes or No
SMOKING Types: Cigarette / Bidi / Huka / Others.		Yes / No
TOBACCO US Form used: Chewing leaves / Paste/ Others		Yes / No
ALCOHOL CONSUMPTION		Yes / No

STATISTICAL ANALYSIS

For statistical analysis of observations, Chi-square test was applied.

RESULTS

Table No. I

DISTRIBUTION ACCORDING TO BIRTH WEIGHT OF BABY OF CASE & CONTROL GROUP

BIRTH WEIGHT	CASE GROUP		CONTROL GROUP	
	No.	%	No.	%
PTLBW	14	28.00	3	6.00
NBW	36	72.00	47	94.00
TOTAL	50	100.00	50	100.00

The table II shows that out of 50 babies delivered in case group (n=50), 6% babies (14/50) delivered were PTLBW and 72% babies (36/50) delivered were full term normal for gestation age. Whereas in control group 6% babies (3/50) were delivered with PTLBW and 94% babies (47/50) were delivered as full term normal for gestation age. The statistical analysis indicated a significant correlation in both groups (P < 0.05, Significant on Chi-square test).

Table No. II

DISTRIBUTION ACCORDING TO AGE GROUP OF MOTHERS & BIRTH WEIGHT OF BABY OF CASE & CONTROL GROUP

AGE GROUP (yrs)	CASE GROUP			CONTROL GROUP		
	PTLBW	NBW	TOTAL	PTLBW	NBW	TOTAL
18 - < 25	12 (24.00)	12 (24.00)	24 (48.00)	2 (4.00)	20 (40.00)	22 (44.00)
≥ 25 - < 30	2 (4.00)	19 (38.00)	21 (42.00)	1 (2.00)	23 (46.00)	24 (48.00)
≥ 30 - 35	0 (0.00)	5 (10.00)	5 (10.00)	0 (0.00)	4 (8.00)	4 (8.00)
TOTAL	14 (28.00)	36 (72.00)	50 (100.00)	3 (6.00)	47 (94.00)	50 (100.00)

Table II describes the distribution of deliveries of PTLBW and full term normal delivery according to the age group of mothers in case and control group. In control group, the statistical analysis indicated a significant correlation in both groups ($P < 0.05$ on chi-square test)

Whereas in case group, the statistical analysis indicated a non significant correlation in both groups ($P > 0.05$ on Chi-square test).

Table No.- III
DISTRIBUTION ACCORDING TO EDUCATIONAL STATUS OF MOTHERS AND BIRTH WEIGHT OF BABY OF CASE GROUP

Educational Status	PTLBW		NBW		Total	
	No.	%	No.	%	No.	%
Illiterate	14	28.00	13	26.00	27	54.00
Primary	0	0.00	3	6	3	6.00
Middle	0	0.00	2	4	2	4.00
High School	0	0.00	1	2	1	2.00
Hr. Secondary	0	0.00	4	8	4	8.00
Graduate & above	0	0.00	13	26	13	26.00
TOTAL	14	28.00	36	72.00	50	100.00

Table III shows the distribution of mothers according to educational level and birth weight of baby in case group. Out of 50 mothers in case group, 27 mothers (54%) were illiterate and out of these 27 illiterate mothers, 14 mothers delivered PTLBW babies. The statistical analysis indicated a significant correlation in both groups ($P < 0.05$ on chi-square test).

Table No. IV
DISTRIBUTION ACCORDING TO SOCIO ECONOMIC STATUS (SES) OF MOTHERS AND BIRTH WEIGHT OF BABY OF CASE & CONTROL GROUP

SES	CASE GROUP			CONTROL GROUP		
	PTLBW	NBW	TOTAL	PTLBW	NBW	TOTAL
I	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
II	4 (8.00)	24 (48.00)	28 (56.00)	3 (6.00)	34 (68.00)	37 (74.00)
III	1 (2.00)	6 (12.00)	7 (14.00)	0 (0.00)	5 (10.00)	5 (10.00)
IV	9 (18.00)	6 (12.00)	15 (30.00)	0 (0.00)	8 (16.00)	8 (16.00)
V	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
TOTAL	14 (28.00)	36 (72.00)	50 (100.00)	3 (6.00)	47 (98.00)	50 (100.00)

Statistical analysis indicated that there is definite correlation between PTLBW and SES in case group ($P < 0.05$ Significant) whereas it is not significant in control group ($P > 0.05$ Not Significant).

Table No. V
DISTRIBUTION ACCORDING TO COMMUNITY PERIODONTAL INDEX (CPI SCORE) OF
MOTHERS & BIRTH WEIGHT OF BABY OF CASE & CONTROL GROUP

CPI SCORE	CASE GROUP			CONTROL GROUP		
	PTLBW	NBW	TOTAL	PTLBW	NBW	TOTAL
CPI SCORE = 1	0	0	0	1	42	43
CPI SCORE = 2	0	0	0	2	5	7
CPI SCORE = 3	14	36	50	0	0	0
TOTAL	14	36	50	3	47	50

Out of 50 mothers in control group, 43 mothers (86%) were having gingivitis with CPI score 1. Out of these 43 mothers, 1 mother (2%) delivered as PTLBW whereas 42 mothers (84%) delivered as full term normal for gestation age. Remaining 7 mothers (14%) in control group were having gingivitis with CPI score 2. Out of these 7 mothers, 2 mothers (4%) delivered as PTLBW and 5 mothers (10%) delivered as full term normal for gestation age.

In case group, out of 50 mothers of case group (as per study protocol) all mothers (100%) were having periodontitis with CPI score 3. Out of these 50 mothers of case group, 14 mothers (28%) delivered as PTLBW whereas 36 mothers (72%) delivered as full term normal for gestation age.

Table No. VI
DISTRIBUTION ACCORDING TO ASSOCIATED RISK FACTORS OF MOTHERS & BIRTH
WEIGHT OF BABY OF CASE & CONTROL GROUP

RISK FACTOR	CASE GROUP			CONTROL GROUP		
	PTLBW	NBW	TOTAL	PTLBW	NBW	TOTAL
HYPERTENSION	3 (6.00)	11 (22.00)	14 (28.00)	0 (0.00)	3 (6.00)	3 (6.00)
TOBACCO	8 (16.00)	6 (12.00)	14 (28.00)	0 (0.00)	3 (6.00)	3 (6.00)
SMOKING	1 (2.00)	13 (26.00)	14 (28.00)	0 (0.00)	3 (6.00)	3 (6.00)
ALCOHOL	0 (0.00)	14 (28.00)	14 (28.00)	0 (0.00)	3 (6.00)	3 (6.00)

Table VI is showing the role of other risk factors viz. Hypertension, Tobacco, Smoking and Alcohol in causation of PTLBW in mothers of case and control group. In case group out of 50 mothers, it was observed that 8 mothers (16%) delivered PTLBW babies. It have been reported in literature that tobacco use (chewing / paste) is playing significant role in causation of PTLBW. In this study, other factors did not play a significant role in causing PTLBW in mothers of both the groups.

Table No. VII
DISTRIBUTION ACCORDING TO HYPERTENSION OF MOTHER AND BIRTH WEIGHT OF
BABY OF CASE & CONTROL GROUP

BIRTH WEIGHT	CASE GROUP			CONTROL GROUP		
	HYPER TENSIVE	NORMO TENSIVE	TOTAL	HYPER TENSIVE	NORMO TENSIVE	TOTAL
PTLBW	3 (6.00)	11 (22.00)	14 (28.00)	0 (0.00)	3 (6.00)	3 (100.00)
NBW	3 (6.00)	33 (66.00)	36 (72.00)	4 (8.51)	43 (46.00)	47 (94.00)
TOTAL	6 (12.00)	44 (88.00)	50 (100.00)	4 (8.00)	46 (92.00)	50 (100.00)

Table VII shows the distribution of cases according to prevalence of hypertension in mothers in case and control group. Out of 50 mothers in case group, 6 mothers were having hypertension and out of these 3 mothers delivered PTLBW babies and 3 mothers delivered as full term normal for gestation age. Whereas out of 50 mothers in control group, 3 mothers were having hypertension but all of them delivered as full term normal for gestation age. Statistical correlation between HT of mother and PTLBW in both groups was non significant ($P > 0.05$).

Table No. VIII
DISTRIBUTION ACCORDING TO ALCOHOL INTAKE HABI OF MOTHER AND BIRTH WEIGHT
OF BABY OF CASE & CONTROL GROUP

BIRTH WEIGHT	CASE GROUP			CONTROL GROUP		
	ALCOHO LISM	NON ALCOHO LISM	TOTAL	ALCOHO LISM	NON ALCOHO LISM	TOTAL
PTLBW	0 (0.00)	14 (28.00)	14 (28.00)	0 (0.00)	3 (6.00)	3 (6.00)
NBW	0 (0.00)	36 (72.00)	36 (72.00)	1 (2.00)	46 (92.00)	47 (94.00)
TOTAL	0 (0.00)	50 (100.00)	50 (100.00)	1 (2.00)	49 (98.00)	50 (100.00)

Table VIII shows the distribution of cases according to mother's history of alcohol intake and birth weight of baby. No case was reported from the mothers of case group whereas only one case was reported from the control group.

In this study, no correlation was observed between mother's alcohol intake and PTLBW in control group ($P > 0.05$).

Table No. IX
DISTRIBUTION ACCORDING TO TOBACCO CHEWING / PASTE HABIT OF MOTHER AND BIRTH WEIGHT OF BABY OF CASE & CONTROL GROUP

BIRTH WEIGHT	CASE GROUP			CONTROL GROUP		
	TOBACCO CHEWER	NON TOBACCO CHEWER	TOTAL	TOBACCO CHEWER	NON TOBACCO CHEWER	TOTAL
PTLBW	8 (16.00)	6 (12.00)	14 (28.00)	0 (0.00)	3 (6.00)	3 (6.00)
NBW	7	29	36	5	42	47
NBW	7 (14.00)	29 (56.00)	36 (72.00)	5 (10.00)	42 (84.00)	47 (94.00)
TOTAL	15 (30.00)	35 (70.00)	50 (100.00)	5 (10.00)	45 (90.00)	50 (100.00)

Table IX shows the distribution of cases according to habit of tobacco use in mother (tobacco chew / paste use) and birth weight of baby, in case and control group. Out of 50 mothers of case group, 15 mothers (30%) were using tobacco, whereas in control group, only 5 mothers (10%) were using tobacco. Further evaluation indicated that 16% mothers (8/50) delivered with PTLBW in case group ($P < 0.05$), whereas no case was reported from the control group ($P > 0.05$).

Table No. X
DISTRIBUTION ACCORDING TO SMOKING HABIT OF MOTHER AND BIRTH WEIGHT OF BABY OF CASE & CONTROL GROUP

BIRTH WEIGHT	CASE GROUP			CONTROL GROUP		
	SMOKER	NON SMOKER	TOTAL	SMOKER	NON SMOKER	TOTAL
PTLBW	1 (2.00)	13 (26.00)	14 (28.00)	0 (0.00)	3 (6.00)	3 (6.00)
NBW	3	33	36	0	47	47
NBW	3 (6.00)	33 (66.00)	36 (72.00)	0 (0.00)	47 (94.00)	47 (94.00)
TOTAL	4 (8.00)	46 (92.00)	50 (100.00)	0 (0.00)	50 (100.00)	50 (100.00)

Table X shows the distribution according to smoking habits of mothers and birth weight of case and control groups. In case group, out of 50 mothers, 4 mothers were smoker whereas in control group, out of 50 mothers there was no case reported as smoker. Out of the 4 mothers of case group only one mother delivered with PTLB and whereas in control group, no case delivered with PTLB.

In this study the data indicated that there is no correlation between smoking and PTLBW ($P > 0.05$). These finding are against the reported studies where pregnant women who smoke cigarettes are nearly twice as likely to have a low birth weight baby as women who do not smoke.

TABLE NO. XI
DISTRIBUTION ACCORDING TO CLINICAL ATTACHMENT LOSS (CAL SCORE) OF MOTHER
AND BIRTH WEIGHT OF BABY OF CASE & CONTROL GROUP

CAL SCORE	CASE GROUP			CONTROL GROUP		
	PTLBW	NBW	TOTAL	PTLBW	NBW	TOTAL
0	14	36	50	3	47	50
TOTAL	14	36	50	3	47	50

Table XI shows the distribution according to Clinical Attachment Loss (CAL score) of mothers and birth weight of baby of case and control groups. In both groups, mean CAL was zero.



FIG 1. PTLBW BABY ON BABY WEIGHING SCALE



FIG 2. NORMAL BABY WEIGHT ON BABY WEIGHING SCALE

DISCUSSION

This study was undertaken to establish a cause effect relationship between periodontal disease in mother and PTLBW babies. The age group considered for the present study was 18 to 35 years. The rationale selecting the age group between 18 to 35 years is that the periodontal diseases are gram-negative anaerobic infections that can occur in women in the age group of 18 to 34 years⁶.

Age group distribution of mothers in case group and control group has indicated that most of deliveries took place in the age group of 18-30 years.

Literacy of mother is an important parameter for the fetal outcome. The findings in this study indicated that there is a significant association between education level of mothers and birth weight of baby. Our observations are in accordance with the reported observations by Garvey A, Douglass C, Chauncey H 1988^{21,22}.

Socio-economic distribution in studied population indicated that in both groups, the maximum number of mother were from SES II (upper middle SE class) but at the same time it was observed that PTLBW deliveries were more in SES IV in case group. This finding was further evaluated and it was observed that inspite of good Socio-economic Status IV in the case group (who delivered 9 (18%) PTLBWs) all of these mothers were illiterate. As reported that positive correlation exists between lower socio-economic status and periodontal disease leading to PTLBW^{23,24,25} in this study illiteracy had been found to be more significant factor in comparison to SES as a cause of periodontal disease leading to PTLBW.

In this study, the babies delivered with PTLBW were 6 % (3/50) in the control group mothers with CPI score 1 or 2 which is comparable with the reported prevalence of 10% of PTLBW in India^{26,27,28}. Whereas in the case group mother with CPI score 3, PTLBW was 28%, which is much higher than the reported in Indian situations ($p < 0.05$). With this observation it is clearly evident that periodontal disease with CPI score 1 and 2 did not contributed to adverse outcome of pregnancy but

periodontitis with CPI score 3 have definite role in adverse outcome of pregnancy causing PTLBW babies.

It had been reported that systemic inflammation leading to release of chemical mediators play a major role in the pathogenesis of preterm delivery, including preeclampsia, intrauterine growth restriction, and preterm delivery²⁹.

It had reported that periodontal disease causes increased levels of biological fluids that induce labor. When periodontal disease is present, the number of bacteria significantly increases by as much as 10,000 times the original population³⁰. The bleeding gums in periodontal disease gives the way to bacteria, who enters in the blood stream, travel through the mother's body, and enter the placenta causing poor fetal growth and as a result PTLBW baby.

Role of other risk factors as a cause of PTLBW was evaluated. The main factors which were evaluated were hypertension, Tobacco, Smoking and Alcohol in both groups. In this study, no other factor was found to play a significant role in causing PTLBW in mothers of both the groups.

As the CPI index selected under our study was restricted to score 1 to 3 and the CPI index of 4 or more were exclude. The CAL score expectedly shows the score of zero, rendering the relationship of our study as insignificant. Although CAL does not yield any data on the activity or the presence of periodontal disease, it is the only value that can be compared with other studies, so we used it.

CONCLUSION

In conclude, this study indicated a 4.66 fold increase in PTLBW in cases of periodontal infection with CPI score 3 in comparison to periodontal infection with CPI score 1 or 2. Many Other workers reported a 4.5 to 7 fold increase in incidence of PTLBW in cases of periodontitis with CPI score ≥ 3 . The important observation made in this study was illiteracy of the mother plays a major role in causation of periodontal disease as well as to PTLBW.

BIBLIOGRAPHY

1. Goldenberg RL, Rouse DJ. Prevention of premature birth. *New England Journal of Medicine* 1998; 339:313-20.
2. Mealey BL. Influence of periodontal infections on systemic health. *Periodontology 2000* 1999; 21:197-209.
3. Li X, Kolltveit KM, Tronstad L, Olsen I. Systemic diseases caused by oral infection. *Clinical Microbiology Reviews* 2000;3:547-58
4. Mokeem SA, Molla GN, Al-Jewair TS. The prevalence and relationship between periodontal disease and preterm low birth weight infants at King Khalid University Hospital in Riyadh, Saudi Arabia. *Journal of Contemporary Dental Practice* 2004; 5(2):40-56.
5. Moreu G, Tellez L, Gonzalez-Jaranay M. Relationship between maternal periodontal disease and low birth weight preterm infants. *Journal of Clinical Periodontol* 2005;32:622-27.
6. Offenbacher S, Katz V, Fertik G, Collins J, Boyd D, Maynor G, McKaig R, Beck J. Periodontal infection as a possible risk factor for preterm low birth weight. *Journal of Periodontol* 1996 Oct; 67 (10 Suppl):1103 - 13.
7. Champagne CM, Madianosa PN, Lief S, Murtha AP, Beck JD, Offenbacher S. Periodontol medicine: Emerging concepts in pregnancy outcomes. *Journal of the International Academy of Periodontology* 2000;2:9-13.
8. Garcia RI, Henshaw MM, Krall EA. Relationship between periodontal disease and systemic health. *Periodontology 2000* 2001; 25:21-36.
9. Paquette DW. The periodontal infection - systemic disease link : a review of the truth or myth. *Journal of the International Academy of Periodontology* 2002; 4: 101-9.
10. Tonetti M, D'Aiuto F, Nibali L, Donald A, Storry C, Parker M, Suvan J, Hingorani A, Vallance P, Deanfield J. Treatment of periodontitis and endothelial function. *New England Journal of Medicine* 2007;356:911-20.
11. Mitchell-Lewis D, Engebretson SP, Chen J, Lamster IB, Papapanou PN. Periodontal infections and preterm birth : early findings from a cohort of young minority women in New York. *Eur J Oral Sci* 2001 Feb; 109 (1):34 - 9.
12. Centres for Disease Control. Increasing incidence of low birth weight .United States 1981 – 1991 *MMWR* 1994; 45: 3354-39.
13. Mortality statistics. Perinatal and infant: social and factors. England and Wales. OPCS. London:HMSO 1995; Series DH3: no. 26.
14. Lopez NJ, Smith PC, Gutierrez J. Periodontal therapy may reduce the risk of preterm low birth weight in women with periodontal disease: a randomized controlled trial. *J Periodontol* 2002 Aug; 73 (8): 911-24.
15. Jeffcoat M.K, Hauth, JC, Geurs NC, Reddy MS, Cliver SP, Hodgkins PM, Goldenberg RL. Periodontal disease and preterm birth: results of a pilot intervention study. *Journal of Periodontology* 2003;74:1214-18.
16. Michalowicz BS, Hodges JS, DiAngelis AJ, Lupo VR, Novak MJ, Ferguson JE, Buchanan W, Bofill J, Papapanou P, Mitchell DA, Matseoane S, Tschida PA. for the OPT study. Treatment of periodontal disease and the risk of preterm birth. *N Engl J Med* 2006; 355: 1885-94.
17. Offenbacher S, Bogess KA, Murtha AP, Jared HL, Lief S, McKaig RG, Mauriello SM, Moss KL, Beck JD (2006a). Progressive periodontal disease and risk of very preterm delivery (published correction appears in *Obstetrics and Gynecology* 2006;107:1171). *Obstet and Gynecol* 2006;107:29-36.
18. Offenbacher S, Lin D, Strauss R, McKaig RG, Irving J, Barros SP, Moss K, Barrow DA, Hefti A, Beck JD (2006b). Effects of periodontal therapy during pregnancy on periodontal status, biologic parameters, and pregnancy outcomes: a pilot study. *J Periodontol* 2006;77:2011-24.
19. Michalowicz BS, Durand R. Maternal periodontal disease and spontaneous preterm birth. *Periodontology 2000* 2007;44:103-12.
20. Glesse S, Saba-Chujfi E. A influencia da doenca periodontal no trabalho de parto pre-termo. *Pesqui Odontol Bras* 2003; 17 Suppl 2:155.
21. Ruben Ovidia, Rafael Zirok, Rosa Maria Diaz-Romero. Relationship between pregnancy and periodontal disease. *Facta universitatis Medicine and Biology series* 2007; Vol. 14 (1) : 10-14.
22. Cruz SS, Costa MCN, Gomes Filho IS, Vianna MIP, Santos CT. Maternal periodontal disease as a factor associated with low birth weight. *Res Saude Publica* 2005;39(5);782-7.
23. Sardesai Suman P, Shinde Namdeo S, Patil Shailesh B, Rayate Mukta N, Muley Bharat. Tobacco handling by pregnant bidi workers: As hazardous as

- smoking during pregnancy. J Obstet Gynecol India 2007; Vol.57 (4): 335-38.
25. Oral Health Surveys. Basic Methods. 4th ed. World Health Organization, Geneva, 1997. p.36-38
 26. Beck JD, Loe H. Epidemiological Principles in studying periodontal diseases. Periodontology 2000 1993 ; 2: 34-45.
 27. Wen SW, Goldenberg RL, Cutter GR, Hoffman HJ, Cliver SP. Intrauterine growth retardation and preterm delivery: prenatal risk factors in an indigent population. Am J Obstet Gynecol 1990;162:213-18.
 28. Carmichael SL, Abrams B. A critical review of the relationship between gestational weight gain and preterm delivery. Obstet Gynecol 1997;89:866 - 73.
 29. Ghai OP. Essential pediatrics. 8th reprint. Interprints, New Delhi. 1989; 49-50.
 30. Kuppuswamy B. Manual of socioeconomic status (Urban), Manasayan, Delhi, 1981.
 31. Park K. Park's Textbook of Preventive & Social Medicine. 2002;17th ed. Chapter 8: 331-332.