

Association between age, gender and education level with the severity of periodontitis in pre-elderly and elderly patients

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ABSTRACT

Background: As individuals grow older, they may be more susceptible to chronic diseases, which can affect their overall health. Periodontitis, for instance, is one of the most common oral diseases that result from prolonged exposure to pathogens. The main etiology of periodontitis is dental biofilms, but several risk factors may also affect the progression of the disease. **Purpose:** The study aimed to determine whether there was an association between age, gender and education level and the severity of periodontitis using the 2017 American Academy of Periodontology (AAP) classification. **Methods:** A retrospective analytical study was used to determine the stage and grade of periodontitis in relation to age, gender and education level. Secondary data in the form of medical record status was analysed using software applications. **Results:** The distribution of periodontitis was 66.7% in pre-elderly patients (45–59 years), 61.5% in male subjects and 39.7% in individuals with middle education levels. Using chi-square analysis, the severity of periodontitis showed a statistically significant correlation with age ($p=0.01$) and gender ($p=0.003$). In contrast, the level of education was not statistically correlated to the severity of periodontitis ($p=0.887$). The percentage of stage IV grade B was highest in elderly patients (65.38%), while stage IV grade C was the highest in male subjects (41.67%). **Conclusion:** The study showed that age and gender significantly influenced the occurrence and severity of periodontitis, while education level showed the opposite.

Keywords: ageing population; periodontitis; severity

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INTRODUCTION

According to the Central Bureau of Statistics (BPS), in 2020, the population of Indonesia began to age, with the percentage of elderly people recorded at 9.92% (approximately 26.82 million people) and projected to reach almost one-fifth of the total population by 2045. This is occurring as a result of the improvements in health facilities, nutrition and socioeconomic conditions.¹ Nonetheless, compared with other age groups, elderly people are more vulnerable to chronic inflammation, including periodontitis. The increased susceptibility to periodontitis among the elderly may be due to prolonged exposure to periodontal pathogens as well as changes in the immuno-inflammatory status of the periodontal tissue.²

Globally, periodontitis in severe form affects more than 10% of the population. In 2010, it was ranked the sixth most prevalent condition, with approximately 743 million people affected.³ As one of the major causes of tooth loss in the adult population, periodontitis may lead to multiple edentulous and masticatory dysfunctions, which affect nutrition, quality of life and self-esteem while also imposing high socioeconomic and healthcare costs.⁴ According to one finding in 2010, direct and indirect costs due to dental diseases amounted to USD442 billion worldwide, with 83% of the direct treatment costs being attributable to high-income countries (e.g. North America, Western Europe and high-income Asia-Pacific).⁵ In line with that, between 1990 and 2010, the global burden of periodontitis increased by 57.3%. These numbers are likely to rise due to increased

tooth retention globally and as many populations continue to grow and age.⁴

Meanwhile, in Indonesia, the 2018 Basic Health Research (Riskesmas) report showed a high prevalence of periodontitis (74.1%), with the highest prevalence in pre-elderly patients (77.8%) and decreasing gradually in elderly patients (66.0%).⁶ This may be due to an unawareness of periodontal diseases symptoms, and many individuals tend to seek dental care only when they can no longer bear the pain. Similarly, tooth loss is regarded as an unavoidable outcome of the ageing process in many cultures. These cultural beliefs can have a negative impact on oral and periodontal health.⁷

The accumulation of dental biofilm as a result of poor oral hygiene habits initiates the colonisation of microorganisms in periodontal tissue. These biofilms can cause direct damage to periodontal tissue by impairing polymorphonuclear leukocyte (PMN) functions, such as chemotaxis, phagocytosis and intracellular killing.⁸ However, their primary role in periodontal pathogenesis is to activate immune-inflammatory responses, which result in tissue damage and may be beneficial to the bacteria in the periodontal pockets by providing nutrient sources.⁹

A possible mechanism is the release of pro-inflammatory cytokines, such as interleukin-1 (IL-1) and tumor-necrotising factor (TNF- α), due to the immune-inflammatory response to bacterial invasion, resulting in the progressive destruction of periodontal tissue characterised by clinical attachment loss, followed by an increase in pocket depth and changes in the density and height of the alveolar bone. Although periodontal diseases are initiated by dental biofilms, several risk factors include socio-demographic characteristics, such as age, gender, educational level and income. Risk behaviours like smoking are also important factors that influence the progression and severity of the disease.^{9,10}

In response to new scientific evidence, the classification of periodontitis has been repeatedly modified in the last 30 years. In 2017, the American Academy of Periodontology (AAP) published an updated classification of periodontal and peri-implant diseases and conditions.¹¹ However, the latest classification of periodontitis is still not commonly used in Indonesia, especially in relation to the medical records of Universitas Sumatera Utara Dental Hospital. Therefore, this study aims to provide data on the distribution of periodontitis in Universitas Sumatera Utara Dental Hospital and identify the association between several risk factors, such as age, gender and education level, that affect the severity of periodontitis by using the new approach for classification.

MATERIALS AND METHODS

This retrospective analytical study was carried out between May and July 2021 at the periodontics clinic of Universitas Sumatera Utara Dental Hospital, one of the referral places for treating periodontitis patients in Medan.

The Research Ethics Commission of Universitas Sumatera Utara approved this study (No.392/KEP/USU/2021) in accordance with the medical and ethics protocols of the Declaration of Helsinki.

Sample selection was made using the purposive sampling technique corresponding to inclusion and exclusion criteria. The inclusion criteria were medical records with the visit years 2015–2019, which included information on age, gender, education level, clinical attachment loss (CAL), pocket depth (PD), number of missing teeth and the diagnosis of periodontitis. Patients under 45 years old, patients with systemic conditions and incomplete or unreadable medical record data were excluded.

During the recording of medical records in 2015–2018, the diagnosis of periodontitis was still based on the 1999 classification of periodontal diseases and conditions; hence, the conversion to the 2017 classification of periodontal and peri-implant diseases and conditions was performed for this study. Periodontitis was classified as stage I to stage IV and determined by CAL, PD, percentage of bone loss and the number of missing teeth stated in the medical record data. CAL 1–2 mm was defined as stage I, 3–4 mm as stage II and ≥ 5 mm as stage III to stage IV. An evaluation of the complexity of management was also performed, wherein stage II was reclassified to stage III if the maximum PD was ≥ 6 mm and stage III was reclassified to stage IV if there were less than 20 remaining teeth or 10 opposing pairs.

In addition to the severity and extent of the disease, grading systems were used to determine the likelihood that periodontitis would progress at a faster rate than the majority of the population or respond less predictably to standard therapy. It was classified into three groups: grade A (slow rate of progression), grade B (moderate rate of progression) and grade C (rapid rate of progression).

Age was classified into two groups: pre-elderly (45–59 years) and elderly (≥ 60 years), while the education level was categorised into low (elementary to junior high school), middle (secondary high school) and high (diploma) levels. The association between age, gender, educational level and the severity of periodontitis was determined by using chi-square analysis. Data analysis was performed using software applications and presented in the table, where the significance level was established at p -value < 0.05 .

RESULTS

The present study was conducted using secondary data in the form of medical records with the visit years 2015–2019 from the periodontics clinic of Universitas Sumatera Utara Dental Hospital. After 297 medical records were collected, several of them were excluded due to incomplete or unreadable sections; hence, 78 subjects were obtained that matched the inclusion criteria.

The characteristics of the study subjects are shown in Table 1. It was found that the percentage of periodontitis in the pre-elderly age group was higher (66.7%) than in the

elderly age group (33.3%). Males were the dominant part of the sample (61.5%), compared with females (38.5%). The frequencies of the study subjects were 34.6%, 39.7% and 25.6% among the three education level groups, respectively.

The highest percentage of periodontitis corresponding to age group, based on the 2017 AAP classification, was stage IV grade B (where the CAL was 5 mm or greater with a moderate rate of the disease's progression) in the elderly age group (65.38%). When categorised by gender, the highest percentage of periodontitis was stage IV grade C (where the CAL was 5 mm or greater with a rapid rate of the disease's progression) in male subjects (41.67%). Based on the education level, stage IV grade B was found to

have the highest percentage in low-education level subjects (37.04%) (Table 2).

Table 3 shows the association between the variables and the severity of periodontitis. When categorised by age, stage IV was more prevalent than stage III in the pre-elderly age group (52.9% and 47.1%, respectively), while the elderly age group suffered from stage IV the most (85.2%), and it was statistically significant ($p=0.01$). Using chi-square analysis, males were found to be more likely to have stage IV periodontitis (79.2%), while stage III periodontitis was found to be more prevalent in female subjects (56.7%) ($p=0.003$). In contrast, there was no significant difference ($p>0.05$) observed in the education level.

Table 1. Characteristics of subjects by socio-demographic variables (n=78)

Variables	Subject (n=78)	Percentage (%)
Age		
Pre-elderly (45–59 years)	52	66.7
Elderly (≥ 60 years)	26	33.3
Gender		
Male	48	61.5
Female	30	38.5
Education level		
Low	27	34.6
Middle	31	39.7
High	20	25.6

DISCUSSION

This study was conducted using secondary data in the form of medical record status because the relationship among variables within a population that has not been previously analysed can be examined, potentially yielding important new findings to advance science, especially in the periodontology field. In addition, using and interpreting data that are already available may be helpful to uncover new information that can be used to improve education, health services and health policy.¹²

Table 2. Staging and grading based on age, gender and education level at the periodontics clinic of Universitas Sumatera Utara Dental and Oral Hospital in Medan

Variables (n=78)	Periodontitis												Total	
	Stage III						Stage IV							
	Grade A		Grade B		Grade C		Grade A		Grade B		Grade C		N	%
Age														
Pre-elderly	1	1.92	14	26.92	10	19.23	0	0	9	17.31	18	34.62	52	100
Elderly	0	0	1	3.85	2	7.69	0	0	17	65.38	6	23.08	26	100
Gender														
Male	1	2.08	3	6.25	6	12.50	0	0	18	37.50	20	41.67	48	100
Female	0	0	12	40.0	6	20.0	0	0	8	26.67	4	13.33	30	100
Education level														
Low	0	0	5	18.52	5	18.52	0	0	10	37.04	7	25.93	27	100
Middle	0	0	7	22.58	4	12.90	0	0	9	29.03	11	35.48	31	100
High	1	5.0	3	15.0	3	15.0	0	0	7	35.0	6	30.0	20	100

Table 3. Distribution of the severity of periodontitis based on age, gender and education level

Variables (n=78)	Severity of Periodontitis		Total	p-value
	Stage III	Stage IV		
Age				
Pre-elderly	24 (47.1%)	27 (52.9%)	51 (100%)	0.01 ^a *
Elderly	4 (14.8%)	23 (85.2%)	27 (100%)	
Gender				
Male	10 (20.8%)	38 (79.2%)	48 (100%)	0.003 ^a *
Female	17 (56.7%)	13 (43.3%)	30 (100%)	
Education Level				
Low	11 (37.9%)	18 (62.1%)	29 (100%)	0.887 ^b
Middle	10 (33.3%)	20 (66.7%)	30 (100%)	
High	6 (31.6%)	13 (68.4%)	19 (100%)	

^aStatistical evaluation by the continuity correction test; ^bStatistical evaluation by the Pearson's chi-square test;

*p-value <0.05 statistically significant

There are currently no studies that show the association of the severity of periodontitis with age, gender and education level using the 2017 AAP classification in Indonesia. This classification describes periodontitis more specifically because it considers the severity of periodontitis progression, history, the possible risk of periodontitis progression in the future and the assessment of the risk of diseases that affect the general condition of the body.¹¹ It is well documented that chronic inflammation (such as periodontitis) may play a role in other disease conditions in which inflammation is a major component. Once periodontal pathogens and their metabolic enzymes have access to blood circulation, they produce inflammatory mediators, which are responsible for systemic inflammation.¹³

In this study, periodontitis was more prevalent in pre-elderly patients, males and subjects with middle education levels (Table 1). The result was similar to a study conducted by Machado et al.,¹⁴ wherein chronic periodontitis mostly occurred in the 45–65 years age group and individuals with elementary to middle education levels. Subsequently, males were more likely to experience greater CAL and deeper PD than females ($p < 0.05$). Lower percentages of elderly patients may occur due to their high adaptability; these individuals tend not to seek treatment simply because they do not experience pain or other noticeable symptoms. In line with that, Spinler et al.¹⁵ concluded that the frequency of dental visits declines with age in older adults.

Greater CAL and deeper PD in males than females may be due to the role of sex chromosomes in mediating the differences in the immune response. Monocyte production of IL-12 and regulatory T cells, which have anti-inflammatory properties, have been found at increased levels in men.¹⁶ When it comes to gender, females show more positive attitudes about dental visits, higher oral health literacy and better oral health behaviours than males. In addition, hormonal mediators (i.e. estrogen, progesterone and testosterone) have been shown to have an effect on innate and adaptive immunity. A sustained level of estrogen has been demonstrated to reduce pro-inflammatory cytokine production, while testosterone suppresses the immune response.^{17,16} Table 1 also shows that the percentages of periodontitis are higher in subjects with low to middle education levels. Similarly, a cohort study from Sweden showed that elderly subjects with less than high school education are twice as likely to have periodontitis compared with those with more than high school education.¹⁸

Stage IV periodontitis was found in higher percentages among all variables (Table 2), showing that patients who came to the periodontics clinic at Universitas Sumatera Utara Dental Hospital encountered $CAL \geq 5$ mm. Based on age, the highest occurrence of periodontitis was stage IV grade B in elderly patients, which indicated a moderate rate of the disease's progression, where the destruction of periodontal tissue corresponded to the deposits of biofilms with age.¹⁹ In line with that, a study by Eke et al.²⁰ showed that more than 50% of individuals had $CAL \geq 5$ mm and 20% of $CAL \geq 7$ mm were found in the elderly. When stratified

by gender, stage IV grade C was found with the highest percentages in male subjects. The rapid progression of the disease was consistent with the effect of smoking on periodontal tissue. Meanwhile, the highest occurrence of periodontitis according to the education level was stage IV grade B in low-education level subjects. This may be due to poor oral hygiene habits as a result of lower levels of dental service use, higher body mass index and irregular oral self-care practices directly or indirectly caused by a lower education level.²¹

A statistically significant correlation between age and the severity of periodontitis in the present study (Table 3) was similarly shown in several studies.^{22,23,24} As a result of the host's innate and adaptive immune-response systems perceiving microbial transitions in biofilms, the prevalence and severity of periodontitis in the ageing population become increasingly high. In addition to the immune system, genetic and epigenetic factors play a role in periodontal changes in the elderly, although the mechanism is still not clearly understood.²⁵

The present study shows that gender and the severity of periodontitis are significantly correlated, but not the education level (Table 3). Similarly, a study by Paksoy et al.²⁶ showed that gender is significantly associated with the severity of periodontitis, with males more likely to suffer from severe periodontitis. Smoking is one possible reason for the increased prevalence and severity of periodontitis, since smoking is vastly more prevalent in males than females in Indonesia.⁶ However, the number of smokers is not shown, which makes it one of the limitations in the present study. Different plausible mechanisms on the effect of smoking towards periodontal tissue include pathogenic subgingival flora, diminished microcirculation, neutrophil dysfunction, pro-inflammatory cytokine production and increased levels of pathogenic T-cells, although there is no clear evidence that points to one particular mechanism as being of greater importance.²⁷

In conclusion, the present study shows that the severity of periodontitis in pre-elderly and elderly patients is significantly related to age and gender but not with the level of education. The majority of patients who visited the periodontics clinic at Universitas Sumatera Utara Dental Hospital had stage IV periodontitis, which may further lead to edentulous if not treated appropriately. The treatment of periodontitis includes mechanical therapy like scaling and root planing. However, in deep and periodontal pockets, such treatments are difficult. In response, systemic or local drugs need to be administered because periodontitis is mainly caused by bacterial deposits.²⁸

This study, however, had several limitations when it came to determining the stage and grade of periodontitis. The data regarding the cause of tooth loss were not recorded; hence, the prevalence of stage IV periodontitis was possibly overrated due to other reasons for missing teeth. In addition, medical records data did not show the radiographic bone loss over a five-year period, which could have assisted in determining the grade of periodontitis.

Nonetheless, the percentages of bone loss per age were examined carefully.

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