Effect of Oral Diseases on Mothers Giving Birth to Preterm Infants

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Key Words

Pregnancy · Maternal oral health · Preterm birth · Periodontal disease

Abstract

Objectives: To determine the association between preterm birth (PTB) and maternal oral diseases during pregnancy.

Subjects and Methods: This prospective study was performed by the neonatal and dental departments at Jordan University Hospital. The study included 100 women who gave birth to preterm singleton infants (born less than 37 complete weeks from last menstrual period) between January and July 2009. The control group included an equal number of women who delivered singleton, full-term infants on the same day or the day after the women in the study. The mothers' demographic data were collected using a questionnaire, and an oral examination was conducted for each participant. Statistical analysis was performed using SPSS for Windows release 16.0 (SPSS Inc., Chicago, Ill., USA). Factors related to PTB were studied in univariate and multivariate logistic regression analyses. **Results:** Significantly higher DMFT (decayed, missing, filled teeth) index scores, Silness and Loe plaque index scores and Mühlemann tooth mobility index scores were associated with PTB. Mothers who did not

have prepregnancy dental checkups had a significantly higher incidence of PTB. Fewer mothers in the PTB group visited dentists during their last pregnancy compared with controls. **Conclusions:** Oral health, especially healthy periodontium, is one reliable indicator for predicting a safe pregnancy outcome.

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Introduction

It has long been suspected that oral diseases could have an effect on the health of the entire body [1]. Oral diseases such as gingivitis and chronic periodontitis are found worldwide and are among the most prevalent microbial diseases affecting mankind. The cause of these common inflammatory conditions is the complex microbiota found in dental plaque, particularly gram-negative anaerobic bacteria [2–4]. Many studies have shown links between oral health and pregnancy outcome, especially preterm birth (PTB), which is one of the greatest problems in obstetrical medicine [2, 5]. Oral infections are considered risk factors for PTB as they are a source of systemic infection, which indirectly contributes to the rupture of membranes leading to early labor by the translo-

cation of bacterial products (such as endotoxins) and the action of maternally produced inflammatory mediators [6]. Evidence exists that untreated periodontal disease in pregnant women may be a significant risk factor for PTB [7–11]. The prevalence of PTB was 11.2% among women with healthy periodontium compared to 28.6% in women with moderate to severe periodontal disease [12]. In addition, the progression of periodontal disease during pregnancy was found to be a significant predictor of poorer pregnancy outcome of PTB [13].

In Jordan, one study revealed that gingival inflammatory symptoms are aggravated during pregnancy, and are related to increased age and a lower level of education and unemployment [14]. Another study published in 2009 analyzed the relationship between maternal periodontal status and preterm low birth weight delivery in northern Jordan [15]. The aim of this study was to explore the relationship between oral periodontal disease, mainly periodontitis and caries, and the condition of mothers delivering preterm infants at Jordan University Hospital (JUH).

Subjects and Methods

This prospective study was conducted at JUH, Amman, a tertiary care hospital, which provides services to residents of Jordan. Approval of the local research committee was obtained. The study included mothers of all preterm infants who had been admitted between January and July 2009. A preterm infant was defined as one with a gestational age less than 37 complete weeks, measured from the last menstrual period.

Data were collected using a standardized format that included the infant's weight, sex and gestational age. Maternal variables were identified and included age, weight, height, and body mass index before pregnancy, medical history, previous pregnancy and abortions, dental history, presence of any dental complaints during pregnancy and oral hygiene practice. Mothers who had hypertension and diabetes or any chronic disease were excluded; also, mothers who delivered twins were excluded. A control group composed of an equal number of mothers who delivered singleton infants at term (full-term births, FTBs) at JUH were selected randomly on the same or next day.

Clinical oral examination was performed by one of the authors at the dentistry department of JUH. According to Armfield et al. [16], the oral health measures to be investigated in this study were DMFT (decayed, missing, and filled teeth) index and its components, periodontitis and gingivitis. DMFT index of all permanent teeth excluding third molars was determined for each mother. Periodontal health was evaluated according to the plaque index of Silness and Loe [17], bleeding on probing of Loe and Silness [18], mobility index of Mühlemann [19], and measurement of pocket depth. One tooth in each sextant was examined, six sites per tooth were checked, and the community periodontal index of treatment needs was adopted. In principle, the community periodontal in-

dex of treatment needs is an epidemiological method that was originally based on the index teeth [20]. Pockets equal to or more than 5 mm were recorded.

Statistical analysis was performed using SPSS for Windows release 16.0 (SPSS Inc., Chicago, Ill., USA). In univariate analysis, one-way ANOVA and χ^2 tests were used to determine the associations between the different variables and PTB. Forward stepwise multivariate logistic regression analysis was then used to control for potential confounding variables and to calculate the odds ratios and confidence intervals (CI) for potential independent predictors of PTB risk. In the stepwise analysis, 0.05 was the cutoff level for inclusion; 0.10 was the cutoff level for exclusion of a variable in the analyses. Differences at the 5% level were accepted as significant.

Results

Demographic variables of the mothers and their relationship to PTB are shown in table 1. The mothers' age range was 17–41 years, with only 4.5% aged <20 and 13% >35 years of age. The mean age was 29.5 ± 5.2 years, with no significant difference between the PTB and FTB groups. The mean birth weight of the FTB group was 3.09 (± 0.40) kg and 1.27 (± 0.64) kg ($p < 0.001$) for the PTB group. Mothers' educational level, history of abortion, tobacco use, and husbands' tobacco use or passive smoking were not significantly associated with the frequency of PTB. Mothers' obesity as well was not found to be a risk factor. However, PTB occurred significantly less frequently with high household income and when the mother had more than three previous pregnancies.

Oral health indicators of the mothers and their association with PTB are shown in table 2. Significantly higher DMFT index scores, plaque index scores, and tooth mobility index scores were associated with PTB. Mothers who did not have prepregnancy dental checkups had a significantly higher incidence of PTB. A lower number of mothers in the PTB group visited dentists during their last pregnancy compared with controls. Mothers in the PTB group brushed their teeth and used dental floss and mouthwash less frequently and had more frequent gingivitis and deep pockets. The frequency of toothache, oral ulceration, and development of epulides during pregnancy had no significant relationship to PTB.

In multivariate logistic regression analysis, only four factors, number of previous pregnancies, plaque index scores, DMFT index scores, and tooth flossing, were found to be independently associated with PTB when the effects of other factors were controlled, as shown in table 3. The risk of PTB or odds ratio for mothers who had 0–3 children was 25.44 (CI: 8.67–74.62), for every one

Table 1. Demographic variables of mothers in the FTB and PTB group

Variable	Total (n = 200)	FTB (n = 100)	PTB (n = 100)	p value
Age, years	29.5 ± 5.2	29.4 ± 5.7	29.5 ± 4.8	0.94*
Weight, kg	66.4 ± 10	67.0 ± 10.3	65.8 ± 9.8	0.40*
Height, m	1.63 ± 0.06	1.64 ± 0.05	1.63 ± 0.06	0.08*
BMI, kg/m ²	24.9 ± 3.7	24.9 ± 3.8	24.9 ± 3.6	0.95*
Educational level				0.61**
Primary school	19 (9.5)	10 (52.6)	9 (47.4)	
High school	87 (43.5)	40 (46)	47 (54)	
University	94 (47)	50 (53.2)	44 (46.8)	
Household income				0.048**
<500 JD	136 (68)	61 (44.9)	75 (55.1)	
≥500 JD	64 (32)	39 (60.9)	25 (39.1)	
Previous pregnancies				<0.001**
0–3	134 (67)	51 (38.1)	83 (61.9)	
>3	66 (33)	49 (74.2)	17 (25.8)	
Previous abortion				
No	83 (41.5)	41 (49.4)	42 (50.6)	1.0**
Yes	117 (58.5)	59 (50.4)	58 (49.6)	
Tobacco use				1.0**
No	189 (94.5)	95 (50.3)	94 (49.7)	
Yes	11 (5.5)	5 (45.5)	6 (54.5)	
Husband's tobacco use				0.38**
No	74 (37)	34 (45.9)	40 (54.1)	
Yes	126 (63)	66 (52.4)	60 (47.6)	

Values are expressed as means ± SD or numbers with percentages in parentheses (first column expressed as column percentage and second and third as raw percentage). BMI = Body mass index; JD = Jordanian dinar (1 JD ~ 1.41 USD).

* ANOVA. ** χ^2 test.

score increase in plaque index it was 2.15 (CI: 1.05–4.38), for every one score increase in DMFT it was 1.40 (CI: 1.22–1.61), and for those who flossed their teeth regularly it was 12% of that in those who do not floss.

Due to the strong association found in this study between the two pregnancy outcomes and mean birth weight, birth weight was significantly affected in univariate and multivariate analysis by the same factors that were found to be significantly associated with PTB.

Discussion

Higher DMFT score in this study was associated with preterm deliveries in contrast to previous reports, which did not find this association [15]. In the present study, the mean number of decayed or restored teeth in mothers of PTB babies was significantly higher than that found in mothers of FTB babies (table 4) [21]. With respect to periodontal disease, clinical examination revealed more

mothers having severe periodontitis, i.e., two or more sites with a pocket depth of ≥ 5 mm, and they were threatened with PTB, as reported previously. This is in agreement with recent studies, demonstrating that maternal periodontal disease is an independent risk factor for PTB in Jordan, Saudi Arabia and many other countries [7, 15, 22–26], whereas others did not find such an association [10, 27–29].

In this study, PTB was more significant in mothers who brushed their teeth less frequently, did not use dental floss or mouthwash and had fewer dental checkups before and during pregnancy. This shows the importance of oral health awareness and conscientious practice of oral hygiene by pregnant women, supporting the findings of Bosnjak et al. [2]. Studies clarifying the effects of hormones on the oral health of pregnant women suggest that a moderate to high percentage of these women experience gingivitis and that many of them may develop pyogenic granuloma. This finding should be communicated to pregnant women in order to motivate them to maintain

Table 2. Oral health indicators of mothers in the FTB and PTB group

Variable	Total (n = 200)	FTB (n = 100)	PTB (n = 100)	p value
DMFT	10.3 ± 4.2	8.3 ± 3.6	12.3 ± 3.7	<0.001*
Plaque index	1.5 ± 0.7	1.3 ± 0.5	1.7 ± 0.7	<0.001*
Mobility index	1.4 ± 0.6	1.2 ± 0.5	1.6 ± 0.6	<0.001*
Regular dentist visits				
No	112 (56)	49 (43.8)	63 (56.2)	0.064**
Yes	88 (44)	51 (58)	37 (42)	
Prepregnancy dental checkup				
No	122 (61)	48 (39.3)	74 (60.7)	<0.001**
Yes	78 (39)	52 (66.7)	26 (33.3)	
Visited dentist in last pregnancy				
No	24 (12)	6 (25)	18 (75)	0.02**
Yes	176 (88)	94 (53.4)	82 (46.6)	
Tooth brushing				
No	4 (2)	1 (25)	3 (75)	0.62**
Yes	196 (98)	99 (50.5)	97 (49.5)	
Brushing frequency				
0	4 (2)	1 (25)	3 (75)	<0.001**
1–2	133 (66.5)	49 (36.8)	84 (63.2)	
>2	63 (31.5)	50 (79.4)	13 (20.6)	
Dental flossing				
No	164 (82)	67 (40.9)	97 (59.1)	<0.001**
Yes	36 (18)	33 (91.7)	3 (8.3)	
Use of mouthwash				
No	120 (60)	40 (33.3)	80 (66.7)	<0.001**
Yes	80 (40)	60 (75)	20 (25)	
Gingivitis				
No	28 (14)	25 (89.3)	3 (10.7)	<0.001**
Yes	172 (86)	75 (43.6)	97 (56.4)	
Gingival bleeding				
No	54 (27)	31 (57.4)	23 (42.6)	0.27**
Yes	146 (73)	69 (47.3)	77 (52.7)	
Periodontal pocket >5 mm				
No	140 (70)	84 (60)	56 (40)	<0.001**
Yes	60 (30)	16 (26.7)	44 (73.3)	
Toothache during pregnancy				
No	2 (1)	2 (100)	0 (0)	0.50**
Yes	198 (99)	98 (49.5)	100 (50.5)	
Oral ulcers during pregnancy				
No	193 (96.5)	97 (50.3)	96 (49.7)	1.0**
Yes	7 (3.5)	3 (42.9)	4 (57.1)	
Pregnancy epulides				
No	151 (75.5)	73 (48.3)	78 (51.7)	0.51**
Yes	49 (24.5)	27 (55.1)	22 (44.9)	

Values are expressed as means ± SD or numbers with percentages in parentheses (first column expressed as column percentage and second and third as raw percentage). SD = Standard deviation.

* ANOVA. ** χ^2 test.

Table 3. Stepwise logistic regression modeling for factors associated with PTB

Variable	Regression coefficient	p value	OR	CI for OR
Constant	-2.638	<0.001	0.07	
0-3 pregnancies	3.236	<0.001	25.44	8.67-74.62
Plaque index	0.764	0.036	2.15	1.05-4.38
DMFT	0.334	<0.001	1.40	1.22-1.61
Teeth flossing	-2.133	0.003	0.12	0.03-0.48

OR = Odds ratio.

Table 4. DMFT index details of mothers in the FTB and PTB group in the present study and some previous studies

Study	FTB	PTB	p value*
Bosnjak et al. [2]			
Mean number of decayed teeth	3.93 ± 1.38	4.28 ± 2.91	0.25
Mean number of missing teeth	5.34 ± 2.66	5.05 ± 3.74	0.24
Mean number of restored teeth	8.18 ± 3.85	9.37 ± 4.83	0.05
Buduneli et al. [7]			
Mean number of decayed teeth	1.43 ± 1.8	1.45 ± 2.03	0.94
Mean number of present teeth	26.96 ± 1.5	26.58 ± 1.93	0.17
Mean number of restored teeth	0.32 ± 1.06	0.26 ± 1.15	0.75
Present study			
Mean number of decayed or restored teeth ^a	3.71 ± 2.16	7.29 ± 3.09	<0.001
Mean number of missing teeth	4.62 ± 2.48	4.98 ± 2.40	0.30

^a For DMFT index we only counted the present teeth and the present sound unrestored teeth. * ANOVA.

a good level of oral hygiene to prevent disease and promote and enhance their own oral health [30] as well as that of their infants.

A possible explanation for avoiding dental visits during pregnancy, as suggested by Ressler-Maerlender et al. [31], could be the belief that poor oral health status during pregnancy is normal, or it may be due to a fear of certain aspects of dental care during pregnancy which might affect the embryo.

High household income had a positive impact to lessen PTB; similarly, Pitiphat et al. [32] found that PTB was more common among relatively low socioeconomic groups. In this study, the age of women and their educational level did not influence the percentage of PTB. On the other hand, many studies linked age and educational level with PTB [33, 34]. Smoking was not a detectable risk factor, unlike the findings of a previous study conducted

in Adelaide, Australia, where 16.4% of PTBs could be attributed to smoking [35]. This may be due to the small number of smoking mothers in Jordan who had PTBs. The number of previous pregnancies had a high impact on PTB; females who delivered 3 or more children were at a lower risk of having PTB, which is in accordance with a study in Zimbabwe that found high-parity women were at a lower risk [36]. Toothache, oral ulceration and the development of epulides in this study were not associated with PTB.

Conclusion

The incidence of PTB is lower for mothers who conscientiously follow a program of oral hygiene and regular professional care before and during pregnancy, indicat-

ing the importance of oral health education for pregnant women. Oral health, especially healthy periodontium, is a reliable indicator of a safe pregnancy. Therefore, we recommend a national policy to support dental examination and awareness of good dental hygiene practices for prospective mothers before pregnancy.

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References

- Cullinan MP, Ford PJ, Seymour GJ: Periodontal disease and systemic health. *Aust Dent J* 2009;54:62–69.
- Bosnjak A, Relja T, Vucićević-Boras V, Plasaj H, Plancak D: Pre-term delivery and periodontal disease. *J Clin Periodontol* 2006;33:710–716.
- Machuca G, Khoshfeiz O, Lacalle JR, Machuca C, Bullón P: The influence of general health and socio-cultural variables on the periodontal condition of pregnant women. *J Periodontol* 1999;70:779–785.
- Tonetti MS, D'Aiuto F, Nibali L, Donald A, Storry C, Parkar M, Suvan J, Hingorani AD, Vallance P, Deanfield J: Treatment for periodontitis and endothelial function. *N Engl J Med* 2007;356:911–920.
- Goldenberg RL, Culhane JF, Iams JD, Romero R: Epidemiology and causes of preterm birth. *Lancet* 2008;371:75–84.
- Taani DQ: Relationship of socioeconomic background to oral hygiene, gingival status, and dental caries in children. *Quintessence Int* 2002;33:195–198.
- Buduneli N, Baylas H, Buduneli E, Türkoğlu O, Köse T, Dahlen G: Periodontal infections and pre-term low birth weight. *J Clin Periodontol* 2005;32:174–181.
- Jeffcoat MK, Geurs NC, Reddy MS, Goldenberg RL, Hauth JC: Current evidence regarding periodontal disease as a risk factor in preterm birth. *Ann Periodontol* 2001;6:183–188.
- Agueda A, Echeverria A, Manau C: Association between periodontitis in pregnancy and preterm or low birth weight: review of the literature. *Med Oral Patol Oral Cir Bucal* 2008;13:609–615.
- Vettore MV, Leal M, Leão AT, da Silva AM, Lamarca GA, Sheiham A: The relationship between periodontitis and preterm low birthweight. *J Dent Res* 2008;87:73–78.
- Ruma M, Boggess K, Moss K, Jared H, Murtha A, Beck J, Offenbacher S: Maternal periodontal disease, systemic inflammation, and risk for preeclampsia. *Am J Obstet Gynecol* 2008;198:389.e1–5.
- Offenbacher S, Boggess KA, Murtha AP, Jared HL, Lief S, McKaig RG, Mauriello SM, Moss KL, Beck JD: Progressive periodontal disease and risk of very preterm delivery. *Obstet Gynecol* 2006;107:29–36. Erratum in: *Obstet Gynecol* 2006;107:1171.
- Offenbacher S, Lin D, Strauss R, McKaig R, Irving J, Barros SP, Moss K, Barrow DA, Hefi A, Beck JD: Effects of periodontal therapy during pregnancy on periodontal status, biologic parameters, and pregnancy outcomes. *J Periodontol* 2006;77:2011–2024.
- Taani DQ, Habashneh R, Hammad MM, Batiha A: The periodontal status of pregnant women and its relationship with socio-demographic and clinical variables. *J Oral Rehabil* 2003;30:440–445.
- Khader Y, Al-shishani L, Obeidat B, Khasawneh M, Burgan S, Amarin ZO, Alomari M, Alkafajei A: Maternal periodontal status and preterm low birth weight delivery. *Arch Gynecol Obstet* 2009;279:165–169.
- Armfield JM, Slade GD, Spencer AJ: Dental fear and adult oral health in Australia. *Community Dent Oral Epidemiol* 2009;37:220–230.
- Silness J, Loe H: Periodontal disease in pregnancy. II. Correlation between oral hygiene and periodontal condition. *Acta Odontol Scand* 1964;22:121–135.
- Loe H, Silness J: Periodontal disease in pregnancy. I. Prevalence and severity. *Acta Odontol Scand* 1963;21:533–551.
- Mühlemann HR: Periodontometry, a method for measuring tooth mobility. *Oral Surg Oral Med Oral Pathol* 1951;4:1220–1233.
- Ainamo J, Barmes D, Beagrie G, Cutress T, Martin J, Sardo-Infirri J: Development of the World Health Organization (WHO) community periodontal index of treatment needs (CPITN). *Int Dent J* 1982;32:281–291.
- Dasanayake AP: Poor periodontal health of the pregnant woman as a risk factor for low birth weight. *Ann Periodontol* 1998;3:206–212.
- Van der Velden U: Purpose and problems of periodontal disease classification. *Periodontology* 2000;39:13–21.
- Alwaeli HA, Al-Jundi SH: Periodontal disease awareness among pregnant women and its relationship with socio-demographic variables. *Int J Dent Hyg* 2005;3:74–82.
- Sacco G, Carmagnola D, Abati S, Luglio PF, Ottolenghi L, Villa A, Maida C, Campus G: Periodontal disease and preterm birth relationship: a review of the literature. *Minerva Stomatol* 2008;57:233–246.
- Offenbacher S, Lief S, Boggess KA, Murtha AP, Madianos PN, Champagne CM, McKaig RG, Jared HL, Mauriello SM, Auten RL Jr, et al: Maternal periodontitis and prematurity. Part I: Obstetric outcome of prematurity and growth restriction. *Ann Periodontol* 2001;6:164–174.
- Mokeem SA, Molla GN, Al-Jewair TS: The prevalence and relationship between periodontal disease and pre-term low birth weight infants at King Khalid University Hospital in Riyadh, Saudi Arabia. *J Contemp Dent Pract* 2004;5:40–56.
- Noack B, Klingenberg J, Weigelt J, Hoffmann T: Periodontal status and preterm/low birth weight: a case control study. *J Periodontal Res* 2005;40:339–345.
- Wood S, Frydman A, Cox S, Brant R, Needoba S, Eley B, Sauve R: Periodontal disease and spontaneous preterm birth: a case control study. *BMC Pregnancy Childbirth* 2006;6:24.
- Bassani DG, Olinto MT, Kreiger N: Periodontal disease and perinatal outcomes: a case-control study. *J Clin Periodontol* 2007;34:31–39.
- Amar S, Chung KM: Influence of hormonal variation on the periodontium in women. *Periodontol* 2000;1994;6:79–87.
- Ressler-Maerlender J, Krishna R, Robison V: Oral health during pregnancy: current research. *J Womens Health* 2005;14:880–882.
- Pitiphat W, Joshipura KJ, Gillman MW, Williams PL, Douglass CW, Rich-Edwards JW: Maternal periodontitis and adverse pregnancy outcomes. *Community Dent Oral Epidemiol* 2008;36:3–11.
- Sarlati F, Akhondi N, Jahanbakhsh N: Effect of general health and sociocultural variables on periodontal status of pregnant women. *J Int Acad Periodontol* 2004;6:95–100.
- Yalcin F, Eskinazi E, Soyuncu M, Basegmez C, Issever H, Isik G, Berber L, Has R, Sabuncu H, Onan U: The effect of sociocultural status on periodontal conditions in pregnancy. *J Periodontol* 2002;73:178–182.
- Freak-Poli R, Chan A, Tucker G, Street J: Previous abortion and risk of pre-term birth: a population study. *J Matern Fetal Neonatal Med* 2009;22:1–7.
- Majoko FM, Nyström L, Munjanja SP, Mason E, Lindmark G: Relation of parity to pregnancy outcome in a rural community in Zimbabwe. *Afr J Reprod Health* 2004;8:198–206.