Factors Related to Periodontal Diseases Among Pregnant Women: A National Cross-Sectional Study in Indonesia

Oktarina Oktarina[1], Tumaji Tumaji[1], Betty Roosihermiatie[1], Suparmi[1], Yunefit Ulfa[1], Tin Afifah[1], Joko Irianto[1], and Basuki Rachmat[1]*

[1] Central Research of Public Health and Nutrition, Health Research Organization, National Research and Innovation Agency, Cibinong Science Center, Bogor, West Java, Indonesia
* Basuki Rachmat, corresponding author. Email: basuki.rachmat@brin.go.id
Submitted: 21 April 2024. Accepted: 19 August 2024. Published: 18 September 2024
Volume 33, 2025. pp. 472–490. http://doi.org/10.25133/JPSSv332025.025

Abstract

Pregnant women are at a high risk of periodontal tissue damage. It is because of changes in food patterns and poor mouth hygiene. This research aims to determine factors associated with periodontal diseases among pregnant women in Indonesia. It was an observational study with a cross-sectional design. The study used secondary data from 2018 Basic Health Research (Riskesdas). From the 300,000 sample households interviewed, there were 8,902 pregnant women. The dependent variable was periodontal diseases, and the independent variables were characteristics, systemic, and behavioral factors. To determine the factors most associated with periodontal disease in pregnant women using multivariate logistic regression. The results of this study indicate that the prevalence of periodontal in pregnant women in Indonesia is 65.7%. The factors most associated with periodontal disease in pregnant mothers are lack of education, living in urban areas, gestational age, brushing teeth after breakfast and before sleeping, and smoking. This research highlights the importance of enhancing oral health education and promoting healthy lifestyles to reduce the risk of periodontal disease in pregnant women.

Keywords

Periodontal disease; periodontal factors; periodontal symptoms; pregnant women

Introduction

The World Health Organization (WHO) (2022) defines oral health as the state of the mouth and teeth that enable individuals to perform crucial activities, and it is a vital component of overall health across the lifespan. Despite this, many people neglect their dental health, resulting in severe periodontal disease. Periodontal diseases are inflammatory conditions affecting the gums and supporting structures around the teeth, including the periodontal ligament and alveolar bone (Mariotti, 2007; Petersen et al., 2013). These conditions range from mild gingivitis, characterized by redness and swelling of the gums, to severe periodontitis, which can lead to tooth loss if untreated (Daalderop et al., 2018). Warning signs include bad breath, red or swollen gums, tender or bleeding gums, painful chewing, loose or sensitive teeth, receding gums, changes in bite, and alterations in the fit of partial dentures.

The Global Burden of Disease Study (GBD) in 2016 reported a prevalence of 750,847 cases of periodontal disease, reflecting a 25.8% increase in cases between 2006 and 2016. Periodontal disease has emerged as a significant health concern, ranking 16th among diseases in 1990 and rising to 11th in 2006, maintaining this position in 2016, with the change being statistically substantial (GBD 2016 Disease and Injury Incidence and Prevalence Collaborators, 2017). According to a research report by Listl et al. (2015) on the global economic impact of dental diseases, direct treatment costs due to dental diseases worldwide are estimated at US$298 billion per year, equivalent to an average of 4.6% of global health expenditures. Additionally, indirect costs amount to US$144 billion annually, comparable to the economic losses caused by the ten most common global causes of death. Oral diseases are among the most prevalent non-communicable diseases in the Southeast Asia Region. Severe periodontal disease affects an estimated 307 million people, with a prevalence of 20.8% among individuals over 15 years old (WHO, 2022).

Indonesia faces a significant burden of periodontal disease. The prevalence of dental and oral problems has risen alarmingly from 23.4% in 2007 to 25.9% in 2013 and 57.6% in 2018 (National Institute of Health Research and Development [NIHRD], 2008, 2014, 2019). According to the 2018 Basic Health Research (Riskesdas) report, the prevalence rate of caries in Indonesia reached 88.8% among three years and older population. Additionally, root caries was reported at 56.6%, while periodontitis, based on specific characteristics, showed a prevalence rate of 74.1%. Despite the high prevalence, only 2.8% of the population practices proper tooth brushing, and just 10.2% seek services from dental professionals (NIHRD, 2019). This data highlights the high incidence of dental and oral health problems in Indonesia, necessitating special attention and appropriate interventions to improve public health.

Pregnant women are particularly susceptible to periodontal diseases due to systemic changes such as hormonal fluctuations and altered immune conditions (Silva de Araujo Figueiredo et al., 2017). A systematic review and meta-analysis by Chen et al. (2022) examined 20 articles worldwide, reporting a prevalence of periodontitis of 40% among pregnant women. The study also revealed that in subgroup meta-analyses, bleeding on probing (BOP) and probing depth (PD ≥4 mm) tend to increase as gestation progresses, while clinical attachment loss (CAL ≥4 mm) peaks in the second trimester. Furthermore, gingivitis, an early stage of periodontal disease, affects approximately 60% to 75% of pregnant women (Centers for Disease Control and Prevention [CDC], 2024). Despite this, many pregnant women do not seek dental care (Kloetzel et al., 2011). In Australia, George et al. (2012) identified various barriers pregnant women face in seeking dental care, including lack of dental awareness, high

treatment costs, and misconceptions about dental treatment during pregnancy.

In Indonesia, a cross-sectional study conducted at several selected public health centers in Surabaya, East Java, involving 98 pregnant women, revealed that 84.7% had caries with a DMF-T index score of 4.34 (fair). Additionally, 73% of the participants experienced gingival bleeding, 34% had a pocket depth of 4–5 mm, and 2% had a pocket depth of 6 mm or deeper (Tedjosasongko et al., 2019). A small-scale study conducted in a village in East Java, Indonesia, involving 50 pregnant women, reported that all participants experienced bleeding gums. Additionally, the participants reported various other complaints: bad breath (36), swollen gums (34), pain due to cavities (20), loose teeth (8), and other issues (5) (Wijaksana et al., 2020). Another study conducted in the Pondok Labu subdistrict, South Jakarta, Indonesia, involving 101 pregnant women, revealed that 66.3% of the participants had calculus, and 6.9% had periodontal pockets measuring 4–5 mm (Rikawarastuti et al., 2016).

Various factors contribute to periodontal disease. In South India, aging, poor oral hygiene, and low educational levels were significant risk factors for periodontal disease (Dain et al., 2023). A literature review in South Asia identified additional risk factors such as socioeconomic status, smoking, alcohol consumption, hypertension, diabetes history, obesity, and stress, which are directly related to the onset of periodontal disease. Specific characteristics of certain populations, such as ethnicity, behavioral traits, and environmental factors, also play a role in the development of periodontitis (Karobari et al., 2022).

Similarly, in Southwest Ethiopia, risk factors for periodontal disease among women attending antenatal care in public hospitals include residence, socioeconomic status, underweight nutritional status, lack of information about periodontal disease, depression, diabetes mellitus history, self-perceived halitosis, no history of antenatal care, and lower gestational age (Belay & Achimano, 2022). Periodontal disease impacts oral health and overall well-being, affecting eating, appearance, confidence, and quality of life, potentially leading to nutritional deficiencies (Tonetti et al., 2017). It has also been linked to adverse pregnancy outcomes, such as preterm birth and low birth weight (Fakheran et al., 2020).

Although numerous studies have highlighted the prevalence and impact of periodontal disease globally, there is a notable gap in research that specifically addresses the unique factors and consequences within the Indonesian context. According to the data, there has been an alarming rise in dental and oral health problems in pregnant women in the last ten years in Indonesia, as documented in the National Institute of Health Research and Development (NIHRD) reports. However, studies in Indonesia are limited in scope and sample size, underscoring the need for extensive population-wide research to understand better the socioeconomic, cultural, and environmental factors contributing to the high prevalence of periodontal diseases. Therefore, using data from Basic Health Research, this study aimed to assess the influence of characteristics, systemic, and behavioral factors on periodontal disease in pregnant women in Indonesia. Addressing this gap is crucial for developing targeted public health strategies and improving dental health outcomes in Indonesia.

Materials and methods

Data source

This research is observational with a cross-sectional design. The Health Development Research Agency of the Republic of Indonesia conducted Riskesdas in 2018, and this study uses secondary data from that survey. Sampling methods are gradual and based on sub-samples of provincial sample estimates (NIHRD, 2019). The population is the entire household in Indonesia. The 2018 Basic Health Research (Riskesdas) sample uses the Susenas 2018 sample framework implemented in March 2018. Several census blocks (CB) were selected using the PPS (probability proportional to size) method in every urban or rural layer per district or city systematically to produce a census block sample list (CBSL). The total number of CBs selected is 30,000 CB. To maintain the representation of the value of the household's diversity characteristic, the HH (Head of Household) completed implicit stratification of the highest education level in each CB when selecting the ten households. Individuals who are the risk samples to be interviewed are all family members (FM) in the chosen household. Out of 300,000 households, 295,720 and 1,091,528 household members were successfully surveyed/visited as a sample of the 2018 Basic Health Research in 34 provinces. From the final data, 8,902 pregnant women aged 13–54 responded for analysis.

Figure 1: Data Selection Flow Diagram

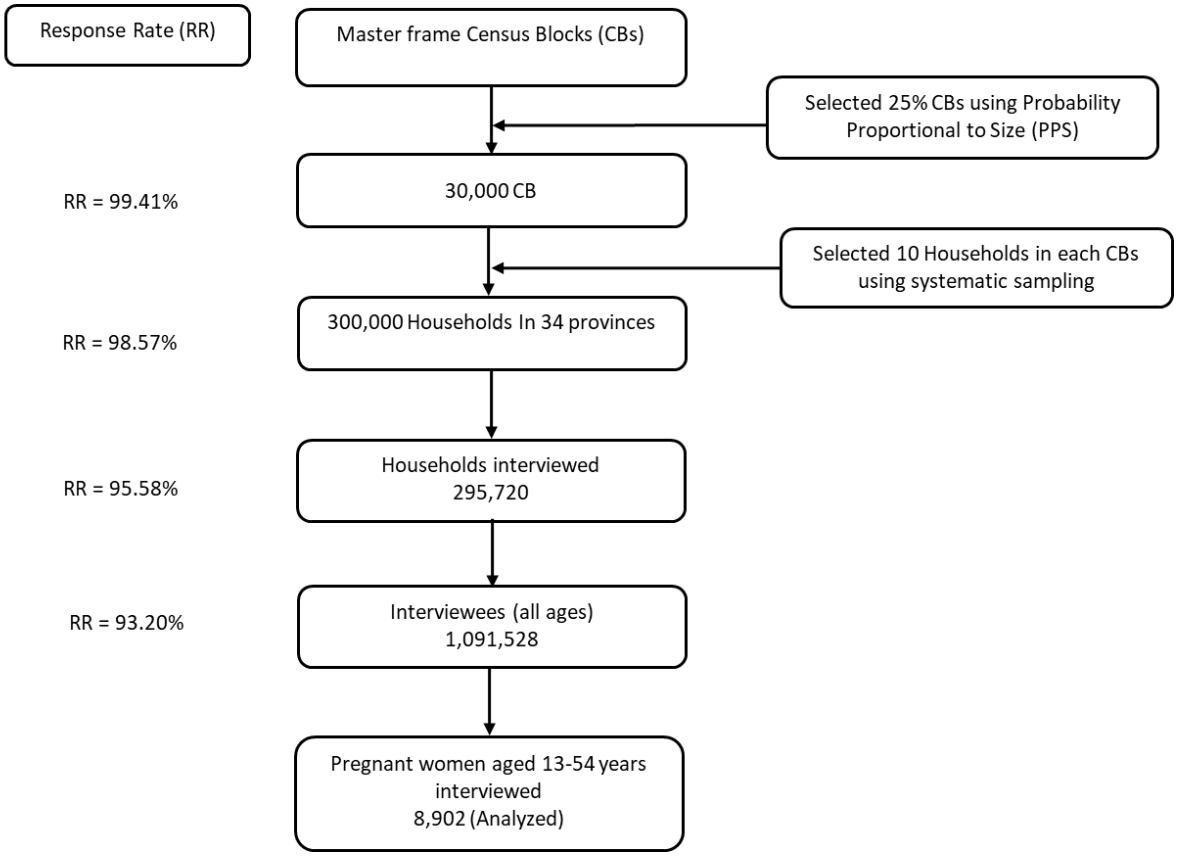

Figure 1 shows the data selection flow diagram modified from the 2018 National Public Health Survey report (NIHRD, 2019) and the article by Idaiani and Indrawati (2021).

Data collection involved trained enumerators at RISKESDAS 2018. In collecting field data, each province was assigned one person as a coordinator tasked with coordinating the district-level person in charge. The district-level person coordinated the enumerators, who will go directly to the field. The number of enumerators is adjusted to the target households to be visited. The enumerators are grouped into several teams led by a team leader to facilitate

coordination. Previously, enumerators received training on how to use questionnaires, approach respondents, communicate effectively, and get approval from respondents. Road guides (village officers) and local health workers accompany the Enumerator in visiting the selected households as samples. Before starting the interview, the enumerators asked for consent from all family members by filling out a consent form. After obtaining approval, the enumerators interviewed the guardians or parents (representatives of the older household, their spouses, and the head of the household), followed by all other household members. During the interview, parents or guardians accompany household members less than 15 years of age. Data collection will be implemented using a structured paper-based questionnaire consisting of structured questions at the household and individual levels. CSPro 7.3 (the Census and Survey Processing System) data entry software was used to perform data entry (United States Census Bureau [USCB], 2018).

Variables and instruments

The dependent variable was *periodontal disease*, categorized into two groups: 0 for no periodontal disease and 1 for the presence of periodontal disease. In this study, an individual is considered to have periodontal disease if they experience any of the signs or symptoms within one year, such as tooth loss, loose teeth, swollen gums or gum abscess, bleeding gums, and Prolonged stomatitis in 1 month (NIHRD, 2019). Periodontal disease was identified through questions about problems, complaints, disorders, or symptoms of dental health experienced by the respondents, so they responded according to their perception, opinion, or view of their oral health condition. The sample was all pregnant women aged 13–54 years, and the research sample was from Indonesia.

The independent variables are characteristic factors (*age*, *education*, *work*, *place of residence*, *gestational age*), systemic factors (*diabetes mellitus*), and behavioral factors (*brushing teeth*, *consumption of risky foods and drinks*, and *smoking*). Diabetes mellitus (DM) is an acknowledgment during an interview with a respondent regarding diabetes that a doctor diagnosed. Diagnosis of diabetes mellitus is made by healthcare professionals based on criteria such as fasting blood glucose (FBG) levels ≥ 126 mg/dL or blood glucose levels 2 hours after glucose loading (2hPG) ≥ 200 mg/dL; or random blood glucose (RBG) levels ≥ 200 mg/dL accompanied by symptoms of frequent hunger, thirst, urination in large amounts, and weight loss (Indonesian Society of Endocrinology [PERKENI], 2019). Diabetes was categorized into two groups, namely "Yes" and "No".

The level of education assessed was categorized into four groups: lack of education (no formal education or incomplete elementary school education), low education (completed junior high school), Middle education (completed high school), and high education (Diploma 1, Diploma 2, Diploma 4, Strata-1, Strata-2, and Strata-3). The age of pregnant women was categorized into two groups: the first was 20–35 years, and the second was < 20 years or > 35 years. Meanwhile, gestational age was grouped into three groups: the first was the First trimester, then the Second trimester, and the Third trimester. The working status was categorized into two categories: "No" (not working or not having a job) and "Work" (government employees, private employees, self-employed, farmers or agricultural workers, fishermen, laborers or drivers of household assistants, and other workers in the informal sector). Residential areas are categorized into two groups, namely urban and rural regions (Mulyana, 2014).

Bruising teeth can remove plaque and bacteria from the teeth and periodontal tissue. Brushing teeth twice a day prevents caries and periodontal disease, particularly from the residues of

breakfast and dinner. Good brushing teeth are those brushing at least twice a day, including after breakfast and before sleeping at night. Poor tooth brushing was characterized by not brushing at least twice daily, including after breakfast and before sleeping at night. It refers to inadequate or ineffective practices for cleaning one's teeth. It can include not brushing frequently enough, not brushing for a sufficient duration, incorrect brushing techniques, or not covering all areas of the mouth. Poor tooth brushing can lead to plaque accumulation, which increases the risk of dental problems such as cavities, gum disease, and periodontal disease. Brushing teeth twice a day was categorized into two groups, namely "Yes" and "No." Meanwhile, brushing teeth after breakfast and before sleeping was classified into two groups, namely "Good" and "Poor."

No consumption or minimal consumption of sweet foods (< 3 times per month) poses the least risk of sweet food residue that promotes bacterial growth in the mouth and teeth. Consumption of sweet foods 1–6 times per week and ≥ three times per day carries a higher risk than no consumption or consumption < 3 times per month. Behavioral patterns of consuming sweet foods were categorized into three groups: "Never or < 3 times per month," "1–6 times per week," and "Once or more per day." Similarly, no consumption or minimal consumption of sweet drinks (< 3 times per month) presents the least risk of sweet drink residue that supports bacterial growth in the mouth and teeth. Consumption of sweet drinks 1–6 times per week and ≥ three times per day is associated with a higher risk than no consumption or consumption < 3 times per month. Behavioral patterns of consuming sweet drinks were categorized into three groups: "Never or < 3 times per month," "1–6 times per week," and "Once or more per day."

In this study, respondents aged 13 years and older, both current smokers and those who have never smoked, were asked to reflect on their smoking habits throughout their lives. Daily smoking habits if the respondent consumes at least one cigarette every day, regardless of whether the cigarette is finished or left over. There are two categories of smoking behavior: No (never smoked) and Yes (smoked every day and did not smoke every day). What "never smoked" means is if the respondent has never smoked. The term "smoked every day" refers to a respondent who has smoked every day of his life, even if only for a short period (such as a month or a few months). The definition of "smoked not every day" is if the respondent has smoked but not every day or only smoked occasionally. Suppose the respondent has smoked every day but at the time of the interview is no longer smoking regularly, either smoking only occasionally or has stopped altogether. it is called "current smoking." In addition, if the respondent has smoked, even if only one cigarette or just tried it, they are also included in the definition of "current smoking." However, the definition of "current smoking" is part of the category of smoking every day and not smoking every day.

Data analysis

A descriptive analysis describes the characteristics of the incidence of periodontal disease symptoms in Indonesia. A bivariate regression analysis was carried out to determine the variables associated with the incidence of periodontal disease in pregnant women in Indonesia. For multivariate analysis, variables with a p value of less than .25 in the bivariate model were included in the multivariate logistic regression model. After controlling for confounding variables, a multivariable logistic regression analysis was carried out to determine factors associated with the incidence of periodontal disease in pregnant women. The final model used in this study included all variables substantially related to the incidence of periodontal disease in pregnant women in Indonesia, using a significance threshold of .05

as the cut-off. We present the odds ratios (OR) and 95% confidence intervals (CI) for all variables in the final model (Sperandei, 2014).

Results

Descriptive analysis

The research results suggest that it can be described based on local factors, respondent characteristic factors (age, education, working status, place of residence, gestational age), systemic factors (DM), and behavioral factors (toothbrushing, consumption of sweet foods and drinks, smoking).

In Table 1, the distribution of variables is based on a univariate analysis of the characteristics of pregnant female respondents based on local factors. Most pregnant women did not have missing teeth (89.9%), did not experience tooth loss (95.5%), did not experience swollen gums (85.1%), did not experience gums that bleed easily (79.1%), and did not experience mouth ulcers for at least one month (99.1%). Characteristic factors consist of age: 74.0% of the respondents are mostly 20–35 years old, 41.2% have low education, 62.3% do not work, 44.2% live in rural areas, and 38.1% are in the third trimester of pregnancy. The majority, 99.7%, did not suffer from diabetes mellitus. Behavioral factors showed that respondents with a frequency of brushing their teeth twice a day amounted to 99.2%, poor behavior in brushing teeth after breakfast and before sleeping amounted to 93.9%, behavior of consuming sweet foods 1-6 times a week amounted to 50.0%, consuming sweet drinks mostly once or more every day amounted to 52.9%, and most never smoked amounted to 98.2%.

Table 1: Mouth Condition, Characteristics, Diabetes Mellitus, and Behavioral Factors Among Pregnant Women in Indonesia (*n* = 8,902)

Variable	*n*	Percentages (%)
Mouth Condition Factor		
Periodontal disease		
No	5,787	65.0
Yes	3,115	35.0
Missing teeth		
No	8,000	89.9
Yes	901	10.1
Loose teeth		
No	8,505	95.5
Yes	397	4.5
Swollen gums		
No	7,579	85.1
Yes	1,323	14.9
Easily bleeding gums		
No	7,073	79.1
Yes	1,865	20.9
Prolonged stomatitis min 1 month		
No	8,818	99.1
Yes	84	0.9
Characteristics Factor		

Variable	*n*	Percentages (%)
Age		
20–35 years	6,587	74.0
< 20 years or > 35 years	2,315	26.0
Education		
Higher education	1,373	15.4
Middle education	3,313	37.2
Low education	3,670	41.2
Lack of education	546	6.1
Working status		
Work	3,360	37.7
No	5,542	62.3
Residence		
Urban	4,964	55.8
Rural	3,938	44.2
Gestational Age		
First trimester	2,287	25.7
Second trimester	3,223	36.2
Third trimester	3,392	38.1
Systemic Factor		
Diabetes Mellitus		
No	8,877	99.7
Yes	25	0.3
Behavioral Factors		
Brushing Teeth Twice a Day		
Yes	8,827	99.2
No	75	0.8
Brushing Teeth After Breakfast and Before Sleeping		
Good	546	6.1
Poor	8,356	93.9
Behavioral Patterns of Consuming Sweet Foods		
Never or < 3times per month	831	0.3
1–6 times per week	4,449	50.0
Once or more per day	3,622	40.7
Behavioral Patterns of Consuming Sweet Drinks		
Never or < 3 times per month	991	11.1
1–6 times per week	3,205	36.0
Once or more per day	4,706	52.9
Smoking Behavior		
No	8,741	98.2
Yes	161	1.8

Bivariate analysis

Table 2 shows the factors that may influence periodontal events in pregnant women. Based on employment status, unemployed mothers had a significant relationship with the incidence of periodontal disease, where unemployed mothers had a 1.10 times greater risk of developing periodontal disease than employed mothers (COR = 1.10, 95% CI [1.002–1.20]). Pregnant women residing in rural areas exhibited a significant association with the incidence of periodontal disease. Mothers in rural areas have an 11% lower risk of developing periodontal disease than those in urban areas (COR = 0.89, 95% CI [0.81–0.97]). The gestational age during the third trimester is related to the incidence of periodontal disease. Mothers in the third

trimester had a 12% lower risk of developing periodontal disease than those in the first trimester (AOR = 0.88, 95% CI [0.79–0.98]). Mothers who brushed their teeth well after breakfast and before bed showed a significant relationship with periodontal disease prevention compared to mothers who brushed their teeth poorly. Those who brushed their teeth well after breakfast and before bed had a 40% lower risk of periodontal disease. (COR = 0,60, 95% CI [0,51–0,72]). Smoking behavior was significantly associated with the incidence of periodontal disease, with mothers who smoked having a 1.92 times greater risk of developing periodontal disease compared to non-smoking mothers (COR = 1.92, 95% CI [1.40–2.62]). However, age, education, diabetes mellitus (DM), tooth brushing twice a day, sweet food consumption patterns, and sweet drink consumption were not found to have a statistically significant relationship with periodontal disease.

Table 2: Factors Related to Periodontal Disease Among Pregnant Women in Indonesia (*n* = 8,902)

Variable	Periodontal disease				*p* value	OR	95%CI	
	No		Yes					
	n	%	*n*	%			Lower	Upper
Characteristics Factor								
Age								
20–35 years	4,273	64.9	2,314	35.1		1		
< 20 years or > 35 years	1,515	65.4	801	34.6	.638	0.98	0.88	1.08
Education								
Higher education	909	66.2	464	33.8		1		
Middle education	2,155	65.0	1,159	35.0	.432	1.06	0.92	1.20
Low education	2,386	65.0	1,284	35.0	.424	1.06	0.93	1.20
Lack of education	337	61.7	209	38.3	.066	1.21	0.99	1.49
Working status								
Work	2,228	66.3	1,132	33.7		1		
No	3,560	64.2	1,983	35.8	.046*	1.10	1.002	1.20
Residence								
Urban	3,167	63.8	1,797	36.2		1		
Rural	2,621	66.6	1,317	33.4	.007*	0.89	0.81	0.97
Gestational Age								
First trimester	1,449	63.4	838	36.6		1		
Second trimester	2,092	64.9	1,131	35.1	.238	0.94	0.84	1.05
Third trimester	2,247	66.2	1,145	33.8	.025*	0.88	0.79	0.98
Systemic Factor								
Diabetes Mellitus								
No	5,776	65.1	3,101	34.9		1		
Yes	12	48.0	13	52.0	.056	2.16	0.98	4.75
Behavioral Factors								
Brushing Teeth Twice a Day								
Yes	5,742	65.0	3,086	35.0		1		
No	46	61.3	29	38.7	.517	1.17	0.73	1.86
Behavioral Patterns of Consuming Sweet Foods								
Never or < 3 times per month	550	66.2	281	33.8		1		
1–6 times per week	2,917	65.6	1,532	34.4	.756	1.03	0.88	1.20
Once or more per day	2,321	64.1	1,301	35.9	.263	1.10	0.93	1.28
Behavioral Patterns of Consuming Sweet Drinks	636	64.2	355	35.8		1		

Variable	Periodontal disease				*p* value	OR	95%CI	
	No		Yes					
	n	%	*n*	%			Lower	Upper
Never or < 3 times per month	2,112	65.9	1,093	34.1	.322	0.93	0.80	1.08
1–6 times per week	3,040	64.6	1,667	35.4	.808	0.98	0.85	1.13
Once or more per day								
Brushing Teeth After Breakfast and Before Sleeping								
Good	292	53.6	253	46.4		1		
Poor	5,495	65.8	2,861	34.2	< .001*	0.60	0.51	0.72
Smoking Behavior								
No	5,708	65.3	3,033	34.7		1		
Yes	80	49.7	81	50.3	< .001*	1.92	1.40	2.62

*Note: COR: Crude Odds Ratio; CI: Confidence Interval; *Significance level, p < .05.*

Multivariate analysis

As seen in Table 3, according to education level, pregnant women who lacked education had a 1.25 times greater risk of experiencing periodontal disease than those with a higher level of education (AOR = 1.25, 95% CI [1.01–1.54]). In the area of residence, pregnant women who lived in rural experienced a reduction of 12% in the odds of having periodontal disease compared to those who lived in urban areas (AOR = 0.88, 95% CI [0.80–0.96]). The gestational age during the third trimester is related to the incidence of periodontal disease. Mothers in the third trimester had a 14% lower risk of developing periodontal disease than mothers in the first trimester (AOR = 0.86, 95% CI [0.77–0.96]). Poor tooth brushing behavior in pregnant women experienced a reduction of 44% in the odds of developing periodontal disease compared to those whose tooth brushing behavior was good (AOR = 0.56, 95% CI [0.49–0.65]). Meanwhile, pregnant women who smoked had a 1.83 times greater risk of periodontal disease compared to those who did not smoke (AOR = 1.83, 95% CI [1.34–2.51]). However, age, working status, diabetes mellitus (DM), brushing teeth twice a day, behavioral patterns of consuming sweet foods, and behavioral patterns of consuming sweet drinks were not found to have a statistically significant relationship with periodontal disease.

Table 3: Logistic Regression of Factors Related to Periodontal Disease Among Pregnant Women in Indonesia

Variable	B	*p* value	AOR	95%CI	
				Lower	Upper
Characteristics Factor					
Age					
20–35 years	–	–	–	–	–
< 20 years or > 35 years	–0.037	.472	0.96	0.87	1.07
Education					
Higher education	–	–	–	–	–
Middle education	0.021	.754	1.02	0.90	1.17
Low education	0.056	.416	1.06	0.92	1.21
Lack of education	0.219	.041*	1.25	1.01	1.54
Working status					
Work	–	–	–	–	–
No	0.068	.159	1.07	0.97	1.18
Residence					

Variable	B	*p* value	AOR	95%CI	
				Lower	Upper
Urban	–	–	–	–	–
Rural	–0.130	.005*	0.88	0.80	0.96
Gestational Age					
First trimester	–	–	–	–	–
Second trimester	–0.078	.161	0.93	0.83	1.03
Third trimester	–0.150	.007*	0.86	0.77	0.96
Systemic Factor					
Diabetes Mellitus					
No	–	–	–	–	–
Yes	0.580	.156	1.79	0.80	3.98
Behavioral Factors					
Brushing Teeth Twice a Day					
Yes	–	–	–	–	–
No	0.146	.547	1.16	0.72	1.86
Behavioral Patterns of Consuming Sweet Foods					
Never or < 3 times per month	–	–	–	–	–
1–6 times per week	0.026	.740	1.03	0.88	1.20
Once or more per day	0.070	.389	1.07	0.92	1.26
Behavioral Patterns of Consuming Sweet Drinks					
Never or < 3 times per month	–	–	–	–	–
1–6 times per week	–0.098	.205	0.91	0.78	1.06
Once or more per day	–0.070	.350	0.93	0.80	1.08
Brushing Teeth after breakfast and before sleeping					
Good	–	–	–	–	–
Poor	–0.572	< .001*	0.56	0.49	0.65
Smoking Behavior					
No	–	–	–	–	–
Yes	0.606	< .001*	1.83	1.34	2.51
Goodness of fit	.000	$\chi^2 = 33.379$; df = 8			
Model Summary -2 Log likelihood = 11,451.809; Cox & Snell R Square = 0.095					

*Note: AOR: adjusted odds ratio; CI: confidence interval; *significance level of p < .05 with multiple logistic regression analysis; ** significance level of p ≥ .05 with Hosmer Lemeshow test.*

Discussion

In this study, we investigated the contributing factors of periodontal disease in pregnant women in Indonesia. Our findings revealed that pregnant women aged less than 20 or more than 35 years old had a lower risk of periodontal disease than women aged 20–35 years old, but it was insignificant. Our findings are consistent with previous research showing that pregnant women under 21 report fewer periodontal diseases than their older counterparts (Bunnatee et al., 2023). However, the results of this study contradict the findings of several other studies, such as a prospective cohort study on 877 pregnant women in Uganda by Wandera et al. (2012) and a cross-sectional survey of 618 pregnant women in southwest Ethiopia by Belay and Achimano (2022), which showed that productive age (25–34 years) is related to a lower risk of periodontal diseases. Similarly, a cross-sectional study involving 405 pregnant women in Thailand by Bunnatee et al. (2023) showed that the age of pregnant women higher than 30 years old is associated with periodontal disease, which is attributed to the accumulation of plaque and calculus with increasing age and loss of periodontal support

tissue (Borrell et al., 2004; Wandera et al., 2012). A local Indonesian study conducted in one of the villages in the coastal area of Puger, Jember District, involving 70 pregnant women, reported that periodontal disease was found in 34 pregnant women aged 26–35 years (Azhria et al., 2024). This finding is in accordance with the results of our study, which reported that women aged 20-35 years have a greater risk of periodontal disease.

Higher education levels were associated with fewer instances of periodontal disease (Baumeister et al., 2022). These results support the findings of this study, where individuals with low education were found to have a significant risk of periodontal disease. It was linked to higher health literacy, demonstrating correct brushing techniques, less plaque accumulation, and an increased likelihood of engaging in preventive oral health practices among more educated individuals (Farsi et al., 2020). According to study results, it was confirmed that low health literacy was significantly associated with a higher likelihood of periodontal disease, particularly among Slovak adults who visited oral hygiene clinics (Timková et al., 2020).

The working status was not found to have a statistically significant relationship with periodontal disease. It may be due to factors affecting periodontal health that are not directly related to working status, such as smoking habits, oral hygiene, and genetic factors. Previous research by Petersen and Ogawa (2012) also indicated that socioeconomic factors and individual behaviors are more dominant in developing periodontal disease than working status. Additionally, a literature review by Corridore et al. (2023) found that work-related stress can affect oral health but does not directly cause an increase in the prevalence of periodontal disease. Therefore, although working status can impact certain aspects of health, the results of this study reinforce the view that other, more complex factors influence periodontal disease.

This study revealed that pregnant women living in rural areas had a lower risk of periodontal disease compared to those in urban areas. This may be because most (99.2%) pregnant women in Indonesia practice brushing twice a day, although brushing their teeth after breakfast and before sleeping remains poor (93.9%). However, this finding differs from the results of a study conducted by Belay and Achimano (2022) in Ethiopia, where pregnant women living in rural areas were almost three times more likely to experience periodontal disease than those living in urban areas. According to a study in India, individuals from rural areas ignore oral health because of a lack of awareness, inadequate availability of dental health services, and lack of an organized healthcare system (Bhat, 2008). This is supported by a recent review conducted by Nghayo et al. (2024), who evaluated a community engagement program to improve oral health knowledge and outcomes in rural areas. This strategy effectively guided oral health knowledge and perceptions among children and mothers/caregivers to improve the oral health and quality of life of children and older adults in rural communities. However, challenges include unequal access to dental care, shortage of professionals, lack of integrated programs, and lack of government support for sustainable oral health resources. Thus, there needs to be an equal distribution of dental health services in urban and rural areas.

This study showed that pregnant women in the third trimester had a lower risk than those in the first. This result is consistent with other cross-sectional studies involving 404 pregnant women in Sudan and Southwest Ethiopia, which found that lower gestational age was associated with periodontal disease (Belay & Achimano, 2022; Salih et al., 2020). However, it differs from a study among 334 pregnant women in Brazil that found that the higher the gestational age, the higher the incidence of periodontal disease (Vogt et al., 2012). According to a study by Gil-Montoya et al. (2023), a significant relationship exists between gestational

age in the third trimester and the incidence of periodontal disease. This study also found that gestational age in the third trimester is related to the incidence of periodontal disease. The high levels of progesterone and estrogen hormones during pregnancy affect blood flow to the gum tissue, increasing the risk of inflammation and plaque formation (Susanto et al., 2024). This condition not only impacts the oral health of pregnant women but can also lead to premature birth and low birth weight (Chambrone et al., 2011). Therefore, pregnant women need to maintain oral hygiene through regular preventive care to reduce the risk of complications associated with periodontal disease during pregnancy.

Research findings show that pregnant women with diabetes mellitus (DM) have a 1.79 higher risk than pregnant women who do not suffer from diabetes mellitus, but this was insignificant. Most of the pregnant women in this study did not suffer from diabetes mellitus. Pregnant women who suffered from diabetes mellitus had periodontal disease and did not have a small proportion. These findings suggest that although there may be a trend, the current data do not provide strong enough evidence to conclude a significant association between diabetes mellitus and periodontal disease in pregnant women. This is likely due to the small sample size of periodontal cases in pregnant women with diabetes mellitus and lack of data variability. This finding contradicts those of previous studies, including a case-control study conducted in Spain and a multicenter cross-sectional study in Ethiopia, which found a significant association between a history of diabetes mellitus and periodontal disease (Belay & Achimano, 2022; Ran et al., 2023). Type 2 diabetes patients with severe periodontal disease have a 3.2 times greater risk of mortality than those without or with mild periodontitis. Individuals with diabetes mellitus may experience dental abscesses, dental caries, oral ulcerative lesions, and candidiasis as manifestations of the oral cavity. Additionally, individuals with diabetes mellitus often experience dry mouth due to decreased salivary flow (Veiga, 2018).

Furthermore, a review indicated a bidirectional relationship between diabetes mellitus and periodontal disease (Păunică et al., 2023). Diabetes mellitus influences the levels of inflammatory mediators, contributing to the worsening of periodontal disease and recurring periodontal abscesses (Llambés et al., 2015). Moreover, severe periodontitis is associated with poorer glycemic control and may lead to diabetes mellitus (Păunică et al., 2023).

Pregnant women's food consumption behavior, particularly the intake of sweet foods once or more per day, has the potential to increase the risk of periodontal disease. However, this association was not statistically significant in multivariate analysis. Residual sugar from sweet foods can facilitate the growth of oral bacteria, creating an acidic environment that can erode the protective enamel layer of teeth, thereby increasing susceptibility to periodontal infection (Angarita-Díaz et al., 2022).

In contrast, the habitual behavior of consuming sweet drinks once or more per day appears to have a lower risk of periodontal disease. However, this finding was also not significant in multivariate analysis. This difference may be associated with the quantity and frequency of sweet drink consumption, which can affect the overall impact on oral health (Asawa et al., 2018). The contrasting effects of solid and liquid sugar intake underscore the complexity of dietary factors in periodontal health, indicating that the physical state of sugar substances and their interaction with oral hygiene practices are essential components to consider.

This study found that pregnant women with poor toothbrushing behavior after breakfast and before sleeping were at a lower risk of developing periodontal disease than those with good brushing habits. This finding diverges from a previous study conducted in Korea, which suggested that brushing after lunch and before bedtime could be considered risk factors for

periodontal disease (Han & Park, 2017). Typically, dental professionals recommend tooth brushing twice daily, once at night and once in the morning (Melo et al., 2018). However, there is no universal agreement on the optimal timing for morning brushing. Some dentists recommend immediate brushing upon waking up, while others advise brushing after breakfast (Sahoo et al., 2022).

Moreover, various factors may influence toothbrushing behavior, including brushing technique, brushing duration, and using fluoride-containing toothpaste. Adequate tooth brushing needs proper and correct technique and must be tailored to the condition of the oral tissues, particularly the periodontal tissues (Pindobilowo et al., 2023).

Additionally, toothbrushing should preferably use fluoride-containing toothpaste to clean the teeth. In this study, pregnant women with poor toothbrushing behavior had a lower risk of developing periodontal disease. According to Lafaurie (2011), during pregnancy, the production of plasminogen activator inhibitor type 2 (PAI-2) is difficult to stop because the production of the inhibitor is disturbed by the hormone progesterone. Progesterone also affects increasing gingival exudate, blood vessel permeability, and proliferation. During pregnancy, there is also an increase in particular bacteria, along with high levels of estrogen and progesterone (Sathish et al., 2022).

One of the bacteria that can cause gingivitis in pregnant women is *Prevotella intermedia*, whose clinical characteristics are easy bleeding but without an increase in plaque (Lafaurie, 2011). *Prevotella intermedia* (PI) is one of the causes of periodontal disease that occurs in periodontal pockets. *Prevotella intermedia* is an anaerobic, black-pigmented, rod-shaped gram-negative bacterium (Ruan et al., 2015). This study indicates an insignificant association between toothbrushing twice daily and periodontal diseases. Similarly, there was no association between toothbrushing behavior and periodontal disease in a study in Sudan (Salih et al., 2020). In contrast, a previous study in Bangladesh found that good periodontal condition was more observed among mothers who brushed twice daily than only daily or did not brush regularly (Chowdhury & Islam, 2021). Meanwhile, toothbrushing behavior (after breakfast and before bedtime) had a significantly lower periodontal risk in this study.

Prevention and treatment generally involve good oral hygiene practices, such as brushing and cleaning teeth regularly, undergoing routine dental check-ups and cleanings, and adopting lifestyle changes, such as quitting smoking (Ran et al., 2023). Therefore, it is vital to provide education on oral hygiene practices and dental care to pregnant women who lack education levels, live in rural areas, suffer from diabetes mellitus, and have a smoking habit. In addition, it is recommended to brush teeth at least twice a day, after breakfast and before bedtime, using the correct technique and gargling (Hong et al., 2023). A good understanding of the relationship between risk factors, impacts, and complications of periodontal in pregnant women is crucial for taking appropriate preventive measures, such as maintaining oral hygiene, regular dental check-ups, and consuming nutritious foods. With these actions, dental and oral health during pregnancy can be maintained.

Pregnant women with a history of smoking have a significantly increased risk of developing periodontal disease, 1.83 times greater than pregnant women who do not smoke. This result is consistent with research findings indicating that smokers are three times more likely to develop periodontal disease compared to non-smokers (Johnson & Hill, 2004). Another study also highlighted the impact of smoking behavior on pregnancy outcomes and children's oral health (Zhong et al., 2021). However, a cross-sectional study in Brazil showed a lower smoking effect on the inflammatory response to microbiological conditions (Piscoya et al., 2012).

Several studies have emphasized the influence of the smoking environment in altering the oral microbiome. This alteration involves a decrease in beneficial species levels while promoting the proliferation of pathogenic microorganisms within 24 hours of biofilm formation. As a result, this change in microbial composition increases susceptibility to periodontitis (Moon et al., 2015; Paropkari et al., 2016). Nicotine has been proven to damage periodontal tissue, both directly and indirectly, when interacting with other factors (Nociti et al., 2001).

Strengths and limitations

The main strength of this study is the use of data from national public health surveys with cross-sectional methods so that the data can describe the prevalence of the disease nationally with large samples. However, the limitation of this study is that the assessment of periodontal disease was evaluated based on respondents' confessions through statements using a structured questionnaire, as well as through physical observations carried out by medical personnel regarding signs of periodontal disease, without using standard dental examination equipment for the diagnosis of periodontal disease.

Conclusion

Factors associated with periodontal disease in pregnant women in Indonesia include lack of formal education, residence in urban areas, gestational age, brushing teeth after breakfast and before sleeping, and smoking. However, age, working status, diabetes mellitus (DM), brushing teeth twice a day, behavioral patterns of consuming sweet foods, and behavioral patterns of consuming sweet drinks were not found to have a statistically significant relationship with periodontal disease. Neglecting to brush teeth after breakfast and before bedtime significantly increased the risk of periodontal disease in pregnant Indonesian women. This study underscores the necessity of implementing a national policy aimed at increasing awareness of periodontal disease prevention among pregnant women, particularly those with a lack of education and residing in rural and urban areas. Additionally, efforts to raise awareness about the risks of smoking during pregnancy, particularly its impact on periodontal health, are imperative. Furthermore, it is crucial to educate pregnant women on the importance of routine dental and oral care check-ups since the first trimester at primary health facilities to prevent the onset of periodontal disease during pregnancy, both in urban and rural areas.

Acknowledgments

The authors would like to thank the Secretary of the National Institute of Health Development Policy, Ministry of Health, for granting permission to publish a scientific article using the data of National Basic Health Research 2018.

References

Angarita-Díaz, M. D. P., Fong, C., Bedoya-Correa, C. M., & Cabrera-Arango, C. L. (2022). Does high sugar intake alter the oral microbiota?: A systematic review. *Clinical and Experimental Dental Research*, *8*(6), 1376–1390. https://doi.org/10.1002/cre2.640

Asawa, K., Sen, N., Bhat, N., Tak, M., Sultane, P., & Patil, V. (2018). Association of sugary foods and drinks consumption with behavioral risk and oral health status of 12- and 15-year-old Indian school children. *Journal of Education and Health Promotion*, *7*, 19. https://doi.org/10.4103/jehp.jehp_53_17

Azhria, I. N., Arina, Y. M. D., Wahyukundari, M. A., & Kiswaluyo. (2024). *Status kesehatan dan kebutuhan perawatan periodontal ibu hamil di wilayah pesisir pantai Puger Jember* [Health status and periodontal care needs of pregnant women in the Puger coastal area of Jember]. *Interdental: Jurnal Kedokteran Gigi, 20*(2), 176–183. https://doi.org/10.46862/interdental.v20i1.7123

Baumeister, S.-E., Freuer, D., Baurecht, H., Reckelkamm, S. L., Ehmke, B., Holtfreter, B., & Nolde, M. (2022). Understanding the consequences of educational inequalities on periodontitis: A Mendelian randomization study. *Journal of Clinical Periodontology*, *49*(3), 200–209. https://doi.org/https://doi.org/10.1111/jcpe.13581

Belay, A. S., & Achimano, A. A. (2022). Prevalence and risk factors for periodontal disease among women attending antenatal care in public hospitals, Southwest Ethiopia, 2022: A multicenter cross-sectional study. *Clinical, Cosmetic and Investigational Dentistry*, *14*, 153–170. https://doi.org/10.2147/CCIDE.S367713

Bhat, M. (2008). Oral health status and treatment needs of a rural Indian fishing community. *The West Indian Medical Journal, 57*(1), 41–47. https://www.mona.uwi.edu/fms/wimj/article/781

Borrell, L. N., Burt, B. A., Neighbors, H. W., & Taylor, G. W. (2004). Social factors and periodontitis in an older population. *American Journal of Public Health*, *94*(5), 748–754. https://doi.org/10.2105/ajph.94.5.748

Bunnatee, P., Abdulsalam, F. I., & Phoosuwan, N. (2023). Factors associated with oral health care behaviors of pregnant women in a northeastern province in Thailand: A hospital-based cross-sectional study. *PLOS ONE*, *18*(8), Article e0290334. https://doi.org/10.1371/journal.pone.0290334

Centers for Disease Control and Prevention (CDC). (2024). *Talking to pregnant women about oral health*. https://www.cdc.gov/oral-health/hcp/conversation-tips/talking-to-pregnant-women-about-oral-health.html

Chambrone, L., Pannuti, C. M., Guglielmetti, M. R., & Chambrone, L. A. (2011). Evidence grade associating periodontitis with preterm birth and/or low birth weight: II: A systematic review of randomized trials evaluating the effects of periodontal treatment. *Journal of Clinical Periodontology*, *38*(10), 902–914. https://doi.org/10.1111/j.1600-051X.2011.01761.x

Chen, P., Hong, F., & Yu, X. (2022). Prevalence of periodontal disease in pregnancy: A systematic review and meta-analysis. *Journal of Dentistry*, *125*, Article 104253. https://doi.org/10.1016/j.jdent.2022.104253

Chowdhury, S. F., & Islam, M. N. (2021). Periodontal diseases among pregnant women attending an antenatal clinic at Dhaka, Bangladesh. *Journal of Oral Research*, *10*(5), 1–10. https://doi.org/10.17126/JORALRES.2021.067

Corridore, D., Saccucci, M., Zumbo, G., Fontana, E., Lamazza, L., Stamegna, C., Di Carlo, G., Vozza, I., & Guerra, F. (2023). Impact of stress on periodontal health: Literature revision. *Healthcare (Basel, Switzerland)*, *11*(10), Article 1516. https://doi.org/10.3390/healthcare11101516

Daalderop, L. A., Wieland, B. V, Tomsin, K., Reyes, L., Kramer, B. W., Vanterpool, S. F., & Been, J. V. (2018). Periodontal disease and pregnancy outcomes: Overview of systematic reviews. *JDR Clinical and Translational Research*, *3*(1), 10–27. https://doi.org/10.1177/2380084417731097

Dain, C. P., Ganapathi, S., Ranjithkumar, A., Geevar, Z., Harikrishnan, S., & Ammu, J. V. (2023). Prevalence and risk factors of periodontal disease among rural and urban residents of a south Indian city: A cross-sectional study. *Journal of International Society of Preventive and Community Dentistry*, *13*(6), Article 77. https://doi.org/10.4103/jispcd.JISPCD_77_23

Fakheran, O., Keyvanara, M., Saied-Moallemi, Z., & Khademi, A. (2020). The impact of pregnancy on

women's oral health-related quality of life: A qualitative investigation. *BMC Oral Health*, *20*(1), Article 294. https://doi.org/10.1186/s12903-020-01290-5

Farsi, N. J., Merdad, Y., Mirdad, M., Batweel, O., Badri, R., Alrefai, H., Alshahrani, S., Tayeb, R., & Farsi, J. (2020). Oral health knowledge, attitudes, and behaviors among university students in Jeddah, Saudi Arabia. *Clinical, Cosmetic and Investigational Dentistry*, *12*, 515–523. https://doi.org/10.2147/CCIDE.S272986

GBD 2016 Disease and Injury Incidence and Prevalence Collaborators. (2017). Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990-2016: A systematic analysis for the Global Burden of Disease Study 2016. *Lancet (London, England)*, *390*(10100), 1211–1259. https://doi.org/10.1016/S0140-6736(17)32154-2

George, A., Johnson, M., Duff, M., Ajwani, S., Bhole, S., Blinkhorn, A., & Ellis, S. (2012). Midwives and oral health care during pregnancy: Perceptions of pregnant women in South-Western Sydney, Australia. *Journal of Clinical Nursing*, *21*(7–8), 1087–1096. https://doi.org/https://doi.org/10.1111/j.1365-2702.2011.03870.x

Gil-Montoya, J. A., Rivero-Blanco, T., Leon-Rios, X., Exposito-Ruiz, M., Pérez-Castillo, I., & Aguilar-Cordero, M. J. (2023). Oral and general health conditions involved in periodontal status during pregnancy: a prospective cohort study. *Archives of Gynecology and Obstetrics*, *308*(6), 1765–1773. https://doi.org/10.1007/s00404-022-06843-3

Han, K., & Park, J.-B. (2017). Association between oral health behavior and periodontal disease among Korean adults: The Korea national health and nutrition examination survey. *Medicine*, *96*(7), Article 6176. https://doi.org/10.1097/MD.0000000000006176

Hong, H. H., Chen, Y. H., Cheng, P. J., Chang, M. Y., & Chuang, L. L. (2023). Risk factors associated with periodontal disease and its impact on quality of life among pregnant women. *Journal of Obstetrics and Gynaecology*, *43*(2), Article 2264382. https://doi.org/10.1080/01443615.2023.2264382

Idaiani, S., & Indrawati, L. (2021). Functional status in relation to depression among elderly individuals in Indonesia: A cross-sectional analysis of the Indonesian National Health Survey 2018 among elderly individuals. *BMC Public Health*, *21*(1), Article 12260. https://doi.org/10.1186/s12889-021-12260-z

Indonesian Society of Endocrinology (PERKENI). (2019). *Konsensus pengelolaan dan pencegahan diabetes melitus tipe 2 di Indonesia [*Consensus on management and prevention of type II diabetes mellitus in Indonesia*]*. Indonesian Society of Endocrinology (PB.PERKENI). https://pbperkeni.or.id/wp-content/uploads/2021/06/Pedoman-Pengelolaan-DM-Tipe-2-Dewasa-di-Indonesia-eBook-PDF.pdf

Johnson, G. K., & Hill, M. (2004). Cigarette smoking and the periodontal patient. *Journal of Periodontology*, *75*(2), 196–209. https://doi.org/10.1902/jop.2004.75.2.196

Karobari, M. I., Siddharthan, S., Adil, A. H., Khan, M. M., Venugopal, A., Rokaya, D., Heboyan, A., Marya, C. M., & Marya, A. (2022). Modifiable and non-modifiable risk factors affecting oral and periodontal health and quality of life in South Asia. *The Open Dentistry Journal*, *16*(1), 1–6. https://doi.org/10.2174/18742106-v16-e2209270

Kloetzel, M. K., Huebner, C. E., & Milgrom, P. (2011). Referrals for dental care during pregnancy. *Journal of Midwifery & Women's Health*, *56*(2), 110–117. https://doi.org/https://doi.org/10.1111/j.1542-2011.2010.00022.x

Lafaurie, G. I. (2011). Gingival tissue and pregnancy. In F. S. Panagakos & R. M. Davies (Eds.), *Gingival diseases* (pp. 101–120). IntechOpen. https://doi.org/10.5772/23796

Listl, S., Galloway, J., Mossey, P. A., & Marcenes, W. (2015). Global economic impact of dental diseases. *Journal of Dental Research*, *94*(10), 1355–1361. https://doi.org/10.1177/0022034515602879

Llambés, F., Arias-Herrera, S., & Caffesse, R. (2015). Relationship between diabetes and periodontal infection. *World Journal of Diabetes*, *6*(7), 927–935. https://doi.org/10.4239/wjd.v6.i7.927

Mariotti, A. (2007). Periodontal diseases. In S. J. Enna & D. B. Bylund (Eds.), *xPharm: The comprehensive pharmacology reference* (pp. 1–5). Elsevier. https://doi.org/10.1016/B978-008055232-3.60697-X

Melo, P., Fine, C., Malone, S., Frencken, J. E., & Horn, V. (2018). The effectiveness of the Brush Day and Night programme in improving children's toothbrushing knowledge and behaviour. *International Dental Journal*, *68*, 7–16. https://doi.org/https://doi.org/10.1111/idj.12410

Moon, J.-H., Lee, J.-H., & Lee, J.-Y. (2015). Subgingival microbiome in smokers and non-smokers in Korean chronic periodontitis patients. *Molecular Oral Microbiology*, *30*(3), 227–241.

https://doi.org/10.1111/omi.12086
Mulyana, W. (2014, October). *Rural-urban linkages: Indonesia case study* (Working Paper Series No. 126). Working Group: Development with Territorial Cohesion, Territorial Cohesion for Development Program. https://rimisp.org/wp-content/files_mf/1422298454R_ULinkages_Indonesia_countrycase_Final_edited.pdf
National Institute of Health Research and Development (NIHRD). (2008, August). *Riset Kesehatan Dasar (Riskesdas) 2007* [Basic Health Research 2007]. Ministry of Health, Republic of Indonesia. https://layanandata.kemkes.go.id/katalog-data/riskesdas/ketersediaan-data/riskesdas-2007
National Institute of Health Research and Development (NIHRD). (2014, April). *Riset Kesehatan Dasar (Riskesdas) 2013* [Basic Health Research 2013]. Ministry of Health, Republic of Indonesia. https://layanandata.kemkes.go.id/katalog-data/riskesdas/ketersediaan-data/riskesdas-2013
National Institute of Health Research and Development (NIHRD). (2019, November). *Riset Kesehatan Dasar (Riskesdas) 2018* [Basic Health Research 2018]. Ministry of Health, Republic of Indonesia. https://layanandata.kemkes.go.id/katalog-data/riskesdas/ketersediaan-data/riskesdas-2018
Nghayo, H. A., Palanyandi, C. E., Ramphoma, K. J., & Maart, R. (2024). Oral health community engagement programs for rural communities: A scoping review. PLOS ONE, 19(2), Article e0297546. https://doi.org/10.1371/journal.pone.0297546
Nociti, F. H. J., Nogueira-Filho, G. R., Tramontina, V. A., Machado, M. A., Barros, S. P., Sallum, E. A., & Sallum, A. W. (2001). Histometric evaluation of the effect of nicotine administration on periodontal breakdown: An in vivo study. *Journal of Periodontal Research*, *36*(6), 361–366. https://doi.org/10.1034/j.1600-0765.2001.360603.x
Paropkari, A. D., Leblebicioglu, B., Christian, L. M., & Kumar, P. S. (2016). Smoking, pregnancy and the subgingival microbiome. *Scientific Reports*, *6*, Article 30388. https://doi.org/10.1038/srep30388
Păunică, I., Giurgiu, M., Dumitriu, A. S., Păunică, S., Pantea Stoian, A. M., Martu, M.-A., & Serafinceanu, C. (2023). The bidirectional relationship between periodontal disease and diabetes mellitus—a review. *Diagnostics (Basel, Switzerland)*, *13*(4), Article 681. https://doi.org/10.3390/diagnostics13040681
Petersen, P. E., Baez, R. J., & World Health Organization. (2013). *Oral health surveys: Basic methods* (5th ed.). WHO Press. https://iris.who.int/handle/10665/97035
Petersen, P. E., & Ogawa, H. (2012). The global burden of periodontal disease: Towards integration with chronic disease prevention and control. *Periodontology 2000*, *60*(1), 15–39. https://doi.org/10.1111/j.1600-0757.2011.00425.x
Pindobilowo, Tjiptoningsih, U. G., & Ariani, D. (2023). Effective tooth brushing techniques based on periodontal tissue conditions : A narrative review. *Formosa Journal of Applied Sciences*, *2*(7), 1649–1662. https://doi.org/10.55927/fjas.v2i7.4838
Piscoya, M. D. B. de V., Ximenes, R. A. de A., Silva, G. M. da, Jamelli, S. R., & Coutinho, S. B. (2012). Periodontitis-associated risk factors in pregnant women. *Clinics (Sao Paulo, Brazil)*, *67*(1), 27–33. https://doi.org/10.6061/clinics/2012(01)05
Ran, E. L., I, M. N., MC, B.-R. de la H., B, M.-P., & A, P.-M. (2023). Periodontal status and gestational diabetes mellitus: A case-control study. *Journal of Dentistry & Oral Disorders*, *9*(1), 1–6. https://doi.org/10.26420/jdentoraldisord.2023.1177
Rikawarastuti, R., Ngatemi, N., & Harahap, N. N. (2016). Periodontal disease in pregnant women (Case study: Pondok Labu Village, South Jakarta, Indonesia). *International Journal of Public Health Science (IJPHS), 5*(2), 170–175. https://doi.org/10.11591/ijphs.v5i2.4782
Ruan, Y., Shen, L., Zou, Y., Qi, Z., Yin, J., Jiang, J., Guo, L., He, L., Chen, Z., Tang, Z., & Qin, S. (2015). Comparative genome analysis of *Prevotella intermedia* strain isolated from infected root canal reveals features related to pathogenicity and adaptation. *BMC Genomics, 16*(1), Article 122. https://doi.org/10.1186/s12864-015-1272-3
Sahoo, S. R., Nandini, D. B., Basandi, P. S., Selvamani, M., & Donoghue, M. (2022). A comparison of pre-and post-breakfast tooth brushing in caries prevention through the estimation of *streptococcus mutans* counts: A prospective clinical and microbiological study. *Journal of Microscopy and Ultrastructure*, *10*(4), 168–173. https://doi.org/10.4103/jmau.jmau_90_21
Salih, Y., Nasr, A. M., Ahmed, A. B. A., Sharif, M. E., & Adam, I. (2020). Prevalence of and risk factors for periodontal disease among pregnant women in an antenatal care clinic in Khartoum, Sudan. *BMC Research Notes*, *13*(1), Article 147. https://doi.org/10.1186/s13104-020-04998-3

Sathish, A. K., Varghese, J., & Fernandes, A. J. (2022). The impact of sex hormones on the periodontium during a woman's lifetime: A concise-review update. *Current Oral Health Reports*, *9*(4), 146–156. https://doi.org/10.1007/s40496-022-00321-0

Silva de Araujo Figueiredo, C., Gonçalves Carvalho Rosalem, C., Costa Cantanhede, A. L., Abreu Fonseca Thomaz, É. B., & Fontoura Nogueira da Cruz, M. C. (2017). Systemic alterations and their oral manifestations in pregnant women. *The Journal of Obstetrics and Gynaecology Research*, *43*(1), 16–22. https://doi.org/10.1111/jog.13150

Sperandei, S. (2014). Understanding logistic regression analysis. *Biochemia Medica*, *24*(1), 12–18. https://doi.org/10.11613/BM.2014.003

Susanto, A., Bawono, C. A., & Putri, S. S. (2024). Hormonal changes as the risk factor that modified periodontal disease in pregnant women: A systematic review. *Journal of International Oral Health, 16*(3), Article 155. https://doi.org/10.4103/jioh.jioh_155_23

Tedjosasongko, U., Anggraeni, F., Wen, M. L., Kuntari, S., & Puteri, M. M. (2019). Prevalence of caries and periodontal disease among Indonesian pregnant women. *Pesquisa Brasileira Em Odontopediatria e Clinica Integrada*, *19*(1), 1–8. https://doi.org/10.4034/PBOCI.2019.191.90

Timková, S., Klamárová, T., Kovaľová, E., Novák, B., Kolarčik, P., & Madarasová Gecková, A. (2020). Health literacy associations with periodontal disease among Slovak adults. *International Journal of Environmental Research and Public Health, 17*(6), Article 2152. https://doi.org/10.3390/ijerph17062152

Tonetti, M. S., Jepsen, S., Jin, L., & Otomo-Corgel, J. (2017). Impact of the global burden of periodontal diseases on health, nutrition and wellbeing of mankind: A call for global action. *Journal of Clinical Periodontology*, *44*(5), 456–462. https://doi.org/10.1111/jcpe.12732

United States Census Bureau (USCB). (2018, May). *CSPro training manual.* https://essp.ifpri.info/files/2018/07/CSPro_Training-manual_May28.pdf

Veiga, N. (2018). Oral manifestations and diabetes. *Biomedical Journal of Scientific & Technical Research*, *7*(5), 6168–6171. https://doi.org/10.26717/bjstr.2018.07.001574

Vogt, M., Sallum, A. W., Cecatti, J. G., & Morais, S. S. (2012). Factors associated with the prevalence of periodontal disease in low-risk pregnant women. *Reproductive Health*, *9*, 3. https://doi.org/10.1186/1742-4755-9-3

Wandera, M., Åstrøm, A. N., Okullo, I., & Tumwine, J. K. (2012). Determinants of periodontal health in pregnant women and association with infants' anthropometric status: A prospective cohort study from Eastern Uganda. *BMC Pregnancy and Childbirth*, *12*. https://doi.org/10.1186/1471-2393-12-90

Wijaksana, I. K. E., Bargowo, L., & Supandi, S. K. (2020). Peningkatan kesehatan periodontal ibu hamil dalam upaya mengurangi resiko bayi dengan berat badan lahir rendah [Improving periodontal health in pregnant women to reduce the risk of low birth weight babies]. *Jurnal Layanan Masyarakat, 4*(2), 275–281. https://doi.org/10.20473/jlm.v4i2.2020.275-281

World Health Organization. (2022, October 25). *Action plan for oral health in South-East Asia 2022–2030: Towards universal health coverage for oral health.* https://www.who.int/publications/i/item/9789290210061

Zhong, Y., Tang, Q., Tan, B., & Huang, R. (2021). Correlation between maternal smoking during pregnancy and dental caries in children: A systematic review and meta-analysis. *Frontiers in Oral Health, 2,* Article 673449. https://doi.org/10.3389/froh.2021.673449