

Relationship between Maternal Periodontal Condition and Body Size of Newborns

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Abstract

Objective: It has been suggested that periodontal disease may be a risk factor for a number of multifactorial systemic conditions such as preterm deliveries. The aim of the present study was to examine the relationship between maternal periodontal disease and body size of newborns.

Methods: After controlling traditional risk factors for premature child birth and low birth weight. One-hundred eighty mothers were selected: 17 were periodontally healthy, 77 had gingivitis, 72 had initial periodontitis and 14 suffered from established periodontitis. These mothers and their newborns formed the study population. The body size consisting of weight, height, and head and chest circumference, were taken from newborns' hospital files.

Findings: A decrease in the newborns' body size was observed as the mothers' periodontal disease severity increased. Birth weight, height, and head and chest circumference of babies born of mothers with established periodontal disease were significantly lower than those who were born of mothers with healthy periodontal condition, gingivitis and initial periodontal disease ($P=0.006$, $P=0.016$, $P<0.001$ and $P<0.001$, respectively).

Conclusion: The data suggest that there is a considerable association between periodontal disease in pregnant women and body size of their newborns, this preliminary finding needs to be confirmed in more extensive studies.

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Key Words: Newborn; Periodontal disease; Body size; Preterm; Low birth weight

Introduction

Systemic maternal infections are hypothesized to increase the risk of placental infections, Premature rupture of membranes, premature labor and preterm birth by release of

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inflammatory cytokines and increased prostaglandin production^[1,2].

Periodontal disease is a chronic, low-grade, gram-negative anaerobic infection of periodontal tissues that is associated with an increase in the systemic levels of inflammatory cytokines^[3]. Periodontal organisms have been isolated from the amniotic fluid, suggesting the possibility of hematogenous spread^[4,5]. Periodontal disease could potentially influence pregnancy outcomes through indirect mechanisms involving inflammatory cytokines or direct translocation of bacteria and its products to the fetoplacental unit. Previous epidemiologic studies have reported positive associations between periodontal disease and adverse pregnancy outcomes, including preterm low birth weight^[6,7], low birth weight^[7,8], preterm birth^[9], fetal growth restriction^[10], and preeclampsia^[11]. Body size (weight, height, and head and chest circumference) at birth are important clinical indicators widely used for evaluation of prenatal growth^[12].

Although a large number of studies have evaluated the effect of periodontal disease on premature child birth, no studies have, so far, focused on the influence of this chronic disease on the developmental status of newborns. Therefore, the present study was undertaken to determine the influence of periodontal disease in pregnant women on the body size of their newborn babies.

The main objective of the present study was to evaluate a hypothesis: Periodontal disease in pregnant women can have a detrimental effect on intrauterine development of babies. In case of an association between these two, future studies can evaluate this hypothesis.

Subjects and Methods

The present study was an analytical/cross-sectional study (correlational type). The study population consisted of pregnant women aged 17 to 40, who had referred to the Alzahra Hospital of Tabriz University (Medical Sciences) between June and August 2007.

Exclusion criteria included systemic conditions such as severe anemia, diabetes, cardiovascular disorders, hepatic deficiency, high blood pressure, venereal disease, urinary infections, bacterial vaginitis, and viral infections or environmental factors such as tobacco use, alcoholism, narcotic drug use, x-rays during the first semester, anti-convulsive drugs, associated premature birth or intrauterine growth delay and an obstetric history which included multiple pregnancies, more than 3 deliveries, severe polyhydramnios and oligohydramnios, umbilical cord coiling, women who did not present for regular prenatal checkups, i.e. fewer than 5 consultations and finally women who had opted for Cesarean section before the onset of labor pains.

A total of 180 women met the criteria for participation in the study and a census procedure carried out in order to acquire and record the data from the subjects during the period of study. The study design was approved by the Ethics Committee and supported by the Pediatric Research Deputy of Tabriz University (Medical Sciences). The nature of this investigation was explained to the patients in detail and the patients signed an informed consent form.

All data were collected within 48 hours after delivery. Clinical histories taken by the attending obstetrician (factors associated with premature birth or intrauterine growth delay) were reviewed by one of the authors to ensure that none of the afore-mentioned exclusion criteria was present. Measurements were taken by one examiner trained in the technique.

After delivery, classification was carried out on the basis of gingival and plaque indices (Ainamo & Bey)^[13] and mean of attachment loss. In this index, bleeding from the gingival margin and visible plaque have a score of "1", while absence of bleeding and no visible plaque have a score of "0".

Attachment loss was measured with a Williams periodontal probe (PWD, Hu-Friedy Immunity, USA) for all the existing teeth on four surfaces (buccal, mesial, distal, and palatal or lingual) and the means were

calculated. Based on the results the pregnant women were divided into 4 groups as follows:

Group 1: Normal with no gingival inflammation (GPI=0) and no attachment loss.

Group 2: Simple gingivitis with gingival inflammation (GPI=1) and no attachment loss.

Group 3: Initial periodontitis with gingival inflammation (GPI=1) and attachment loss of <2 mm.

Group 4: Established periodontitis with gingival inflammation (GPI=1) and attachment loss of >2 mm.

Measurements relating to birth weight by gr, newborn length by cm, and head and chest circumference by cm were retrieved from the newborns' medical files.

Means of these variables were calculated for each group and compared using one-way ANOVA. If there were statistically significant differences between the groups, post hoc tests were used for further analysis. A *P*-value of <0.05 was considered significant.

Since various factors can influence developmental parameters an effort was made to control other known risk factors and omit confounding parameters using regression analyses. These confounding factors included age, weight, height and the educational status (defined as the years of school attendance) of mothers, the economic status of the family (defined as poor, moderate, and good), the number of pregnancies, newborn gender, and fathers' height and age^[12,14,15,16].

Findings

The subjects in the present study consisted of 180 mothers aged 17-40 years with a mean age of 26.5 (± 4.6) years. Means of mothers' weight and height were 64.1 (± 11.9) kg and 160.5 (± 8.0) cm, respectively. The mean of mothers' school attendance years was 7.9 (± 5.1). A total of 70 (69%) of mothers came from poor families, 74 (41.1%) had moderate economic status, and 36 (20.0%) came from affluent families. A total of 91 (50.6%) of mothers were experiencing their first

pregnancy, 56 (31.1%) were having their second pregnancy and 33 (18.4%) were experiencing their third pregnancy. A total of 157 (87.2%) mothers had no history of abortion/miscarriage, 16 (8.9%) mothers had one abortion/miscarriage experience in their history and 7 (3.9%) had 2 cases of abortion/miscarriage in their medical history. Evaluation of mothers' periodontal status revealed that 17 (9.4%) mothers had normal periodontium, 77 (42.8%) had simple gingivitis, 72 (40.0%) had initial periodontitis, and 14 (7.8%) suffered from established periodontitis.

Means of fathers' height and age were 174.3 (± 12.6) cm and 30.8 \pm 6.4 years, respectively. Baby girls and baby boys comprised 80 (44%) and 100 (55%) of the newborns. A total of 172 (95.6%) of the babies were carried to full term and 8 (4.4%) were born preterm, one of whom was born of a mother with simple gingivitis, three were born of mothers with initial periodontitis and four were born of mothers with established periodontitis.

Statistical analysis using one-way ANOVA demonstrated statistically significant associations between the weight, head and chest circumference, and height at birth and the periodontal status of mothers from healthy and normal periodontium to gingivitis, to initial periodontitis, and to established periodontitis (Table 1). Multiple regression analyses revealed that of all the variables involved only the following variables had associations with weight at birth, respectively:

1. the number of pregnancies
2. mother's educational status
3. mother's weight
4. mother's periodontal status

The correlation coefficient ($R=0.52$) for those variables was highly significant ($P<0.001$). It is noteworthy that mothers' periodontal status had the strongest influence on gestational age at birth ($P=0.22$, $R=0.17$), followed by mothers' educational status ($P=0.22$) and the number of pregnancies ($P=0.006$).

A post hoc Tukey test revealed that there was only a statistically significant difference between the periodontal health and established periodontitis, i.e. periodontal

Table 1: Infant body size based on mother's periodontal condition (Mean±SD)

Mother's periodontal condition	Birth weight	Height	Head circumference	Chest circumference
Normal (N=17)	3464.7±278.2	50.5±2.1	34.5±1.0	34.1±1.4
Simple gingivitis (N=77)	3127.2±667.1	49.9±3.2	34.0±1.7	32.8±1.9
Initial periodontitis (N=72)	3079.8±587.4	50.1±2.8	33.9±2.1	32.6±2.0
Established periodontitis (N=14)	2678.5±731.0	47.4±3.4	33.8±2.0	30.7±1.7
P value (ANOVA)	0.006*	0.016*	<0.001*	<0.001*

* Asterisk indicates statistical significance based on $P < 0.05$

disease in mild forms (gingivitis) and initial periodontitis do not influence these variables and only the severe form of the disease influences the variables (table 2). Multiple regression analyses indicated that mothers' periodontal status and fathers' age had an independent correlation with the newborns' head circumference ($P = 0.001$, $R = 0.25$).

Newborns' chest circumference had the strongest correlation with the following variables, respectively, and other variables had no influence on it ($P < 0.001$, $R = 0.3$):

1. mother's periodontal status
2. mother's weight
3. number of pregnancy
4. mother's age
5. mother's educational status

Newborns' length at birth had the strongest correlation with the number of pregnancies and mothers' periodontal status and other

variables did not demonstrate any correlation:

1. number of pregnancies ($P < 0.001$, $R = 0.25$)
2. number of pregnancies plus periodontal status ($P < 0.001$, $R = 0.3$)

Discussion

This research examined the relationship between maternal periodontal disease and the body size of the newborn infants after controlling for the traditional risk factors for premature child birth and low birth weight. The average birth weight decreased as the severity of mother's periodontal disease increased. In addition, a strong association was observed between maternal periodontal disease and preterm birth.

Table 2: Comparison between normal periodontal status and various stages of maternal periodontal disease in newborn related variables (data are expressed in p value)

Maternal Periodontal Status	Newborns variables			
	Birth weight	Height	Head circumference	Chest circumference
gingivitis	0.17	0.84	0.73	0.8
Initial periodontitis	0.92	0.94	0.56	0.2
Established periodontitis	0.002*	0.02*	0.00*	0.00*

* Asterisk indicates statistical significance based on $P < 0.05$

These results are consistent with those reported by Collins et al, who suggested that infection with Gram-negative periodontal pathogens might induce adverse effects on the fetus, depending on the degree of infection^[17]. Offenbacher et al had similar results when they measured the attributable risk of periodontal disease in pregnant women after controlling for traditional risk factors. A study by Pitiphat et al showed that periodontitis is an independent risk factor for poor pregnancy outcome among middle-class women^[18]. Radnai et al showed that the average weight of newborns of mothers with periodontitis was significantly less than that of women without periodontitis^[19].

What distinguishes the present study from other studies on the subject is the evaluation of developmental parameters in newborns whose mothers suffered from varying degrees of periodontal disease. Since a number of factors can influence these parameters^[12,14-16] an effort was made to control other known risk factors and eliminate confounding parameters using regression analysis. This test indicated that the greatest independent correlation existed between head circumference and maternal periodontal status. This relationship might be attributed to the effect of chronic infections on nervous system development. Animal studies have demonstrated the influence of chronic infections on nervous system development in infants^[20].

Of the variables evaluated, chest circumference had the strongest correlation with maternal periodontal status. Evaluation of newborns' length demonstrated that, second to the number of pregnancies, it had the strongest correlation with maternal periodontal status. Although no explanation can be found in the references available, the effect of chronic infections on skeletal system development has been documented in animals^[20].

The results showed that number of pregnancies, mother's educational status, mother's weight, and mother's periodontal status can influence weight of the newborn, are consistent with the results of related

articles. The study of Gazolla et al showed that educational level, previous preterm birth, and periodontal disease were related significantly to preterm delivery^[21].

There was only a statistically significant difference between the periodontal health and established periodontitis, but the study of Vettore et al revealed that periodontal disease was not more severe in women with preterm low birth weight babies^[22].

It should be pointed out that the present study was carried out to establish an association between height, and head and chest circumference in newborns with maternal periodontal disease and this disease cannot be considered a causative agent.

It is important to consider the possibility that there is some underlying mechanism causing both periodontal disease and pregnancy outcomes. Impaired immune system can be mentioned as an example. Some authors suggest that the response of peripheral blood monocytes to lipopolysaccharides (LPS) from various sources may vary in individuals from the same population^[23]. This implies that some individuals experience an abnormal inflammatory response to bacterial LPS, resulting in high levels of mediators such as prostaglandin E₂, interleukin-1 β , and TNF- α ^[23,24]. This situation may contribute to an increase in periodontal disease severity, preterm labor, and low birth weight in some women.

Cross sectional studies have their own limitations and at the present study, although the periodontal indices evaluating the gingival inflammation (such as Ainamo- Bey, Loe & Sillness etc.) showed the mothers periodontal condition shortly after delivery, it does not provide reliable information on previous disease activity (in normal and simple gingivitis groups).

The present study indicated that the periodontal disease of pregnant women was associated with infant body size. In order to improve oral hygiene and periodontal status there is a need to develop preventive programs for pregnant women in coordination with the gynecological and dental professions.

Periodontal therapy is able to reduce pregnancy adverse^[25] and it would be an essential to prevent future complications among pregnant women particularly those with periodontitis.

Conclusion

The present study demonstrated that the strongest association was observed between maternal periodontal status with infant body size (length, and head and chest circumference). It is noteworthy that longitudinal studies are required to substantiate this association.

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References

- Gibbs RS, Romero R, Hillier SL, et al. A review of premature birth and subclinical infection. *Am J Obstet Gynecol.* 1992; 166(5):1515-28.
- Goldenberg RL, Hauth JC, Andrews WW. Intrauterine infection and preterm delivery. *N Engl J Med.* 2000;342(20): 1500-7.
- Page RC. The role of inflammatory mediators in the pathogenesis of periodontal disease. *J Periodontol Res.* 1991;26(3 pt 2):230-42.
- Hill GB, Eschenbach DA, Holmes KK. Bacteriology of the vagina. *Scand J Urol Nephrol Suppl.* 1984;86(1):23-39.
- Hillier SL, Nugent RP, Eschenbach DA, et al. Association between bacterial vaginosis and preterm delivery of a low birth-weight infant. The Vaginal Infections and Prematurity Study Group. *N Engl J Med.* 1995;333(26):1737-42.
- Offenbacher S, Katz V, Fertik G, et al. Periodontal infection as a possible risk factor for preterm low birth weight. *J Periodontol.* 1996;67(10 suppl):1103-13.
- Lopez NJ, Smith PC, Gutierrez J. Higher risk of preterm birth and low birth weight in women with periodontal disease. *J Dent Res.* 2002;81(1):58-63.
- Dasanayake AP. Poor periodontal health of the pregnant woman as a risk factor for low birth weight. *Ann Periodontol.* 1998;3(1):206-12.
- Jeffcoat MK, Geurs NC, Reddy MS, et al. Periodontal infection and preterm birth: results of a prospective study. *J Am Dent Assoc.* 2001;132(7):875-80.
- Offenbacher S, Lief S, Boggess KA, et al. Maternal periodontitis and prematurity. Part I. Obstetric outcome of prematurity and growth restriction. *Ann Periodontol.* 2001;6(1):164-74.
- Boggess KA, Lief S, Murtha AP, et al. Maternal periodontal disease is associated with an increased risk for preeclampsia. *Obstet Gynecol.* 2003; 101(2):227-31.
- Ayatollahi SM, Shahsawary S. Sizes at birth in Shiraz, Iran. *J Trop Pediatr.* 2002;48(4):245-7.
- Ainamo J, Bay I. Problems and proposals for recording gingivitis and plaque. *Int Den J.* 1975;25(4):229-35.
- Pitiphat W, Joshipura KJ, Gillman MW, et al. Maternal periodontitis and adverse pregnancy outcomes. *Community Dent Oral Epidemiol.* 2008;36(1):3-11.
- Marakoglu I, Kahraman UG, Marakoglu K, et al. Periodontitis as a risk factor for preterm low birth weight. *Yonsei Med J.* 2008;49(2):200-3.
- Siqueira FM, Cota LO, Costa JE, et al. Intrauterine growth restriction, low birth weight, and preterm birth: adverse pregnancy outcomes and their

- association with maternal periodontitis. *J Periodontol.* 2007;78(12):2266-76.
17. Collins JG, Windly HW, Arnold RR, et al. Effects of a Porphyro-monas gingivalis infection on inflammatory mediator response and pregnancy outcome in the hamster. *Infect Immun.* 1994;62(10): 4356-61.
 18. Offenbacher S, Lin YY, Boyd DL, et al. Actinobacillus actinomycetemcomitans infection associated with low birth weight. *J Dent Res.* 1993;72(Suppl):373.
 19. Radnai M, Gorzó I, Urbán E, et al. Possible association between mother's periodontal status and preterm delivery. *J Clin Periodontol.* 2006;33(11):791-6.
 20. Lanning JC, Hilbelink DR, Chen LT. Teratogenic effects of endotoxin in the golden hamster. *Teratoge, Carcinog Mutagen.* 1983; 3(2):145-9.
 21. Gazolla CM, Ribeiro A, Moyses MR, et al. Evaluation of the incidence of preterm low birth weight in patients undergoing periodontal therapy. *J Periodontol.* 2007;78(5):842-8.
 22. Vettore MV, Leal M, Leao AT, et al. The relationship between periodontitis and preterm low birthweight. *J Dent Res.* 2008;87(1):73-8.
 23. Beck J, Garcia R, Heiss G, et al. Periodental disease and cardiovascular disease. *J periodontol.* 1996;67(10 Suppl):1123-37.
 24. Agarwal S, Etzel KE, Suzuki JB, et al. Variability in the expression of inflammatory mediators in human monocytes. *J Dent Res.* 1993;72(Suppl): 373.
 25. Sadatmansouri S, Sedighpoor N, Aghaloo M. Effects of periodontal treatment phase I on birth term and birth weight. *J Indian Soc Pedod Prev Dent.* 2006; 24(1):23-6.

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