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ORIGINAL ARTICLE

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Oral health in women with pregnancy and delivery complications

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Abstract Oral health was retrospectively studied in 207 women (mean age 30 years) in the Helsinki Womens' Hospital with the hypothesis that women with pregnancy complications and/or delivery complications would present poorer dental status than women without complications. Computerized dental records of the City of Helsinki Health Department were used with decayed, missing, filled index (DMF) and community periodontal index (CPI) scoring systems and a summary dental health index (DHI) was constructed for statistics. In 72%, the delivery was uncomplicated, while 18% had Caesarean section. Of the women, 8% had gestational diabetes, 7.1% had gestational hypertension, and 1.8% had preeclampsia. Fifteen (6.6%) preterm babies were born; eight (3.5%) babies weighed <2.500 g, seven (3.2%) received a 1-min Apgar point <7 indicating less than satisfactory state of the newborn. DMF was 12.9±6.6 in women without complications compared to 15.3±6.7 in women with complications (n.s.). CPI values did not differ between the groups. The mean DHI values were 2.07 in women with normal pregnancy complications and no delivery complications, 2.23 in those with pregnancy complications, and 2.13 in those with delivery complications, respectively. In logistic regression analysis, no oral health parameters associated with any complications. Thus, this study failed to show an association between poor dental health and pregnancy or delivery complications.

Keywords Oral health · Periodontal disease · Pregnancy complications · Low-birth-weight babies · Preterm delivery

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Introduction

Periodontal disease may be an independent risk factor for pregnancy complications, preterm delivery, and low birth weight [14]. Postulated mechanisms include translocation of periodontal pathogens to the fetoplacental unit and action of a periodontal reservoir of lipopolysaccharides or inflammatory mediators [10, 11].

Offenbacher et al. [14], who were the first to suggest that poor oral health may cause pregnancy complications, further reported experiments from 48 case-control subjects where gingival crevicular fluid (GCF) levels of prostaglandin E-2 (PGE-2) and interleukin-1-beta (IL) were measured to determine whether mediator levels were related to pregnancy outcome. In addition, the levels of four periodontal pathogens were measured by using microbe-specific DNA probes. Results indicated that GCF PGE-2 levels were significantly higher in mothers who gave preterm delivery and had low-birth-weight babies, as compared with controls. Furthermore, within primiparous preterm low-birth-weight mothers, there was a significant inverse association between birth weight, gestational age, and GCF PGE-2 levels. Microbial data indicated that four organisms associated with mature plaque and progressing periodontitis, namely, *Bacteroides forsythus (*new name is *Tannerella forsythensis)*, *Porphyromonas gingivalis*, *Actinobacillus actinomycetemcomitans*, and *Treponema denticola,* which were detected at higher levels in the preterm low-birth-weight mothers, as compared to controls [15]. Other studies have later been

published on this issue and some results, but not all, seem to support the original hypothesis [2, 9, 17]. Davenport et al. [3] failed to show any association between preterm low birth weight and periodontal disease in a case-control study comprising 236 cases and 507 controls.

Fusobacterium nucleatum and *Streptococcus* spp. of possible oral origin have been detected in the amniotic fluid, but the PGE-2 and cytokine levels in the amniotic fluid were not significantly different between women with or without signs of infection [1]. *F. nucleatum,* a common oral species, is the most frequently isolated species from amniotic fluid cultures among women with preterm labor and intact membranes. The isolation of *F. nucleatum*, *Capnocytophaga*, and other oral species from amniotic fluid has been suggested to support a possible oral–hematogenous route which may lead to infection and subsequent preterm birth [5].

The present study was made to investigate retrospectively if a statistical association can be seen between recorded oral health variables and outcome of pregnancy in a material comprising all women who in 1998–99 had given birth at the Women's Hospital of the Helsinki University Central Hospital, Helsinki, and whose dental records could be found at the data base of the Health Department of the City of Helsinki. The study hypothesis was based on what Offenbacher et al. [14] presented in 1996.

Materials and methods

The patients

Medical records and maternity charts were studied of all the women who had given birth in 1998–1999 at the Women's Hospital of the Helsinki University Central Hospital, Finland, and whose dental records were available at the City of Helsinki Health Department. Pregnant women in Finland are offered free dental examination by the community when they attend the maternity health centers for a compulsory medical examination. This, in turn, is a prerequisite for maternity allowance money paid by the state. All medical and dental records were received as computer files. The study protocol had been approved by the Ethics Committee of the Health Department.

Women who were hepatitis B or hepatitis C positive and/or infected by the human immunodeficiency virus were excluded. Altogether, data from 224 women fulfilled the inclusion criteria; two of them gave birth to twins, so they were removed from the data. According to the records and maternity charts, 68 women had given birth in 1998, 141 in 1999, while 17 women also included had given birth just after the new year in 2000. The mean age was 30 years (range 17–43 years) and 10% had reported smoking during pregnancy.

Women with risk factors for gestational diabetes mellitus (BMI >27 kg/m^2, age >40 years, previous child >4,500 g), previous gestational diabetes, glucosuria, macrosomia in current pregnancy underwent a 75 g oral glucose tolerance test (OGTT). A positive OGTT was defined as venous plasma glucose concentration of ≥4.8 mmol/l for fasting, ≥10.0 for 1 h or ≥8.7 for 2 h. A patient was considered having gestational diabetes when two or three of the OGTT values are at or above these thresholds [8].

Gestational hypertension was defined as elevated blood pressure (BP ≥140/90 mmHg) measured at least twice (>6 h apart) after 20th gestational weeks. Preeclampsia was defined as gestational hypertension with proteinuria (positive Albustix or total diurnal proteinuria of 0.3 g or more) [13].

The number of preterm deliveries (at or before the 37th gestational week) and low-birth-weight babies (<2,500 g) had been recorded together with medical and obstetric observations during the pregnancy or at the delivery. Five-minute Apgar points were routinely recorded. Apgar below seven indicates a less than satisfactory clinical state of the newborn.

Dental records

By definition, all the mothers included in the study had visited a community dental clinic for routine check-up during the first trimester of their pregnancy. However, dental charts were available for only 207 women of the 224 originally included. The City of Helsinki Health Department uses WHO criteria for dental records, such as the decayed, missing, filled index (DMF), while the periodontal examination is based on the community periodontal index of treatment needs (CPI). The women had been examined by different dentists at the community health centers, which were usually located close to the area of residence of the patient. No calibration of the examining dentists was possible due to the nature of this study. The oral health data were thus based on existing, computerized dental charts.

Table 1 Characteristics of the women and newborn (*n*=207)

	Mean	SD
Mothers		
Weight of the woman in first trimester (kg)	63	11
Height (cm)	166	6
Weight gain (kg)	14	5
Body mass index	23	4
Duration of pregnancy		
week	40	2
days	281	12
Babies		
Apgar points	8.7	0.8
Birth weight (g)	3516	521
Expected birth weight (g)	3570	286
Length (cm)	50	2

Table 2 Dental health parameters in the women with or without complications

Dental health parameter	Normal pregnancy group (*n*=158)	Pregnancy complication group (*n*=31)	Delivery complication group (*n*=18)	Pregnancy and/or delivery complication group (*n*=49)
DMF[a] mean (SD)	13.4 (6.4)	15.3 (6.7)	15.7 (7.0)	15.2 (6.7)
DMF index ≥20	29 (19%)	10 (32%)	5 (31%)	13 (31%)
CPI[b] = 0	18 (11%)	4 (12%)	1 (6%)	5 (11%)
CPI = 1	24 (15%)	10 (30%)	3 (19%)	12 (27%)
CPI = 2	104 (66%)	16 (49%)	11 (69%)	23 (52%)
CPI = 3	12 (8%)	3 (9%)	1 (6%)	4 (9%)
Other oral infection such as third molar pericoronitis	14 (8%)	3 (8%)	2 (10%)	4 (8%)

[a]Decayed, missing, filled teeth index
[b]Maximum score of the community periodontal index for treatment needs

Statistical methods

Medical and dental data were analyzed with Mann–Whitney U tests, chi-square tests, and logistic regression analyses. In addition to the clinically recorded dental indexes used in the analyses, CPI, DMF, and occurrence of pericoronitis were used in constructing a summary dental health index (DHI) as follows: CPI score 0 = 0, CPI score 1–2 = 2, CPI score 3 = 2; tertiles of DMF values of the whole material were used, respectively, so that DMF ≤10 = 0, 11≤ DMF ≤16 = 1, and DMF ≥17 = 2; and no pericoronitis = 0, pericoronitis present = 2. The maximum DHI score would thus be 6.

In the sequential logistic regression model, pregnancy complications (gestational hypertension and/or preterm delivery <37th gestational week or birth weight <2,500 g), delivery complications, or both were dependent variables. Oral health index values were the predictor variables. The effects of smoking and maternal age were controlled for. In all analyses, $p<0.05$ was the criterion of statistical significance.

Results

Of the women, 75% were healthy, while 8% had diabetes. Thirteen women (6%) used labetalol (100–200 mg daily) for high blood pressure; five women (2%) used thyroxin medication for hypothyreosis. Primiparous pregnancies were recorded in 51% of the cases. In 73% of all cases, the delivery had been normal vaginal delivery, 9% assisted delivery, while in 18% a caesarean section had been made. All babies born were alive (Table 1).

Pregnancy and delivery complications

In 31 cases of the 207 women pregnancy complications had been recorded (14.9%), while in 18 cases (8.6%) the delivery was complicated. In 44 cases (21.2%), either pregnancy or delivery complications had been recorded (Table 2). Gestational hypertension was recorded in 7.1% and preeclampsia in 1.8%. Fifteen babies were born preterm, before the 37th gestational week. Reasons for

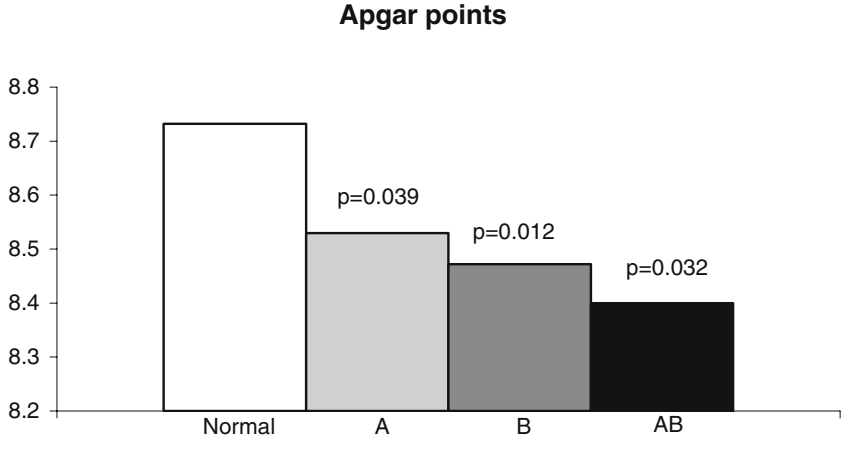

Fig. 1 Distribution of mean Apgar points of newborn of women with normal pregnancy and normal delivery, of those with pregnancy complications (**a**), delivery complications (**b**), and women with either or both the complications (**ab**)

Table 3 Associations of health parameters with pregnancy and delivery complications

Parameter	Pregnancy complication group OR (CI)	Delivery complication group OR (CI)	Pregnancy and/or delivery complication group OR (CI)
BMI[a]	1.020 (0.906–1.150)	1.007 (0.869–1.167)	0.989 (0.893–1.096)
Gestational weight gain	0.909 (0.819–1.009)	1.043 (0.927–1.174)	0.950 (0.873–1.032)
CPI[b]-score 1–3	0.542 (0.155–1.900)	1.826 (0.206–16.193)	0.652 (0.206–2.061)
DS[c] index score	1.067 (0.860–1.324)	1.298 (0.923–1.826)	1.263 (0.977–1.632)
DMF[d] index score	1.021 (0.932–1.118)	1.045 (0.929–1.176)	1.012 (0.937–1.094)
Age	0.977 (0.875–1.092)	1.039 (0.900–1.200)	1.054 (0.956–1.163)

Odds ratios (OR) with 95% confidence interval (CI). No significant associations were found in the logistic regression analysis
[a]BMI = Body mass index
[b]CPI = Community periodontal index for treatment needs
[c]DS = Decayed tooth surface index
[d]DMF = Decayed, missing, filled teeth index

preterm delivery were loss of amniotic fluid or cervix insufficiency. Of the preterm women, 8% had preeclampsia. Eight low-birth-weight babies were born (birth weight <2,500 g). The distribution of Apgar points in the groups of women with or without complications is given in Fig. 1. As expected, babies of women with no complications had significantly higher Apgar points than newborn from the groups with complications. In women with no complications, the mean Apgar points was 8.7±0.8 compared with 8.5±0.9 in women with pregnancy complication (p=0.039), 8.5±1.0 in those with delivery complication (p=0.012), and 8.4±0.9 in those with either pregnancy or delivery complication (p=0.032).

Oral health findings

On average, the pregnant women had only one caries lesion in need of restoration albeit the range in this respect was 0–21. In 39% of the total material, less than three carious lesions had been recorded. The mean DMF index score was 13.4±6.4 in women without complications in comparison to 15.3±6.7 in women with pregnancy complications, and 15.7±7.0 in women with delivery complications. The mean DMF score was 15.2±6.7 in women with either pregnancy or delivery complications. Also, the percentage of high DMF scores (≥20) did not differ between the groups. (Table 2). There was neither any difference between the groups in the number of recorded signs of other dental infections, including pericoronitis and periodontal treatment need.

Results of the logistic regression analysis

Sequential logistic regression model was constructed for each complication type. After controlling for the effects of maternal age and smoking, the second block predictor variables, including the oral health index values, failed to show any statistically significant results in the models (Table 3). Nevertheless, a trend could be seen showing higher DHI scores in women with complications in comparison to healthy mothers with normal delivery. The results are given in Fig. 2.

Discussion

Poor dental health characteristics can be regarded as surrogate markers for lifestyle factors but they may also reflect past dental infections. Thus, our results do not necessarily upset the infection hypothesis, although this study failed to show a significant association between the mothers' oral health parameters and frequency of the

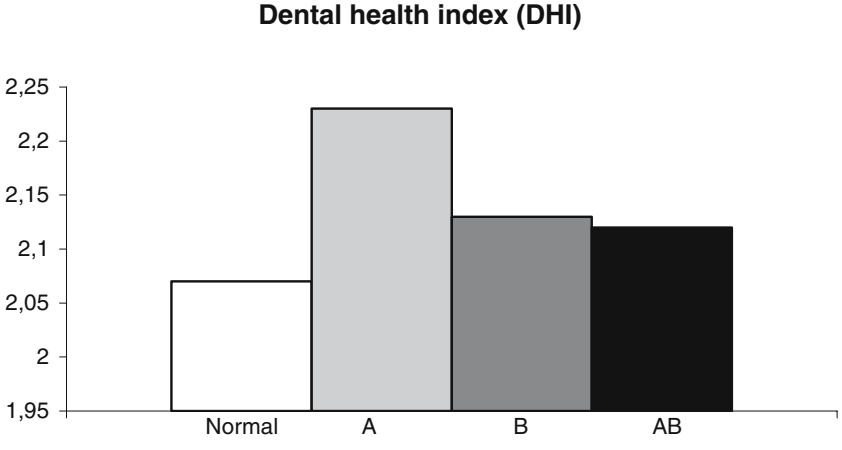

Fig. 2 Mean dental health index (DHI) in women with normal pregnancy and normal delivery, of those with pregnancy complications (**a**), delivery complications (**b**), and women with either or both of the complications (**ab**). The differences between groups were statistically not significant. See "Materials and methods" for explanation of the DHI

studied pregnancy complications. It was interesting, though, to observe the trend in DHI scores in this respect between women with or without complications. The validity of a corresponding index which summarizes the overall oral health characteristics has been recently discussed by our group [6].

The mean age of the women who gave birth was fairly high (30 years) regarding that 51% of them were primiparas. On the whole, the material did not differ from what is seen in our hospital and can thus be regarded representative. Dental health of the women, however, was good because the treatment need both with respect to restorations and periodontal disease was low. No deep periodontal pockets had been recorded and on average, only one tooth per subject had been assessed to call for treatment. The maximum CPI score in this material was 3 indicating that there were no deep periodontal pockets exceeding >5 mm. The use of CPI may be criticized because this epidemiological index does not provide information on disease severity. Due to the nature of the present study, however, no other periodontal records were available. Pericoronitis, on the other hand, was included in the analyses as representing true infection burden at the time of examination [12] but the number of cases with this infection was low (Table 2). In general, our population was of good oral health representing, thus, a low-risk population regarding oral diseases.

The study was retrospective and based on patient charts only, which is the weakness of this investigation. Because the catchment area was the whole City of Helsinki, however, the material can still be regarded as representative. The City of Helsinki Department uses computerized dental recording system and the dentists' perception of the diagnostic criteria and clinical decision making has been shown to vary between 77 to 82% [4]. All dental examinations had been carried out during the first trimester.

As said earlier, by Offenbacher et al. [16] the antepartum maternal periodontal disease and its progression may be a risk of preterm delivery and low birth weight with odds ratios of the magnitude of 7.9 in African-American women. However, in the studies by Dasanayake et al. [2], investigating immigrant population in East London, no such association was observed. Of other groups, Lopez et al. [9] investigated whether the maintenance of the mothers' periodontal health after 28-week gestation reduces the risk of preterm low-birth-weight babies. The incidence of the pregnancy complications was 2.5% in periodontally healthy women, and 8.6% in women with periodontal disease relative risk 3.5, 95% CI 1.7–7.3). Similarly, Jeffcoat et al. [7] observed in their intervention study that scaling and root planning appeared to reduce the risk of preterm delivery albeit not significantly. Offenbacher et al. [16] observed a decrease in the average newborn's weight and gestational age as the mother's level of periodontal disease increased. Correlation analysis demonstrated a highly significant clinical relationship between more severe periodontal disease and lower birth weight (r=−0.49; p<0.01). A highly significant relationship was also clinically demonstrated between increasing severity of periodontal disease and decreasing gestational age of the newborn babies (r=−0.59; p<0.01). It is, thus, possible that the eventual association between oral health parameters and pregnancy outcome differs between different populations.

Our sample represented the fairly well-to-do all-Caucasian women in Helsinki. The frequency of pregnancy and delivery complications observed in our study sample corresponds to their general prevalence figures in our hospital; thus the study sample is valid example of a population with low frequency of dental disease. When reflecting the cited literature on the results of the present study, we need to reemphasize that in our material, the number of mothers with actual periodontal treatment need was low which fact might reduce the power of our study. Less than 10% of the women had presented with 4–5 mm deep periodontal pockets (CPI score 3) and no one had severe periodontitis. It also needs to be emphasized that all the mothers in the present study had received subsidized dental care with focus on preventive care at the community health centers.

Preterm delivery of low-birth-weight infants remain a significant public health issue and a leading cause of neonatal death and long-term neuro-developmental disturbances and health problems. Therefore, investigating the possible associations between the highly prevalent dental diseases and pregnancy or delivery complications is of importance. However, noncausal explanations for the correlation between periodontitis and preterm low birth weight or delivery complications can also be offered. There may be, for example, common lifestyle or other factors not yet identified. Prospective studies, and eventually interventional studies, will be necessary before dental infections such as periodontitis can be considered as causal factors in this respect [11].

Conclusion

In the present study of Caucasian Finnish women, no statistically significant association was found between dental health indexes and preterm birth or low-birth-weight babies, or with delivery complications.

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