



## Portrait of Periodontal Disease Risk Factors among Adults

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### Abstract

Periodontal disease is still a common oral disease all over the world. The yearly report from the Wonosobo District Health Office revealed that 17,807 out of 780,667 people had dental problems, with 5,422 of them having periodontal disease. This number was higher compared to the national number in Central Java Province. The study aimed to identify periodontal disease risk factors. A cross-sectional study was conducted using subjects aged 20-50 years old who resided in Wonosobo District. The data were analyzed using chi-square and logistic regression. A total of 440 subjects were included in the study. Independent variables consisted of demographic and oral conditions namely sex, age group, education level, economic status, smoking, salivary flow rate, plaque accumulation, crowded teeth, and oral hygiene. The result of the study indicated that higher education level (OR 2.09; 95% CI 1.266-3.463) and lower plaque accumulation (OR 3.61; 95% CI 2.310-5.640) were found to be significant risk factors, whereas uncrowded teeth (OR 0.54; 95% CI 0.342-0.852) and good oral hygiene (OR 0.07; 95% CI 0.036-0.152), and fair oral hygiene (OR 0.28; 95% CI 0.142-0.572) were found to be significant protective factors for the occurrence of periodontal disease among adults in Wonosobo District.

### Introduction

Periodontal disease remains a prevalent oral health issue, second only to untreated dental caries in terms of prevalence (Chen et al., 2021; Kassebaum et al., 2015). It is distinguished by inflammation of the gingiva and adjacent tissues that support the teeth. Gingivitis is an early infection characterized by swollen and reddish gums, which can evolve to periodontitis as the infection progresses. Periodontitis is characterized by the deterioration of the periodontal ligament, which can later result in pocket formation and clinical attachment loss. It is also distinguished by the loss of the alveolar bone. Thus, periodontitis can cause tooth mobility and loss (Caton et al., 2018). According to the World Health Organization (WHO), severe periodontal disease affected around one million population. In the last three decades, the number of cases of severe

periodontitis rose by 8.44%; thus, in 2019, it was up to 1.1 million cases (Chen et al., 2021). In Indonesia, there were 95.21% of adults who had periodontal disease in 2013, and the number decreased to 74.1% in 2018 (Indonesia Basic Health Research, 2018). In 2013, the prevalence of oral health problems in Wonosobo District was higher than the national average in Central Java Province. There were 17,807 people with oral health problems out of 780,667 people, and 5,442 had periodontal disease (Wonosobo District Health Office, 2013).

Although it is avoidable, periodontal disease has the potential to harm not just masticatory function but also the quality of life and self-esteem (Barbe et al., 2020; Bulut et al., 2023; Shamim et al., 2022). Many studies also suggested that periodontal disease, mainly periodontitis, was linked to several non-communicable diseases (NCDs), namely

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cardiovascular disease, diabetes, cancer, and respiratory diseases (Dörfer et al., 2017; Lee et al., 2017; Peres et al., 2019). The inflammation associated with periodontal disease could contribute to the development or worsening of these conditions (Lee et al., 2017; Peres et al., 2019). A bidirectional relationship was also found between periodontitis and diabetes mellitus (Păunică et al., 2023; Preshaw et al., 2012).

According to Jiao et al (2021) periodontal disease became more common and more severe as people aged. By identifying the risk factor, periodontal disease can be prevented before it occurs. One of the main causes of periodontal disease was plaque bacteria (World Health Organization, 2023). Several studies found that socio-demographic factors also contributed to the occurrence of periodontal disease. Kassier (2016) indicated that the most prevalent NCDs and periodontitis had similar social determinants and risk factors. The purpose of the current study is to identify possible risk factors that might eventually result in periodontal disease.

## Method

A cross-sectional study was conducted in the public health centers (PHCs) in Wonosobo District from March to May 2018. Four PHCs were identified as a result of a cluster random sample: Selomerto I, Kalikajar I, Sukoharjo I, and Garung. Patients over the age of 20 who resided in the Wonosobo District and visited a PHC dental clinic were considered the subjects. 440 participants were determined to be the sample size. The following were the exclusion criteria: diagnosed with diabetes, under medication that decreased salivary flow, menstruating or pregnant, and used fixed orthodontic appliance. The study was approved by the Medical and Health Research Ethics Committee of the Faculty of Medicine, Public Health, and Nursing at Universitas Gadjah Mada under protocol number KE/FK/0504/EC/2018.

Periodontal disease was identified by the PHC dentist as ICD X code K.05. Through the use of a questionnaire, the socio-demographic information (age, gender, socioeconomic status, and degree of education)

and smoking habits were gathered. The dental hygienist documented the status of oral hygiene, plaque accumulation score, unstimulated salivary flow rate, and crowded teeth status. Oral hygiene status was measured using the Oral Hygiene Index-Simplified (OHI-S) of Greene & Vermillion (1964). The OHI-S score was calculated by adding the debris and calculus indices collected on six index tooth surfaces. There are three horizontal divisions on each tooth surface. The OHI-S score ranges from 0 to 6, depending on the amount of debris or calculus present on each index tooth surface. This rating can be divided into three categories: good oral hygiene (OHI-S score 0-1.2), fair oral hygiene (OHI-S score 1.3-3.0), and poor oral hygiene (OHI-S score 3.1-6.0). On the other hand, the plaque accumulation score was measured using the Patient Hygiene Performance Modified (PHP-M) of Martens & Meskin (1972). The buccal/labial and lingual/palatal surfaces of six index teeth were inspected for plaque after being treated with a disclosing agent in this examination. This examination separates the tooth surface into five sections instead of the three that the OHI-S did. Plaque presence in each area was assigned a score of 1, while the absence of plaque in the area was assigned a score of 0. The PHP-M score ranged from 0 to 60. Data were analyzed in bivariate and multivariate using chi-square and logistic regression using STATA.

## Result and Discussion

Only 440 of the 480 subjects who agreed to take part in the study were used in the analysis. The largest percentage of the subjects (76.59%) were female, had a mean age of  $31.55 \pm 8.87$ , were non-smokers (85.68%), had a higher level of education (57.73%), and were in a higher economic status (66.14%). Furthermore, half of them had a normal salivary flow rate (55.68%), higher plaque accumulation score (51.59%), crowded teeth (58.64%), and good oral hygiene (40.91%). Among these demographic and oral condition variables, age group 20-29 years old, higher education level, being a current and former smoker, had lower plaque accumulation level, had a normal salivary flow rate, had good and moderate oral hygiene were linked to the development of periodontal disease ( $p < 0.05$ ),

according to the Chi-square test shown in Table 1. On the other hand, sex and economic status were not associated with the occurrence of periodontal disease ( $p>0.05$ ). These results were in contrast with the previous study that showed a significant association between sex and economic status. Shiao & Reynolds (2010) demonstrated that males had higher rates of severe periodontal disease than females. This difference in prevalence may be due to hormonal, genetic, and behavioral reasons (Lipsky et al., 2021). Kim (2018) found that lower economic status increased the risk of developing periodontal disease symptoms.

According to Park (2016), socioeconomic status was associated with oral health behavior. This is attributed to the higher socioeconomic group's usage of a wider range of tooth-cleaning devices and the higher frequency of dental cleaning and visits. However, this finding was not in line with those previous studies.

The multivariate analysis in Table 2 showed that only four variables were substantially linked with the occurrence of periodontal disease among adults in the Wonosobo District, namely crowded teeth, plaque accumulation, oral hygiene status, and education level. Whereas age group and

Table 1. Bivariate Analysis of The Demographic and Oral Conditions Variables

Variables	Periodontal disease		OR (95% CI)	p-value
	Yes n (%)	No n (%)		
<b>Sex</b>				
Female	167 (49.55)	170 (50.45)	1.08 (0.695 - 1.675)	0.736
Male	53 (51.46)	50 (48.54)	1	
<b>Age group</b>				
20-29 years	67 (31.02)	149 (68.98)	0.15 (0.039 - 0.571)	0.005
30-39 years	86 (66.15)	44 (3.85)	0.65 (0.168 - 2.528)	0.536
40-49 years	58 (70.73)	24 (29.27)	0.80 (0.200 - 3.236)	0.761
50-59 years	9 (75.00)	3 (25.00)	1	
<b>Education level</b>				
Higher	46 (38.66)	73 (61.34)	1.88 (1.224 - 2.881)	0.004
Lower	174 (54.21)	147 (45.79)	1	
<b>Economic status</b>				
Higher	142 (48.80)	149 (51.20)	1.15 (0.777 - 1.710)	0.481
Lower	78 (52.35)	71 (47.65)	1	
<b>Smoking</b>				
Current smoker	180 (47.75)	197 (52.25)	0.22 (0.094 - 0.516)	0.000
Former smoker	11 (40.74)	16 (59.26)	0.17 (0.054 - 0.512)	0.002
Nonsmoker	29 (80.56)	7 (19.44)	1	
<b>Plaque accumulation</b>				
Lower	75 (33.04)	152 (66.96)	4.32 (2.901 - 6.439)	0.000
Higher	145 (68.08)	68 (31.92)	1	
<b>Unstimulated salivary flow rate</b>				
Normal	134 (54.69)	111 (45.31)	0.65 (0.448 - 0.954)	0.027
Low	86 (44.10)	109 (55.90)	1	
<b>Crowded tooth</b>				
No	98 (53.85)	84 (46.15)	0.77 (0.526 - 1.124)	0.175
Yes	122 (47.29)	136 (52.71)	1	
<b>Oral hygiene status</b>				
Good	47 (26.11)	133 (73.89)	0.06 (0.032 - 0.127)	0.000
Fair	102 (57.95)	74 (42.05)	0.25 (0.130 - 0.489)	0.000
Poor	71 (84.52)	13 (15.48)	1	

Source: Primary data, 2018

smoking status were not significantly associated with the occurrence of periodontal disease. Different from this result in the age group, a study from Relvas (2022) found that increased age was a risk factor for periodontal disease occurrence. Jiao (2021) & Susanto (2020) discovered that as people aged, periodontal disease became more common and more severe. On the other hand, a similar result in smoking status was found in Gayatri (2021), which shows no significant association between smoking and periodontal disease after logistic regression. Jiang (2020) showed smoking enhanced plaque accumulation, which can lead to calculus buildup and interfere with the subgingival microflora. As a result, smoking was linked to the degradation of the periodontal tissues, including the alveolar bone, which can lead to tooth mobility and ultimately tooth loss. Other than that, smoking reduces the response of the immune system to infections, causing periodontal disease to progress rapidly. Additionally, smoking lowers blood flow to the gums and inhibits the body's capacity to provide necessary nutrients and immune cells to the oral tissues, called microvascular dysfunction which can prolong the healing process (Silva, 2021).

According to the result of this study, adults who had higher education levels had a 2.09 times higher risk of having periodontal disease than adults who had lower education levels. It can be assumed that higher level education showed a greater chance of experiencing periodontal disease than lower education level. This result was in contrast with a systematic review by Boillot (2011) that demonstrated low education level as a predictor of chronic periodontitis which is also similar to a recent study that showed higher education level lowered the risk for periodontal disease (Baumeister et al., 2022; Walther et al., 2022). Low education affects the likelihood of using dental services, regardless of an individual's oral health behavior and status. Moreover, people with lower education levels are more likely to receive emergency care and treatment than routine dental check-ups or examinations (Ghanbarzadegan et al., 2022). The different results shown in this study might be linked to

poor oral health behavior, which in this study was not identified and became a limitation of the study.

Table 2. Multivariate Analysis of The Variables

Variables	OR (95% CI)	p-value
Education level		
Higher	2.09(1.266-3.463)	0.004
Lower	1	
Plaque accumulation		
Lower	3.61(2.310-5.640)	0.000
Higher	1	
Crowded tooth		
No	0.54(0.342-0.852)	0.008
Yes	1	
Oral hygiene		
Good	0.07(0.036-0.152)	0.000
Fair	0.28(0.142-0.572)	
Poor	1	

Source: Primary data, 2018

This study also revealed that adults who had lower plaque accumulation were 3.61 times more susceptible to developing periodontal disease than those with higher plaque accumulation. This result was different from the theory and previous study which stated that the absence of dental plaque was consistent with the presence of healthy gingiva and increased dental plaque was associated with the occurrence of gingivitis (Carvajal et al., 2016; Mostafa & El-Refai, 2018). Gingivitis is recognized as the most common form of periodontal disease affecting most adults. Bacterial plaque that builds up close to the gingival border is the primary contributory factor of gingivitis. Without proper oral hygiene, these bacteria can build up and penetrate the gingiva and cause inflammation. Contrary to this, oral hygiene behaviors such as toothbrushing before the examination were not identified which might be biased in this study. As reported by Lertpimonchai (2017) & Relvas (2022) there was a protective effect of regular toothbrushing on the occurrence of periodontitis since toothbrushing is effective in plaque control removal. In other words, a lack of oral hygiene habits such as brushing teeth and flossing might increase the probability of experiencing periodontal disease.

Additionally, it was discovered that poor oral hygiene increased the risk of periodontal disease. The odds ratio for good oral hygiene was 0.07 (CI 95%;  $p$ -value <0.001) which means adults with good oral hygiene had a 93% lower risk of experiencing periodontal disease than adults with poor oral hygiene. The odds ratio for fair oral hygiene was 0.28 (CI 95%;  $p$ -value <0.001) which means adults with moderate oral hygiene had a 72% lower risk of experiencing periodontal disease than adults with poor oral hygiene. It can be assumed from the results that poor oral hygiene had a greater risk of experiencing periodontal disease than good and fair oral hygiene. This result was similar to the study of Susanto et al. (2020) in the severity of periodontal disease increased as oral hygiene deteriorated. In contrast to good dental hygiene, several studies have revealed that fair and poor oral hygiene greatly increases the chance of developing periodontitis (Lertpimonchai *et al.*, 2017).

Other than that, the findings of the study revealed a link between periodontal disease and crowded teeth. Adults who had crowded teeth were 46% less likely to have periodontal disease than adults without crowded teeth. The formation of dental plaque, which is known to play a key role in the development of periodontal disease, was influenced locally by crowded teeth. Crowded teeth can cause less optimal plaque cleaning since they enhance food retention and plaque accumulation in that area (Arora & Bhateja, 2015; Bahirrah, 2018). Furthermore, crowded teeth were found to be associated with higher dental calculus, which is one of the predisposing factors for periodontal disease as it provides a retentive surface for plaque attachment (Arora & Bhateja, 2015; Farooq et al., 2019). However, another study found that crowded teeth did not contribute to the progression of gingivitis when people practiced proper oral care. Therefore, maintaining good dental hygiene might lessen the likelihood of food retention and plaque buildup.

## Conclusion

Higher education levels, lower plaque accumulation, crowded teeth, and poor oral hygiene were significantly associated with the

occurrence of periodontal disease among adults in the Wonosobo District. Periodontal disease management and treatment are expected to be optimized by modifying some of the risk factors. However, it is vital to improve the oral health prevention program in the population.

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