Original Article

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Quick Response Code:

Website: www.pogsjournal.org

DOI: 10.4103/pjog.pjog_47_22

Oral health is overall health: Association of maternal periodontal disease with preterm birth, a case–control study

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Abstract:

BACKGROUND: When it comes to health, the most overlooked aspect of health in the Philippines is oral health. Numerous studies have reported the possible association of maternal periodontal diseases with preterm birth (PTB). However, their association remains controversial. To our knowledge, this is the first local study to describe the prevalence of periodontal disease in pregnant women and its association with PTB.

OBJECTIVE: This study aims to determine the association between PTB and maternal periodontal disease.

MATERIALS AND METHODS: PTB or cases (n = 28) included subjects who had spontaneous labor or rupture of membrane and delivered before 37 weeks of gestation. Full-term birth or controls were normal births at or after 37 weeks of gestation (n = 28). Sociodemographic and health-related characteristics were obtained through interviews and medical records. Full-mouth periodontal examination was performed on all mothers within 2 days of delivery. Three indices were utilized to assess periodontal diseases– oral hygiene index Simplified, Modified Gingival Index and Lindhe Classification of Tooth Mobility. The number of missing teeth and the presence of dental caries, pus, and calcular deposits were likewise noted.

RESULTS: Majority of the subjects had poor oral health care - 94.6% visit the dentist only as needed and 53.7% cannot recall their last dental consult. The multivariate logistic regression model, after controlling for other risk factors, demonstrated that gingivitis is a risk factor for PTB (P = 0.0057) with an odds ratio of 20.25. The presence of dental caries is another risk factor (P = 0232).

CONCLUSION: With the findings of gingivitis and the presence of dental caries having a significant association with PTB, we recommend a review of current antepartum practice guidelines to include preventive dental care as part of routine prenatal care.

Keywords:

Periodontal disease, pregnancy, preterm birth, risk factors

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Submitted: 05-Nov-2022
Revised: 05-Nov-2022
Accepted: 05-Nov-2022
Published: 27-Dec-2022

Introduction

When it comes to health, the most overlooked aspect in the Philippines is oral health. According to the Department of Health – National Monitoring and Evaluation Dental Survey, in 2011, 87% of Filipinos have dental caries and 48.3% have periodontal diseases. Statistics show that 77% of Filipinos have never been to a dentist. Although preventable, oral diseases affect almost every Filipino.[1,2]

Worldwide, about 50% of pregnant women have gingival disease.[3] In the Philippines, however, data on the periodontal health of pregnant women are limited.

Numerous studies have reported the possible association of maternal periodontal

*Third Place, 2022 PHILIPPINE OBSTETRICAL AND GYNECOLOGICAL SOCIETY (Foundation), INC., Annual Research Paper Contest, October 21, 2022, Online Platform: ZOOM Webinar.

How to cite this article: Festejo BL, Bandola MR, Estrada ML. Oral health is overall health: Association of maternal periodontal disease with preterm birth, a case–control study. Philipp J Obstet Gynecol 2022;46:249-57.

diseases with adverse pregnancy outcomes, particularly preterm birth (PTB). However, their association remains controversial because of various clinical parameters of adverse pregnancy outcomes and periodontitis assessment and the heterogeneity of enrolling subjects.[4]

Given the global disease burden of both periodontal diseases and PTB, a better understanding of their relationship and potential effectiveness of preventive and therapeutic interventions, are clearly needed in order to provide recommendations for clinical practice as well as guide future research into their possible underlying mechanisms. To our knowledge, this is the first local study to describe the prevalence of periodontal disease in pregnant women and its association with PTB.

Review of related literature

Preterm birth

The World Health Organization defines PTB as births before 37 weeks of gestation. Globally, there are an estimated 15 million PTB s yearly. Consequently, there are approximately 1 million deaths due to its complications.[5] Prematurity is the leading cause of death in children under the age of 5 years.[6]

The Philippines ranks 8th among the top 10 countries with the highest numbers of PTB s. The Philippine Obstetrics and Gynecology Society has gathered data from its training institutions from 2014 to 2018, and it showed that the prevalence of preterm live birth rate in the Philippines ranges from 32.22% to 95.68%. While the preterm neonatal death rate is between 27.13% and 73.78%.[7]

Periodontal disease

Periodontal disease is a chronic bacterial infection that targets the structures supporting the teeth.[8] Gingivitis manifests as swelling of the gums. Periodontitis is the severe form and induces inflammation in the gingival epithelium, periodontal membrane, dental cement, and alveolar bone. Ultimately, the loss of these connective tissues and bone could lead to tooth loss.[4]

Periodontal disease is a global public health issue with a prevalence between 10% and 90%, depending on the population studied and the diagnostic criteria used.[9-11] In pregnant women, the prevalence is 5%–50%, and the rate is higher among minorities and women of low socioeconomic status.[11-13] Data on the prevalence of oral diseases in pregnant women in the Philippines, however, are limited.

Periodontal diseases and preterm birth

Although periodontal diseases are localized to the periodontal tissues, it has been reported to have a role in systemic conditions and chronic diseases.[9,14] There are two theories on the biological plausibility of this association. First is the direct pathway wherein the periodontal bacteria and/or their pathogenic products disseminate to the fetoplacental unit. Second is the indirect pathway wherein inflammatory cytokines and mediators produced at the gingival level enter the blood circulation and reach either the fetoplacental unit or the liver [Figure 1].[4,15-17]

At present, various studies suggested the association of maternal periodontal diseases with adverse pregnancy outcomes, not only PTB but also fetal growth restriction, low birth weight, preeclampsia, and gestational diabetes mellitus.[4,13]

Currently, the relationship between periodontitis and PTB is still controversial. Some researches concluded that periodontitis is a risk factor for PTB. In a meta-analytic review of 17 studies by Vergnes and Sixou, periodontal disease was associated with PTB, with odds ratio (OR) of 2.83 (95% confidence interval [CI]: 1.95–4.10, $P < 0.0001$).[18] The same association was seen in a meta-analysis of 40 articles by Khader and Ta'ani, which showed that pregnant women with periodontal disease had a risk of PTB 4.28 (95% CI: 2.62–6.99; $P < 0.005$) times that risk for healthy controls.[19]

These epidemiological studies have led to randomized controlled trials assessing outcomes of pregnancy with periodontal treatment. In a meta-analysis of randomized trials by George *et al.*, it was found that periodontal

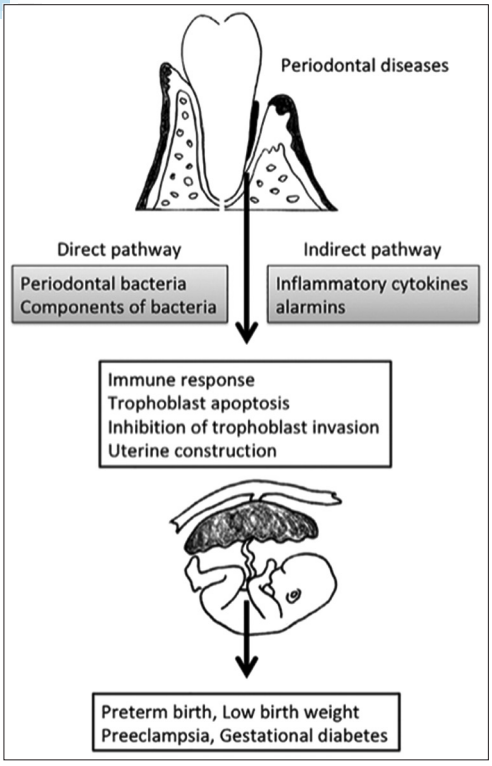

Figure 1: Potential biological mechanism of periodontal disease inducing adverse pregnancy outcome

treatment significantly lowered PTB (OR: 0.65; 95% CI: 0.45–0.93; $P = 0.02$).[20] The same association was found in the meta-analysis of Polyzos *et al.*, and their study concluded that periodontal treatment resulted in significantly lower PTB (OR: 0.55; 95% CI: 0.35–0.86; $P = 0.008$). The subgroup analysis of the same study suggested a significant effect of treatment in the absence of a history of PTB or low birth weight (OR: 0.48; 95% CI: 0.29–0.77; $P = 0.003$) and less severe periodontal disease as defined by probing depth (OR: 0.49; 95% CI: 0.28–0.87; $P = 0.014$) or bleeding on probing site (OR: 0.37; 95% CI: 0.14–0.95; $P = 0.04$).[13]

Several studies, on the other hand, have shown no relationship between periodontal diseases and adverse pregnancy outcomes. In the meta-analysis of 10 articles by Fogacci *et al.*, they concluded that periodontal treatment was not associated with a reduction of PTB incidences.[21] According to Bassani *et al.*, in their case–control study, the OR for periodontitis was not significant OR: 0.92 (95% CI: 0.54–1.57) for preterm low birth weight.[22] Similarly, Lunardelli and Peres, in their population-based study, reported that periodontal pocket was not associated with low birth weight and/or PTB.[23] Abati *et al.*, in their multicentric epidemiologic study. Also reported that periodontitis and adverse pregnancy outcome have no significant association.[24]

Objectives of the study

The general objective of the study was to determine the association between PTB and maternal periodontal disease.

The specific objectives of the study were:

1. To compare the sociodemographic characteristics of the participants, particularly age, educational attainment, marital status, occupation, and gross family income
2. To compare the health-related characteristics of the participants, particularly comorbidities, frequency of prenatal consult, history of smoking and or alcohol consumption, nutritional status, and frequency of dental visits
3. To describe the severity of maternal periodontal disease using different periodontal indices, including the Oral Hygiene Index (OHI), Lindhe Classification of Tooth Mobility, and Modified Gingival Index (MGI)
4. To determine the association of maternal periodontal disease and PTB.

Materials and Methods

Sample size

At a 95% two-sided confidence level and 90% power of the test, with a 1:1 ratio of cases to controls, the minimum sample size needed to test for correlation is at least 56 women. This is based on the results of the study of Bosnjak *et al*., that demonstrated periodontal disease as an independent risk factor for PTB, with an adjusted OR of 8.13 for the PTB group.[25]

Study design

The design and methods of this study have been approved by the Research Ethics Board of the institution. This is a case–control study that included consenting pregnant women admitted for labor and delivery at the maternity unit of a tertiary hospital. Purposive sampling was employed to recruit participants who fit the inclusion criteria. The study lasted from January 2021 to January 2022.

Study population

The study population had a total of 56 participants. The case/PTB group PTB consisted of subjects who had spontaneous labor or rupture of membrane and delivered before 37 weeks of gestation. The control/full-term birth (FTB) group are subjects who had delivery after 37 weeks of gestation.

Participants included pregnant women with the following criteria: (1) Singleton pregnancy, (2) At least 18 years old; (3) Gestational age between 28 and 42 weeks, (4) Could write and communicate in Filipino and/or English.

Exclusion criteria were as follows: (1) Multifetal gestation, (2) Women with a history of previous preterm delivery, (3) Women with identified systemic infection apart from periodontitis, (4) Women who had medically indicated PTB, and (5) Those who lack the number of teeth necessary to perform the full-mouth periodontal examination [Figure 2].

Demographic data, such as age, marital status, educational level, and detailed data about the pregnancy, were recorded from their medical records. Medical, obstetrical, and social history were gathered in an interview with every subject.

Clinical examination

A full-mouth periodontal examination was performed on all subjects within 2 days of delivery. The evaluation was done by an experienced dentist from the hospital's dentistry department. The examination was done at the bedside with women either in a supine or sitting position and lasted for 0.5–1 h. Three indices to assess periodontal diseases were utilized – OHI-Simplified (OHI-S) [Table 1], MGI [Table 4], and Lindhe Classification of Tooth Mobility [Table 5]. The number of missing teeth and the presence of dental caries, pus, and calcular deposits were also noted.

Data analysis

Data were analyzed using MedCalc Software Version 20.014 (MedCalc Software Ltd, Ostend, Belgium).

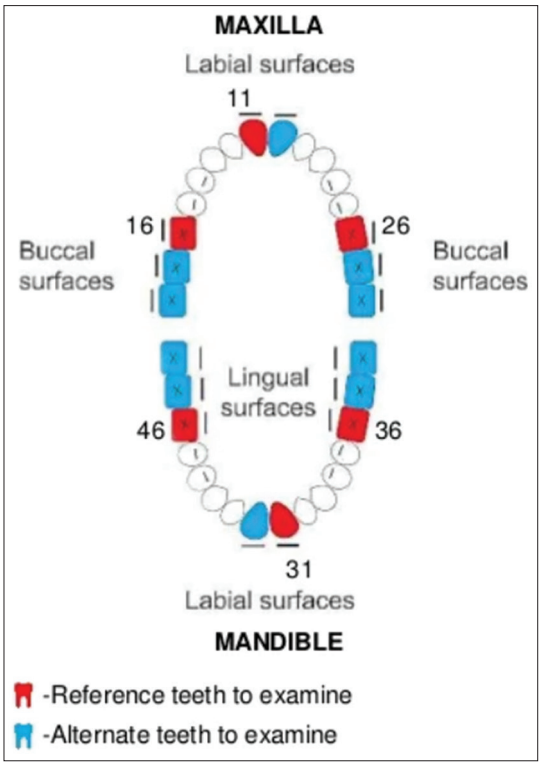

Figure 2: Reference teeth for examination

Descriptive statistics were summarized using mean and standard deviation for continuous variables, while frequency and proportions were used for categorical variables. Chi-square/Fisher's exact test was also utilized in comparing the control and case group, while logistic regression for variables, when applicable, was applied to provide OR. $P < 0.05$ (two-tailed) was considered statistically significant.

Results

Demographic data are shown in Table 6. Fifty-six women were divided based on their age of gestation into the PTB group and the FTB group. The mean maternal age in the PTB group was 29.0 ± 7.0 years, and 28.8 ± 4.7 in the FTB. Majority of the participants are single (71.4% vs. 28.6%) and multigravid (78.6% vs. 12.4%). Majority of them reached college level and/or college graduates (46.4%). There were more unemployed subjects in the PTB group (78.6% vs. 60.7%). Most had a monthly income of < 10,000 (58.9%).

Pregnancy variables are shown in Table 7. Majority of the subjects had no known comorbidities (69.6%). Personal and social history, including smoking, alcohol consumption, and drug use, did not differ between the groups (17.9% vs. 17.9%, 28.6% vs. 17.9% and 0%, respectively). More patients who delivered term had >4 prenatal consults (89.3% vs. 75.0%). In terms of maternal weight, more patients under the PTB had normal body mass index (BMI) (28.6% vs. 50.0%), while more patients under the FTB were overweight and obese (71.4% vs. 50%). The mode of delivery of subjects was mostly cesarean section (67.9% vs. 53.6%).

In terms of frequency of dental visits, majority of subjects reported as needed dental consults at 94.6% ($P = 0.5564$). More subjects in the PTB group had their last dental visit more than 5 years ago and/or could not recall when they last had their consult (64.3% vs. 42.9%, $P = 0.2019$). During the duration of the subjects' pregnancy, 53.6% had dental complaints, including but not limited to toothache and tooth mobility.

The subjects' dental information are presented in Table 8. Based on the OHI-S, the oral hygiene of subjects was as

Table 1: Oral hygiene index, simplified

Oral hygiene classification	OHI-S score
Good	0.0-1.2
Fair	1.3-3.0
Poor	3.1-6.0

OHI-S=Debris index + calculus index. OHI-S: Oral hygiene index, simplified

Table 2: Debris index

0 - Soft debris covering not >1/3 of the tooth surface
1 - Soft debris covering >1/3 but not >2/3 of the exposed tooth surface
2 - Soft debris covering >2/3 of the exposed tooth surface
3 - Soft debris covering not >1/3 of the tooth surface

Debris index=Total debris score/number of segments scored

Table 3: Calculus index

0 - No calculus present
1 - Supragingival calculus covering not >1/3 of the exposed tooth surface
2 - Supragingival calculus covering >1/3 but not >2/3 of the exposed tooth surface or the presence of individual flecks of subgingival calculus around the cervical portion of the tooth or both
3 - Supragingival calculus covering >2/3 the exposed tooth surface or a continuous heavy band of subgingival calculus around the cervical portion of tooth or both

Calculus index=Total calculus score/number of segments scored

Table 4: Modified gingival index

0 - Normal, absence of inflammation
1 - Mild inflammation, slight change in color, little change in the texture of any portion of the gingival unit
2 - Mild inflammation of the entire gingival unit
3 - Moderate inflammation, moderate glazing, redness, edema, or hypertrophy of the gingival unit
4 - Severe inflammation, marked redness, and edema/hypertrophy, spontaneous bleeding or ulceration of the entire gingival unit

Table 5: Lindhe classification of tooth mobility

0 - Physiologic mobility
1 - Movability of crown of tooth <1 mm in horizontal direction
2 - Movability of crown of tooth >1 mm in horizontal direction
3 - Movability of crown of tooth in vertical direction as well

Table 6: Demographic variables between full-term birth and preterm birth groups

	All (*n*=56), *n* (%)	FTB (*n*=28), *n* (%)	PTB (*n*=28), *n* (%)	*P*
Age (years), mean±SD	28.9±5.9	28.8±4.7	29.0±7.0	0.8751
<20	4 (7.1)	2 (7.1)	2 (7.1)	0.1171
20-25	14 (25.0)	5 (17.9)	9 (32.1)	
26-30	15 (26.8)	10 (35.7)	5 (17.9)	
31-35	16 (28.6)	10 (35.7)	6 (21.4)	
>36	7 (12.5)	1 (3.6)	6 (21.4)	
Civil status				
Single	40 (71.4)	20 (71.4)	20 (71.4)	1.0000
Married	16 (28.6)	8 (28.6)	8 (28.6)	
Widow		0	0	
Obstetric score				
Primigravid	12 (12.4)	3 (10.7)	9 (32.1)	0.1011
Multigravid	44 (78.6)	25 (89.3)	19 (67.9)	
Age of gestation (weeks)				
Extreme preterm <28	1 (1.8)	0	1 (3.6)	0.0001
Very early preterm 28-30 6/7	3 (5.4)	0	3 (10.7)	
Early preterm 31-33 6/7	11 (19.6)	0	11 (39.3)	
Late preterm 34-36 6/7	14 (25.0)	1 (3.6)	13 (46.4)	
Early term-37-38 6/7	23 (41.1)	23 (82.1)	0	
Full term-39-40 6/7	3 (5.4)	3 (10.7)	0	
Late term-41-41 6/7	1 (1.8)	1 (3.6)	0	
Postterm 42 and beyond	0	0		
Educational attainment				
Grade school level	0	0	0	0.2575
Grade school graduate	1 (1.8)	0	1 (3.6)	
High school level	8 (14.3)	4 (14.3)	4 (14.3)	
High school graduate	16 (28.6)	7 (25.0)	9 (32.1)	
College level	14 (25.0)	6 (21.4)	8 (28.6)	
College graduate	12 (21.4)	6 (21.4)	6 (21.4)	
Vocational	5 (8.9)	5 (17.9)	0	
Occupation				
Unemployed	22 (69.6)	17 (60.7)	22 (78.6)	0.3261
Employed	11 (19.6)	7 (25.0)	4 (14.3)	
Self-employed	2 (3.6)	2 (7.1)	0	
Student	4 (7.1)	2 (7.1)	2 (7.1)	
Monthly income				
<10,000	33 (58.9)	16 (57.1)	17 (60.7)	0.3575
10, 000-20,000	20 (35.7)	9 (32.1)	11 (39.3)	
20,000-30,000	2 (3.6)	2 (7.1)	0	
30,000-40,000	1 (1.8)	1 (3.6)	0	
>50,000	0	0	0	

SD: Standard deviation, FTB: Full-term birth, PTB: Preterm birth

follows: poor (42.9% vs. 46.4%), fair (46.4% vs. 53.6%), and good (10.7% vs. 0%). Moreover, patients with missing teeth were higher in the PTB (85.7% vs. 82.1%, $P = 0.7164$) with an average of 6.8 versus 4.33 in the FTB group ($P = 0.1043$). All subjects under the PTB group had dental caries, while only 78.6% in the FTB had the same findings ($P = 0.0232$). The average number of teeth with caries was higher in the PTB group (4.0 vs. 5.2). In terms of tooth mobility, only 17.9% had mobile teeth, and of this, the mobility was classified as physiologic (80.4%). Based on the MGI, more subjects under the FTB had normal gingival status (42.9% vs. 3.65%), while more subjects in the PTB had gingivitis (57.1% vs. 96.4%, $P = 0.0057$). The severity of gingivitis in the PTB group was as follows-mild (3.6% vs. 14.3%), moderate (50% vs. 57.1%), and severe (3.6% vs. 3.6%). Pus and calcular deposits were noted in more subjects under the FTB group (53.6% vs. 32.1% and 67.9% vs. 57.1%; $P = 0.1083$ and $P = 0.4089$).

Discussion

The average age of women who delivered preterm is 29.0 ± 7.0. This average age is slightly older than the findings of Bosˇnjak *et al* in their study in Croatia and Ramo´n *et al* in their study in Spain at 27.3 ± 2.1 and

Table 7: Pregnancy variables between full-term birth and preterm birth groups

	All (*n*=56), *n* (%)	FTB (*n*=28), *n* (%)	PTB (*n*=28), *n* (%)	*P*
Comorbidities				
Without comorbidities	39 (69.6)	18 (64.3)	21 (75.0)	0.3876
With comorbidities	17 (30.4)	10 (35.7)	7 (25.0)	
Gestational hypertension	5 (8.9)	2 (7.1)	3 (10.7)	1.0000
Gestational diabetes mellitus	4 (7.1)	1 (3.6)	3 (10.7)	0.6110
Thyroid disorder	4 (7.1)	3 (10.7)	1 (3.6)	0.6110
Asthma	1 (1.8)	1 (3.6)	0	1.0000
Rheumatic heart fever	1 (1.8)	1 (3.6)	0	1.0000
Rheumatoid arthritis	1 (1.8)	1 (3.6)	0	1.0000
Hypertension + diabetes	9 (16.1)	3 (10.7)	6 (21.4)	0.4688
Vices				
History of smoking	10 (17.9)	5 (17.9)	5 (17.9)	1.0000
History of alcohol consumption	13 (23.2)	8 (28.6)	5 (17.9)	0.3467
History of illicit drug use	0	0	0	-
Number of antenatal visits				
≤4	10 (17.9)	3 (10.7)	7 (25.0)	0.1865
>4	46 (82.1)	25 (89.3)	21 (75.0)	
Mode of delivery				
Vaginal delivery	22 (39.3)	9 (32.1)	13 (46.4)	0.4121
Cesarean section	34 (60.7)	19 (67.9)	15 (53.6)	
Maternal weight				
Underweight	0	0	0	0.1712
Normal	22 (39.3)	8 (28.6)	14 (50.0)	
Overweight	10 (17.9)	4 (14.3)	6 (21.4)	
Obese I	14 (25.0)	10 (35.7)	4 (14.3)	
Obese II	10 (17.9)	6 (21.4)	4 (14.3)	
Frequency of dental visits				
As needed	53 (94.6)	26 (92.9)	27 (96.4)	0.5564
Yearly	3 (5.4)	2 (7.1)	1 (3.6)	
Last dental visit (a year ago)				
<1	8 (14.3)	4 (14.3)	4 (14.3)	0.2019
1-5	18 (32.1)	12 (42.9)	6 (21.4)	
Cannot recall or >5	30 (53.7)	12 (42.9)	18 (64.3)	
Dental complaints during pregnancy				
No	26 (46.4)	13 (46.4)	13 (46.4)	1.000
Yes	30 (53.6)	15 (53.6)	15 (53.6)	

FTB: Full-term birth, PTB: Preterm birth

28.0, respectively.[25,26] There is no statistically significant association of preterm birth with maternal age in published literature as well as in this study ($p = 0.8751$). In terms of socioeconomic status, majority of the participants were unemployed with a monthly income of <10,000. There were more unemployed patients in the PTB group but it is not statistically significant (78.6% vs. 60.7%; $P = 0.3261$). This is consistent with the findings of Torresyap *et al*., in 2014, that concluded that financial reasons were the main barrier to oral care.[27]

Most subjects in the study had no comorbidities (64.3% vs. 75%, $P = 0.3876$) and is not associated with PTB. This lack of correlation was also demonstrated by the study of Auger et al. It was found out that comorbidities overall were associated with higher likelihoods of medically indicated PTB, while only comorbidities localized to the reproductive tract were associated with 56 spontaneous PTB.[28]

Lifestyle factors, such as smoking and illicit drug use, have been identified as possible risk factors for PTB.[5] In this study, no subject had drug use, and there was no significant association of PTB and smoking observed ($P = 1.00$).

No association of maternal weight with PTB was noted in this study ($P = 0.1712$), with more patients under the PTB having normal BMI (28.6% vs. 50.0%) while more patients under the FTB were overweight and obese (71.4% vs. 50%). This is somehow contradictory to most published studies that identify obesity as a risk factor for PTB. In the studies of Cnattingius *et al*., and Girsen *et al*., it was found that extremes of weight – Both underweight and obese mothers – Have an enhanced risk of PTB.[29,30]

Table 8: Periodontal variables between full-term birth and preterm birth groups

	All (*n*=56), *n* (%)	FTB (*n*=28), *n* (%)	PTB (*n*=28), *n* (%)	OR with (95% CI)	*P*
OHI index					
Poor	25 (44.6)	12 (42.9)	13 (46.4)	–[a]	0.3132
Fair	38 (67.9)	13 (46.4)	15 (53.6)		
Good	3 (5.4)	3 (10.7)	0		
DI-S					
Soft debris covering not >1/3 of the tooth surface	23 (41.1)	13 (46.4)	10 (35.7)	–[a]	0.5784
Soft debris covering>1/3 but not >2/3 of the exposed tooth surface	27 (48.2)	13 (46.4)	14 (50.0)		
Soft debris covering >2/3 of the exposed tooth surface	6 (10.7)	2 (7.1)	4 (14.3)		
CI-S					
No calculus present	0	0	0	–[a]	0.4118
Supragingival calculus covering not>1/3 of the exposed tooth surface	21 (37.5)	9 (32.1)	12 (42.9)		
Supragingival calculus covering >1/3 but not >2/3 of the exposed tooth surface or the presence of individual flecks of subgingival calculus around the cervical portion of the tooth or both	35 (62.5)	19 (67.9)	16 (57.1)		
Supragingival calculus covering >2/3 the exposed tooth surface or a continuous heavy band of subgingival calculus around cervical portion of tooth or both	0	0	0		
Presence of missing teeth					
No	9 (16.1)	4 (14.3)	5 (17.9)	Reference: 0.77 (0.18-3.22)	0.7164
Yes	47 (83.9)	24 (85.7)	23 (82.1)		
Average teeth missing (SD) among those “yes”	10 (17.9)	4.33 (4.1)	6.8 (6.1)		0.1043
Presence of dental caries					
No	6 (10.7)	6 (21.4)	0	–[a]	0.0232
Yes	50 (89.3)	22 (78.6)	28 (100)		
Average teeth with dental caries (SD) among those “yes”	9 (16.1)	4 (3.2)	5.2 (3.1)	–[a]	0.1808
Presence of mobile teeth					
No	46 (82.1)	22 (78.6)	24 (85.7)	Reference: 0.61 (0.15-2.46)	0.4878
Yes	10 (17.9)	6 (21.4)	4 (14.3)		
Lindhe classification of tooth mobility (severity)					
0 - Physiologic	45 (80.4)	21 (75.0)	24 (85.7)	–[a]	0.3618
1 - Increased mobility to at most 1 mm in a horizontal direction	2 (3.6)	1 (3.6)	1 (3.6)		
2 - Increased mobility of the tooth exceeding 1 mm in the horizontal direction	6 (10.7)	3 (10.7)	3 (10.7)		
3 - Severe mobility both in horizontal and vertical directions	3 (5.4)	3 (10.7)	0		
Presence of gingivitis					
No	13 (23.2)	12 (42.9)	1 (3.6)	Reference: 20.25 (2.4-170.7)	0.0057
Yes	43 (76.8)	16 (57.1)	27 (96.4)		
MGI					
0 - Normal, absence of inflammation	13 (23.2)	12 (42.9)	1 (3.6)	–[a]	0.0017
1 - Mild inflammation, slight change in color, little change in the texture of any portion of the gingival unit	5 (8.9)	1 (3.6)	4 (14.3)		
2 - Mild inflammation of entire gingival unit	6 (10.7)	0 (0.0)	6 (21.4)		
3 - Moderate inflammation, moderate glazing, redness, edema or hypertrophy of the gingival unit	30 (53.6)	14 (50.0)	16 (57.1)		
4 - Severe inflammation, marked redness and edema or hypertrophy, spontaneous bleeding or ulceration of the gingival unit	2 (3.6)	1 (3.6)	1 (3.6)		
Presence of pus					
No	32 (57.1)	13 (46.4)	19 (67.9)	Reference: 0.41 (0.14-1.22)	0.1083
Yes	24 (42.9)	15 (53.6)	9 (32.1)		
Presence of calcular deposits					
No	21 (37.5)	9 (32.1)	12 (42.9)	Reference: 0.63 (0.21-1.88)	0.4089
Yes	35 (62.5)	19 (67.9)	16 (57.1)		

[a]Error and cannot be computed due to 0 and small values. OHI: Oral hygiene index, DI: Debris index, CI: Calculus index, MGI: Modified gingival index, SD: Standard deviation, OR: Odds ratio, CI: Confidence interval, FTB: Full-term birth, PTB: Preterm birth

There was no significant difference in terms of the number of dental visits of the subjects. Majority reported as needed dental consult at 94.6% (92.9% vs. 96.4%, $P = 0.5564$). More subjects in the PTB group had their

last dental visit more than 5 years ago and/or could not recall when they last had their consult (64.3% vs. 42.9%, $P = 0.2019$). During the duration of the subjects' pregnancy, 53.6% had dental complaints. This is consistent with the findings of Torresyap *et al*., in 2014 that oral health is usually not considered a priority issue by the public health sector in developing countries.[27] The study published by Hwang *et al.,* supports the association of dental care and PTB. In their multivariate analysis, mothers who did not receive dental care and did not have teeth cleaning during pregnancy were at higher risk for delivering preterm (OR: 1.15, CI: 1.02–1.30).[31]

Various dental parameters were used in this study. The Oral Hygiene Index (OHI index) [Table 1] shows patient's oral cleanliness and expresses the presence of plaque on the surface of the teeth. The OHI has two components, the Debris Index (DI-S) [Table 2] and the Calculus Index (CI-S) [Table 3]. Calculation of these components allows classification of a person's oral hygiene as to poor, fair and good.[32] Based on the index, the oral hygiene of subjects was as follows: poor (42.9% vs. 46.4%), fair (46.4% vs. 53.6%), and good (10.7% vs. 0%). Although not significant ($P = 0.3132$), fair to poor oral hygiene was noted in more subjects under the PTB group, while more subjects in the FTB group had good oral hygiene (10.7% vs. 0%). A linear regression model in the study by Hope *et al*., in 2014, concluded that there was an association between plaque coverage and women at risk for PTB. They reported that increasing levels of plaque correspond with declining gingival health, which in turn is linked to PTB (OR: 0.959, 95% CI: 0.923–0.996, $P = 0.031$).[33]

There was no significant difference in the number of missing teeth (85.7% vs. 82.1%, $P = 0.7164$), presence of pus (53.6% vs. 32.1%, $P = 0.1083$), and calcular deposits (67.9% vs. 57.1%, $P = 0.4089$) between groups. This is congruent with the study of Bosnjak *et al.,* which also showed no association.[25]

100% of the subjects under the PTB group had dental caries, in contrast to 78.6% in the FTB. The average number of teeth with dental caries was higher in the PTB group (5.2 vs. 4.0). This showed a significant association of dental caries with PTB ($P = 0.0232$). This, however, is the contrast to the findings of Wagle *et al*., in their systematic review and meta-analysis, women affected by dental caries during pregnancy did not show a significantly higher risk of PTB (OR: 1.16, 95% CI: 0.90–1.49, $P = 0.25$).[34]

The Modified Gingival Index (MGI) by Lobene *et al* is an index for evaluating the severity of gingivitis.[35] Based on the MGI, more subjects under the FTB had normal gingival status (42.9% vs. 3.65%), while more subjects in the PTB had gingivitis (96.4% vs. 57.1%, $P = 0.0057$) with an OR of 20.25 (CI: 2.4–170.7). The severity of gingivitis in the PTB group was as follows – mild (3.6% vs. 14.3%), moderate (50% vs. 57.1%), and severe (3.6% vs. 3.6%). Gingivitis is a risk factor for PTB, and this is in congruence with the findings reported by Vergnes and Sixou in their meta-analysis of 17 articles – the OR was 2.83 (95% CI: 1.95-4.10, $P < 0.0001$).[18] Moreover, Micu *et al.*, in 2020, concluded that the presence of maternal periodontitis and its severity remained risk factors of PTB (OR: 3.46, 95% CI: 1.08–11.15).[36]

Conclusion

Low socioeconomic status may be one of the possible barriers to oral health. In the Philippines, the oral disease continues to be a serious public health problem, as evidenced by the poor health-seeking behavior noted – 94.6% visit the dentist only as needed and 53.7% cannot recall their last dental consult. Finally, periodontal conditions – gingivitis and dental caries – put a woman at a higher risk for PTB. Gingivitis is associated with PTB ($P = 0.0057$) with an OR of 20.25. The presence of dental caries is another risk factor ($P = 0.0232$).

Limitations

This study is limited by its sample size and the population being studied. This study employed various indices, including OHI, MGI, and Tooth Mobility Index. These indices, however, did not include periodontal probing and panoramic radiography – methods to represent a reasonably accurate estimate of sulcus or pocket depth, which are important findings in periodontal disease.

Recommendations

Further studies are recommended in a bigger population to have generalizability of results. While the periodontal indices employed in this study showed varying degrees of periodontitis, the inclusion of dental probing and imaging, particularly panoramic radiographs also prove valuable in diagnosing the presence of periodontitis. We recommend further researches to explore the possible association of maternal periodontal disease to other adverse pregnancy outcomes, including fetal growth restriction, low birth weight, preeclampsia, and gestational diabetes mellitus.

With the findings of periodontal diseases having a significant association with PTB, we recommend including preventive dental care as part of routine prenatal care. Educating women on the importance of oral health during pregnancy and ensuring access to dental services for all are thrusts that may prove effective in promoting positive birth outcomes.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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