

Determinants for Periodontal Disease during Pregnancy among Indonesian Women: A Cross-sectional Study using National *Riskesdas* 2013 Data

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Abstract

Hormonal changes occurring in women during pregnancy can affect periodontal tissue health. Elevated estrogen and progesterone levels alter the bacterial composition, permeability of blood vessels, and general condition of periodontal tissues, making them more susceptible to periodontal disease. This study aimed to determine the relationship between periodontal disease during pregnancy and sociodemographic factors, pregnancy, oral health behavior, and other local factors among pregnant women in Indonesia. In this cross-sectional study, information from 1733 pregnant women was retrieved from *Riskesdas* 2013 data. Multiple logistic regression was conducted to assess the relationships between periodontal disease in pregnant women and the other variables. Statistical analysis provided the prevalence odds ratio (POR) and the respective 95% confidence interval (CI). Periodontal disease was present in 4.4% of pregnant women. Among the local factors, calculus (POR, 4.297; 95% CI, 2.047-9.023) and teeth crowding (POR, 2.126; 95% CI, 1.232-3.669) were associated with periodontal disease occurrence in pregnant women; additionally, the dental and oral health behavioral factor affecting periodontal disease occurrence during pregnancy was frequency of tooth brushing (POR, 2.543; 95% CI, 1.041-6.210). Our findings indicate the importance of maintaining cooperation between medical professionals and dentists to provide effective oral health service during antenatal care. Provision of information regarding correct tooth brushing techniques and benefits of calculus removal during pregnancy is recommended.

Clinical article, (J Int Dent Med Res 2019; 12(1): 337-343)

Keywords: Periodontal disease, pregnancy, calculus.

Received date: 25 August 2018

Accept date: 30 September 2018

Introduction

The number of people affected by dental caries and periodontitis has increased substantially, globally increasing the total burden of these diseases by 37% for untreated dental caries and 67% for severe periodontitis, as estimated between 1990 and 2013.¹ In Indonesia, the prevalence of oral and dental problems increased from 23.5% in 2007 to 25.9% in 2013,² with dental caries and periodontal disease being the most common.³

Periodontal disease is an inflammatory condition affecting soft and hard structures that support the teeth.⁴ Increase in periodontal disease risk and severity is associated with several hormonal changes in women, such as

puberty, pregnancy, menstruation, oral contraceptive use, and menopause.⁵ However, pregnant women are most commonly affected due to increased levels of estrogen and progesterone. At the end of the third semester, progesterone and estrogen levels in the plasma were 10 (peak, 100 mg/mL) and 30 (peak, 6 mg/mL) times higher, respectively, than those during the menstrual cycle.⁶

Gingivitis is a light form of periodontal disease characterized by inflamed, red, swollen, and easily bleeding gingiva, which is sometimes accompanied by pain. It is caused by toxins and irritants, such as plaque and calculus.⁷ Periodontitis is a more complex disease with a layered and multifactorial etiology.⁸ It is characterized by the presence of extensive inflammation affecting the gingiva and alveolar bone.⁹

Gingival inflammation is usually associated with poor oral hygiene and the presence of local irritants, especially bacterial flora in plaque. However, hormonal and vascular changes accompanying pregnancy

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often exaggerate inflammatory responses to these local irritants.¹⁰ Estrogen and progesterone levels during the second month of pregnancy continue to rise until the eighth month, resulting in gingival exudates, capillary permeability changes, and gingival epithelial keratinization.¹¹ Moreover, changes in interactions between the host and periodontal microbiota during pregnancy may be conducive to periodontal damage. Periodontal tissue inflammation due to plaque-induced periodontal disease dramatically increases in extent and severity.¹² A high *Porphyromonas gingivalis* prevalence in pregnant women, especially in combination with *Tannerella forsythia* and *Treponema denticola*, was associated with increased risk of developing periodontitis, especially in pregnant women aged ≥ 30 years.¹³

Pregnancy is characterized by complex physiological alterations such as nausea and vomiting, which can affect oral health due to diet changes and poor oral hygiene.¹⁴ Poor oral hygiene can also exacerbate pre-existing unfavorable periodontal conditions.¹⁵

Periodontal disease prevalence among pregnant women in China ranges from 10% to 74%.¹⁶ Periodontal disease represents an infectious disease that affects >23% of women aged between 30 and 54 years.¹⁷ In Brazil, 47% of pregnant women presented with symptoms of gingivitis and periodontitis, which were significantly associated with higher gestational age, maternal age, obesity, and the presence of bleeding on probing.¹⁵ In Manado, 80% of pregnant women experienced gingivitis in their second and third trimesters.¹⁴

Several epidemiologic studies have examined the association between periodontal disease and hypertension,¹⁸ cardiovascular disease,¹⁹ diabetes mellitus,⁹ carotid artery calcifications,²⁰ and adverse pregnancy outcomes.²¹ There is sufficient evidence that lack of oral health during pregnancy has negative outcomes for mothers and their newborns.⁴

The purpose of the current study was to identify predictors associated with periodontal disease in pregnancy, including sociodemographic factors (age, educational level, occupation status, socioeconomic status, and geographic location), pregnancy factor (gestational age), dental and oral health behavior factors (tooth brushing frequency and time), and other local

oral factors (calculus, teeth crowding, and dental caries status). The findings might provide additional input, which may be useful during antenatal care (ANC) policy formulation; moreover, they may help increase knowledge among women about the importance of oral health maintenance, especially during pregnancy.

Materials and methods

This cross-sectional study using secondary data from the National Basic Health Survey (Riskesdas) of Indonesia, which was held during May 2013–June 2013. The study population covered 33 provinces and 497 districts/cities spreading throughout Indonesia. The sample comprised 1733 pregnant women at different pregnancy stages who met the following eligibility criteria: (a) age 15–40 years; (b) availability of complete oral examination data; (c) no history of hypertension or consumption of hypertension medications; (d) no history of diabetes mellitus; and (e) never smoked.

Information was collected to identify predictors that could be associated with periodontal disease during pregnancy. Trained interviewers with public health background visited the subjects in their homes, and standardized health examinations were administered to the subjects. Oral examinations were performed by dental nurses with the aid of two mouth mirrors and a flashlight. A questionnaire was designed by the Ministry of Health and included sociodemographic data (age, educational level, occupation status, socioeconomic status, and geographic location), gestational age, tooth brushing frequency, and tooth brushing time.

The definition of periodontal disease in this study was based on that described by Surya in 2013.²² Healthy periodontal tissue was determined based on the presence or absence of gum abnormalities (such as enlargement, redness, bleeding, and soft consistency) and tooth mobility. The decayed, missing, and filled teeth (DMFT) index was used to measure the dental caries status, and the presence of calculus and crowding was ascertained by oral examination. Participants were asked as to whether they had brushed their teeth every day. The time of day when participants brushed their teeth was categorized

as follows: morning bath, afternoon bath, after breakfast, after waking up in the morning, after lunch and before bedtime. The tooth brushing frequency was calculated by estimating the total number of times the teeth were brushed each day. The exact time of tooth brushing was obtained from participants who selected both after breakfast and before bedtime in the questionnaire.

Riskesdas 2013 was ethically approved by the National Institute for Health Research and Development Ethics Committee, Ministry of Health, Republic of Indonesia. Informed consent was obtained from all subjects prior to Riskesdas participation. This study was approved by the Ethics Committee of Public Health Research and Service of Public Health Faculty, University Indonesia No. 191/UN2.F10/PPM.00.02/2017.

The distribution of sociodemographic characteristics, gestational age, dental and oral health behavior, and local oral conditions was evaluated. The chi-square test was used to measure statistically significant differences between each variable, where the significance level was established at $P < 0.05$. Multiple logistic regression analysis involving periodontal disease as the outcome and all other factors as independent variables was conducted.

Results

Among the 1733 pregnant women included, 77 (4.4%) were diagnosed with periodontal disease, whereas the remaining 1656 (95.6%) had no periodontal disease. Bivariate analysis using the chi-square test revealed significant associations between periodontal disease during pregnancy and calculus ($P=0.000$), teeth crowding ($P=0.003$), dental caries ($P=0.014$), and frequency of tooth brushing ($P=0.036$; Table 1).

Table 2 shows the results of the initial multivariate analysis of all predictors chosen for periodontal disease during pregnancy; only two significant predictors, calculus ($P=0.000$) and teeth crowding ($P=0.007$), were identified. The model was gradually developed by discarding the nonsignificant predictors. The final regression model consisted of three predictors; calculus, teeth crowding, and frequency of tooth brushing (Table 3). Calculus was most significantly associated with periodontal disease during pregnancy

($P=0.000$). Pregnant women with calculus presented with increased risk of periodontal disease when compared with those without calculus (POR = 4.297; 95% CI = 2.047–9.023). Crowding was also significantly associated with periodontal disease during pregnancy ($P=0.007$). Pregnant women with crowded teeth had increased risk of periodontal disease when compared with those who had no teeth crowding (POR = 2.126; 95% CI = 1.232–3.669). Furthermore, pregnant women who did not brush their teeth everyday had increased risk of periodontal disease when compared with those who brushed their teeth at least twice a day ($P=0.041$; POR = 2.543; 95% CI = 1.041–6.210).

Discussion

The present study aimed to evaluate the potential predictors of periodontal disease during pregnancy among Indonesian women in 2013. The prevalence of periodontal disease during pregnancy in this study was low (4.4%; 77/1733 women) when compared with that reported in other studies conducted in Brazil (47%),¹⁵ China (73.9%),¹⁶ and India (95%).¹¹ The low prevalence in this current study could be attributed to an underestimation of the result due to information bias.

Information bias could occur while obtaining information regarding exposure or disease from the study population.²² In the current study, oral examinations were conducted by visual inspection using two mouth mirrors; therefore, underestimation of data regarding dental caries and periodontal disease prevalence may be expected. It is almost impossible to detect early caries or gingivitis clearly without a dental probe or explorer.

Based on the selected predictors in the final model, calculus, teeth crowding, and frequency of tooth brushing were found to be significantly associated with periodontal disease during pregnancy. Calculus, the predictor with the highest significance in this study, consists of mineralized bacterial plaque that forms on the surfaces of teeth and dental prostheses. It plays an important role in maintaining and accentuating periodontal disease by retaining plaque in gingival tissue.²³ Women with moderate and severe periodontitis also presented with poorer oral health due to heavy deposition of plaque and calculus.²⁴

Irregular teeth alignment may hinder plaque control in the oral cavity. Several authors have reported positive correlations between crowding and periodontal disease.²³ A study conducted by Goldstein stated that local tooth crowding is a predisposing factor for alveolar bone loss.²⁵ Crowding can create a conducive environment for plaque retention,

and thus, become a potential risk factor for gingival inflammation.^{8,26}

In addition to calculus and crowding, frequency of the brushing was also found to be significantly associated with periodontal disease during pregnancy. Inadequate oral hygiene is one of the risk factors for periodontal disease.²⁷

Independent Variables	Periodontal Disease		TOTAL (100%)	P Value	POR	95% CI
	Yes (%)	No (%)				
Age (years)						
15–20	7 (9)	197 (11.9)	204		1	
21–30	35 (45.5)	887 (53.6)	922	0.964	1.110	0.486–2.537
31–40	35 (45.5)	572 (34.5)	607	0.263	1.722	0.753–3.939
Education level						
Diploma or higher	5 (6.5)	206 (12.4)	211		1	
High School	17 (22.1)	514 (31.1)	531	0.717	1.363	0.496–3.742
Under High School	55 (71.4)	936 (56.5)	991	0.080	2.421	0.957–6.123
Occupational status						
Employed	22 (28.6)	596 (36)	618		1	
Unemployed	55 (71.4)	1060 (64)	1115	0.227	1.406	0.849–2.328
Socioeconomic status						
High	13 (16.9)	347 (21)	360		1	
Middle	30 (39)	705 (42.6)	735	0.833	1.136	0.585–2.205
Poor	34(44.1)	604 (36.4)	638	0.282	1.503	0.782–2.886
Geographic location						
Urban	31 (40.3)	767 (46.3)	798		1	
Rural	46 (59.7)	889 (53.7)	935	0.355	1.280	0.804–2.039
Gestational Age						
1 st Trimester	14 (18.2)	376 (22.7)	390		1	
2 nd Trimester	32 (41.6)	638 (38.5)	670	0.449	1.347	0.710–2.557
3 rd Trimester	31 (40.2)	642 (38.8)	673	0.525	1.297	0.681–2.469
Tooth brushing						
Frequency						
≥2x/day	65(84.4)	1524 (92)	1589		1	
1x/day	6 (7.8)	80 (4.8)	86	0.175	1.758	0.740–4.180
Not everyday	6 (7.8)	52 (3.2)	58	0.036	2.705	1.121–6.527
Tooth brushing Time						
Correct	3 (3.9)	74 (4.5)	77		1	
Incorrect	74 (96.1)	1582 (95.5)	1656	1.000	1.154	0.355–3.746
Calculus						
No	8 (10.4)	577 (34.8)	585		1	
Yes	69 (89.6)	1079 (65.2)	1148	0.000	4.612	2.203–9.657
Dental caries (DMFT)						
Low (≤ 3)	39 (50.6)	1077 (65)	1116		1	
High (>3)	38 (49.4)	579 (35)	617	0.014	1.812	1.146–2.865
Teeth Crowding						
No	58 (75.3)	1449 (87.5)	1507		1	
Yes	19 (24.7)	207 (12.5)	226	0.003	2.293	1.339–3.928

Table 1. Association between periodontal disease during pregnancy and sociodemographic characteristics, gestational age, oral health behavior, and local oral conditions in the pregnant women in this study (Riskesdas 2013 Data Analysis). CI, confidence interval; DMFT, decayed, missing, and filled teeth; POR, prevalence odds ratio.

Independent Variables	P-Value	POR	95% CI
Age			
15–20	0.339	1	
21–30	0.874	1.071	0.459–2.497
31–40	0.345	1.514	0.640–3.578
Education level			
Diploma or higher	0.237	1	
High School	0.772	1.170	0.404–3.388
Under High School	0.248	1.831	0.656–5.115
Occupational status			
Employed		1	
Unemployed	0.171	1.460	0.850–2.510
Socioeconomic status			
High	0.897	1	
Middle	0.645	0.848	0.419–1.715
Poor	0.707	0.862	0.398–1.870
Geographic location			
Urban		1	
Rural	0.923	1.026	0.608–1.731
Gestational age			
1 st Trimester	0.621	1	
2 nd Trimester	0.330	1.387	0.718–2.678
3 rd Trimester	0.530	1.236	0.638–2.392
Tooth brushing frequency			
≥2x/day	0.107	1	
1x/day	0.208	1.785	0.724–4.400
Not every day	0.062	2.518	0.955–6.640
Tooth brushing time			
Correct		1	
Incorrect	0.604	0.727	0.217–2.431
Calculus			
No		1	
Yes	0.000	3.811	1.797–8.083
Caries status (DMFT)			
Low (≤ 3)		1	
High (>3)	0.168	1.398	0.868–2.252
Teeth crowding			
No		1	
Yes	0.007	2.148	1.237–3.730

Table 2. Multivariate analysis of the association between sociodemographic factors, gestational age, oral health behavior, local oral factors, and periodontal disease during pregnancy in the pregnant women (Riskesdas 2013 Data Analysis). CI, confidence interval; DMFT, decayed, missing, and filled teeth; POR, prevalence odds ratio.

Self-reported optimal oral hygiene practices such as brushing twice per day and flossing daily were found to be significantly associated with lower risk of periodontal disease.²⁸ In the case of severe periodontal disease, post-partum women who brushed their teeth up to two times/day were at higher risk of having periodontal disease when compared with those who brushed their teeth three times/day.²⁹

Several risk factors for periodontal disease during pregnancy including old age,^{8,30} lower socioeconomic status,^{8,11,30-32} lower education level,^{8,11,30,31} and increased gestational age^{7,15} have been identified previously. Although these potential factors were examined in the current study, no significant associations were found. This is in accordance with a study in India where no significant differences in bleeding index scores

Independent variables	P-Value	POR	95% CI
Calculus			
No			
Yes	0.000	4.297	2.047–9.023
Teeth crowding			
No			
Yes	0.007	2.126	1.232–3.669
Tooth brushing frequency			
>2x/day	0.058	1	
1x/day	0.164	1.865	0.776–4.483
Not Everyday	0.041	2.543	1.041–6.210

Table 3. Determinants of periodontal disease during pregnancy in the Indonesia women (Riskesdas 2013 Data Analysis).

CI=confidence interval; POR=prevalence odds ratio

and mean probing depth were reported among the different categories, such as age, profession, education level, place of residence, and trimester of pregnancy.³² Another study conducted in Brazil also found no significant associations between periodontal disease during pregnancy and age, gestational trimester, and income level.³³ These differences among studies may be accredited to differences in study populations.

The results of the multivariate analysis in the present study also varied from those of other studies wherein a significant relationship was observed between severe periodontal disease and dental caries. In the study by Villa et al., women with three dental caries or more were found to be twice as likely to have periodontal disease when compared with those with less decay.²⁹ DMFT index is commonly used to measure caries prevalence, especially in the large surveys such as the National Health and Nutrition Examination Survey in USA.³⁴ Nevertheless, restrictions in Riskesdas instrumentation may lead to false-negative diagnoses, which may result in different values in this study.

This study has other limitations, besides information bias, which may have limited the external validity of the results. One of them is the lack of information about the tooth brushing method and instruments among the participants. In addition to the frequency or time of tooth brushing, the quality of instrumentation and the correct method of brushing are also of utmost importance.³⁵

Although the majority of the population reported brushing their teeth daily, we did not assess the techniques used by the participants; it is possible that the subjects might require adequate training regarding proper tooth brushing techniques from oral health professionals.²⁹

Conclusions

The prevalence of periodontal disease during pregnancy among women in Indonesia in the current study was 4.4%. Calculus, crowded teeth, and frequency of tooth brushing were found to be significant predictors of periodontal disease during pregnancy. Further research may be required to study the association between periodontal disease in pregnancy and sociodemographic variables as well as oral health behavior in the Indonesian population. There is a need to improve oral health knowledge, especially about the correct method of tooth brushing and the benefits of dental treatment for women during pregnancy. ANC providers should collaborate with dentists to make oral health program as an integral part of antenatal and primary health care.

Acknowledgments

The authors would like to thank Enago (www.Enago.Com) for the English language review.

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