

The Influence of Social Determinant and Chronic Disease on Self-Reported Tooth Loss in Indonesian Middle-Aged and Elderly

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Abstract

The study aimed to analyze the influence of social determinants and history of chronic disease on self-reported tooth loss in Indonesian middle-aged and elderly. The research design was cross-sectional with an observational method.

The population was all secondary data from respondents aged 45 years and over who were interviewed using public health questionnaires of the 2018 National Health Research (Riskesdas) from 2,499 census blocks. Following the inclusion criteria, the total number of samples taken was 17,095 respondents. Independent variables were social determinants including sex, age group, location of residence, occupation, education, and history of chronic disease. The dependent variable was self-reported tooth loss. Data were processed and analyzed using the chi-square test and logistic regression. The risk factors for tooth loss based on simple logistic regression were the age group (middle-aged and elderly) with an OR value of 0.770 ($p=0.000$); location of residence (OR=0.923; $p=0.016$); education level (OR=1.076; $p=0.000$) and the history of chronic disease included diabetes mellitus (OR=1.259, $p=0.001$); heart disease (OR=1.354; $p=0.000$); hypertension (OR=1.160 $p=0.001$); and stroke (OR=1.356, $p = 0.004$).

Based on multiple logistic regression, only age group, education level, diabetes mellitus, and heart disease affected the self-reported tooth loss in the Indonesian middle-aged and elderly.

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Introduction

The increase in life expectancy has the consequence of increasing the percentage of the elderly population in Indonesia. Since 2020, Indonesia has been transitioning to the era of the aging population, when the percentage of the elderly population reaches more than 10 percent.¹ The aging process that occurs will impact the oral health of the elderly.^{2,3} Increasing disorders in the elderly can cause changes in their quality of life. Quality of life in the elderly can be influenced by various factors, one of which is tooth loss.^{4,5} Quality of life disorders due to decreased masticatory and swallowing

function was higher in elderly with tooth loss that was not replaced with dentures.⁶

Tooth loss is experienced by the elderly, which causes a decrease not only in the masticatory efficiency but also in other health problems.⁷ In addition, tooth loss is one of the essential indicators of oral health because it reflects the accumulation of diseases and conditions in the oral cavity.^{8,9} Tooth loss shows the cohort effect of oral hygiene attitudes and behaviors, accessibility to oral health services, and cultural beliefs and values about oral health.^{10,11} The study of tooth loss in the elderly is relevant to understanding risk factors and social determinants. Various studies have shown a social determinant relationship with tooth loss: age, gender, socio-economic status, area of residency, education level, and other social determinants.¹²⁻¹⁴

Another factor influencing tooth loss in the elderly is a history of chronic disease. Various studies have shown a causal relationship

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between tooth loss and a history of chronic diseases such as diabetes, hypertension, stroke, and cancer.^{15,16} However, research on the correlation between tooth loss and history of chronic disease in Indonesia with a national sample is still minimal. Therefore, it is essential to determine the influence of social determinants and history of chronic disease as risk factors for tooth loss based on self-reported results.

Measuring tooth loss can be performed based on self-report or clinical examination results.^{17,18} Measurement of oral health status in the elderly based on self-report is the first stage of core indicators of oral health for the elderly from WHO Oral Health STEPwise.^{19,20} Data on tooth loss, social determinants, and chronic disease history in the current study were obtained from the 2018 National Health Research (Riskesdas).

The study results are expected to be the basis for increasing oral health efforts for the pre-elderly and elderly population, especially in Indonesia, through integrating oral health into elderly health programs and non-communicable disease prevention programs. Therefore, this study aimed to analyze the final model of influencing social determinants and history of chronic diseases on self-reported tooth loss in Indonesian elderly.

Materials and methods

The research design was cross-sectional with an observational method, as a further analysis from secondary data of the 2018 National Health Research by the National Institute of Health Research and Development, Ministry of Health of the Republic of Indonesia, with the ethical approval number of IR.03.01/4/6264/2021. Furthermore, the latter research has received ethical approval from the Ethics Commission of the National Institute of Health Research and Development, Ministry of Health of the Republic of Indonesia, with the approval number of LB.02.01/2/KE.024/2018.

The population in this study was all secondary data from 100,000 respondents from 2,500 Census Blocks from 26 provinces, where every Census Block consisted of 10 households, and each household had four members. Census Blocks that have successfully visited were 2,499 census blocks with a response rate of 99.95%, and from the total of 19,553 households, the

response rate was 78.2%. A household member who fulfilled inclusion criteria, aged 45 years and over, and interviewed by public health questionnaires were 17,095 individuals.

The independent variables in this study were social determinants including sex, age (45-59 considered as the pre-elderly age group, and the age group of >60 as the elderly), education level, occupation, area of residency, and history of chronic diseases, including a history of diabetes mellitus, heart disease, hypertension, stroke, and diagnosed cancer.

The dependent variables in this study were tooth loss due to extraction or self-loss, which was obtained based on an interview with public health questionnaires (self-reported tooth loss). Variable data collection was obtained through interviews, and the interviewers had been trained and calibrated priorly.

Data analysis was conducted univariate to see the frequency distribution of respondents. Bivariate analysis was performed by tabulating the independent variables with the dependent variable, and the difference test was performed with chi-square because the data were categorical. The risk factor for tooth loss was determined from the Odds Ratio (OR) value. Finally, multivariate analysis with multiple logistic regression was conducted to analyze the influence of social determinants and history of chronic disease on self-reported tooth loss.

Results

Data of social determinants, history of chronic disease, and self-reported tooth loss of Indonesian elderly based on the 2018 National Health Research data set from the National Institute of Health Research and Development, Ministry of Health of the Republic of Indonesia, were presented in Tables 1, 2, 3, and 4. Based on Table 1, male respondents' percentage was 44.4%, and females were 55.6%. The percentage of the pre-elderly group was 65%, while the elderly group was 35%. Respondents who live in rural areas were 50.9%, and 49.1% were in urban areas. The education level of respondents who finished junior high school, high school, and higher education was 30.4%. Most respondents were general/Islamic elementary school (MI) graduates (33.4%). Most of the respondents' occupation was farmers (30.1%), followed by entrepreneurs (14.7%).

The history of chronic disease was as follows: diabetes mellitus was found in 5.4% of all respondents, heart diseases in 3.7%, hypertension in 17.3%, stroke in 2.3%, and cancer in 0.4%. In addition, respondents who reported having experienced tooth loss due to caries or other reasons were 30.8%.

Table 2 presented no difference in self-reported tooth loss between females and males ($p=0.992$), while there was a very significant difference in the pre-elderly and elderly age groups ($p=0.000$). In addition, there were significant differences in self-reported tooth loss among respondents living in rural and urban areas ($p=0.016$) and respondents based on education level ($p=0.000$). However, there was no difference in the self-reported tooth loss among respondents based on their occupations ($p=0.814$).

There was a very significant difference related to self-reported tooth loss in respondents with and without a history of diabetes mellitus ($p=0.001$); respondents with and without a history of heart disease ($p=0.000$); respondents with and without a history of hypertension ($p=0.001$); respondents with and without a history of stroke ($p=0.004$); however, no difference was found in respondents with and without a history of cancer ($p=0.189$).

Through a simple logistic regression test, the OR value of each social determinant variable and a history of chronic disease on self-reported tooth loss can be determined (Table 3). The OR value based on the highest order was a history of stroke, heart disease, diabetes mellitus, hypertension, education level, residency, and age.

Based on the p -value presented in Table 3, only age group factors (pre-elderly and elderly), residency, education level, history of chronic diseases (diabetes mellitus, heart disease, and stroke) were included in the logistic regression analysis to obtain the model. In addition, the history of hypertension was not included in the test of multiple logistic regression because there are some missing data. The results based on the multiple logistic regression test were formulated and presented in Table 4.

Discussion

Tooth loss is a sign of inequality in health aspects. The association between tooth loss and

socio-economic conditions has been described in various studies.^{21,22} Risk factors for tooth loss vary in different studies. Khazaei et al.²³ suggested that the risk factors for tooth loss were age, sex (mainly male), low education level, smoking habit, and the presence of metabolic disorders. The prevalence of tooth loss, poor periodontal health, and caries experience increase with age.²⁴ Tooth loss can also be related to age, smoking habits, and education level.²⁵ Lower levels of education and limited access to information or health services are usually related closely to oral health hygiene, which will increase the risk of tooth loss.²⁶

In the present study, the number of female respondents was more than male, but there was no difference in the self-reported tooth loss. The result was in line with survey results conducted in Ghana, India, and South Africa, which stated no association between gender and tooth loss.²⁷ According to the age characteristics, the percentage of the pre-elderly group in the present study was higher than the elderly group. In the study conducted by Tiwari et al.²⁸, the elderly were shown to have worse oral health conditions, including tooth loss. The condition of tooth loss associated with age is associated with the accumulation of oral disease over the life span.²⁸ The fact that tooth loss is positively related to age was also found in other studies.^{12,29} According to Silva et al.¹², age, pain as motivation for seeking oral health treatment, previous tooth loss, and dental caries are risk factors for tooth loss in adults.¹²

The results showed differences in self-reported tooth loss of respondents who lived in rural and urban areas. This result aligned with a study in Poland where tooth loss in rural communities was significantly higher than in urban communities.³⁰ Ayebameru et al.³¹ found similar findings in Nigeria, which showed that the absence of dental health facilities in rural areas is a contributing factor to the differences in tooth loss in the rural and urban populations.^{31,32}

The most education level found was the elementary school graduates. Poor socio-economic conditions can interfere with the risk factors, for example, the behavior of seeking oral health treatment.¹² In the study conducted by Maia et al.³², education level is a social determinant associated with tooth loss. The lower the education level, the higher the tooth loss rate.²² Education can be a health modifying

factor by influencing health knowledge, behaviour, and social beliefs.^{6,33}

The current research showed no differences in self-reported tooth loss among respondents based on occupation. However, different results were obtained in a study conducted in Poland, where farmers had a higher tooth loss rate than other occupations.³⁰ Employment status is indirectly related to education level and income, as suggested by Maia et al.³², who stated no association between tooth loss and income.

The elderly with chronic diseases have a significantly higher probability of tooth loss than those without chronic diseases.¹⁶ The current study discovered that most respondents had a history of hypertension with a rate of 17.3%. In addition, hypertensive conditions are associated with the prevalence of tooth loss. Therefore, there is a high prevalence of tooth loss in the hypertensive population.^{34,35}

A total of 5.3% of respondents in this study had a history of diabetes. Other studies have also found a high prevalence of tooth loss in the diabetic population.^{16,32} Diabetic patients show increased proinflammatory cytokines in the gingival fluid and periodontal tissues.³⁶ These pathogens can initiate tissue damage when accompanied by poor wound healing ability, resulting in tooth loss.³⁷

The present study results stated that the history of chronic heart disease was 3.7%, stroke was 2.3%, and cancer was 0.4%. Tooth loss is related to heart disease and stroke. Chronic systemic inflammation is associated with periodontal disease.¹⁵ Momen-Heravi et al.³⁸ discovered that tooth loss was associated with a higher cancer risk. A history of chronic diseases in the elderly is associated with tooth loss, rheumatoid arthritis, asthma, diabetes, emphysema, heart disease, and stroke. Socio-economic conditions affect tooth loss in the elderly. It also can limit mobility, which makes it difficult to visit the dentist or have oral health care at home.¹⁶

Based on the multiple logistic regression analysis results, age, sex, and history of chronic diseases (diabetes mellitus and heart disease) are risk factors that affect self-reported tooth loss. This finding showed that social determinants and a history of chronic disease could be considered predictors of self-reported tooth loss. This result aligned with the research of Elani et al.³⁹, which

showed that age, education level, routine dental care, employment, the ratio of family income to the poverty level, race, and homeownership are strong predictors of tooth loss. However, medical conditions such as arthritis, diabetes, high cholesterol, hypertension, and cardiovascular diseases were considered minor significant predictors. Previous studies suggested a strong relationship between chronic disorders and impaired oral function. Although the elderly remains healthy when visited dental providers, there is an increased rate of age-related changes in the oral cavity resulting from underlying illness and medications taken to treat their chronic diseases.⁴⁰

Therefore, it is necessary to prevent oral diseases in the elderly based on risk factors and integrate them into the prevention of non-communicable diseases. The advantages of preserving the teeth in the elderly are good masticatory ability, good quality of diet and food intake, improved quality of life, and maintaining cognitive function.^{7,25} The elderly must be encouraged to improve their oral hygiene, including using artificial as a means to improve their quality of life.⁶ Various promotive, preventive, and curative efforts need to be made to overcome the risk factors for tooth loss so that the elderly can preserve their teeth. The limitation of this research was the history of hypertension as one of the chronic diseases. This data was not included in the multiple logistic regression test because there are some missing data.

Conclusions

The result of the research showed that social determinants (age, level of education) and history of the disease (diabetes mellitus, heart disease) affected the self-reported tooth loss in the Indonesian middle-aged and elderly.

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Characteristics	n	%
Socio-determinant		
Sex		
Male	7587	44.4
Female	9508	55.6
n = 17095		
Age		
45-59 (Pre-elderly Group)	11109	65
>60 (Elderly Group)	5986	35
n = 17095		
Residency region		
Urban area	8402	49.1
Rural area	8693	50.9
n = 17095		
Education level		
Uneducated	2330	13.6
Elementary school ungraduated	3851	22.5
General/Islamic elementary school (SD/MI) graduated	5706	33.4
General/Islamic high school (SLTP/MTS) graduated	1764	10.3
General/Islamic high school (SMA / MA) graduated	2526	14.8
Diploma (D1/D2/D3) graduated	331	1.9
Higher education graduated	587	3.4
n = 17095		
Occupation		
Unemployed	5613	32.8
Academicians	78	0.5
Government employees	395	2.3
Private employees	718	4.2
Entrepreneurs	2510	14.7
Farmers	5145	30.1
Fishermans	97	0.6
Laborers/drivers/housekeepers	1592	9.3
Others	947	5.5
n=17905		
Chronic Condition		
Have you ever been diagnosed with diabetes mellitus?		
Yes	924	5.4
No	16171	94.6
n = 17905		
Have you ever been diagnosed with heart disease?		
Yes	627	3.7
No	16468	96.3
n = 17905		
Have you ever been diagnosed with hypertension?		
Yes	2962	17.3
No	8634	50.5
Missing	5499	32,2
n = 17095		
Have you ever been diagnosed with a stroke?		
Yes	395	2.3
No	16700	97.7
n = 17095		
Have you ever been diagnosed with cancer?		
Yes	74	0.4
No	17021	99.6
n = 17095		
Self-reported Tooth Loss/Missing Teeth		
Lost teeth due to extraction or self-loss		
Yes	5265	30.8
No	11830	69.2
n = 17905		

Table 1. Frequency Distribution based on Characteristics of Respondents.

Characteristic	Self-reported tooth loss			
	Yes n(%)	No n(%)	p-value	
Socio-determinant				
Sex				
Male	2337 (30.8)	5250 (69.2)	0.992	
Female	2928 (30.8)	6580 (69.2)		
Age				
45-59 (Pre-elderly Group)	3202 (28.8)	7907 (71.2)	0.000*	
>60 (Elderly Group)	2063 (34.5)	3923 (65.5)		
Residency region				
Urban	2515 (29.9)	5887 (70.1)	0.016*	
Rural	2750 (31.6)	5943 (68.4)		
Education level				
Uneducated	792 (34.0)	1538 (66.0)	0.000*	
Elementary school ungraduated	1272 (33.0)	2579 (67.0)		
General/Islamic elementary school (SD/MI) graduated	1757 (30.8)	3949 (69.2)		
General/Islamic high school (SLTP/MTS) graduated	498 (28.2)	1266 (71.8)		
General/Islamic high school (SMA / MA) graduated	708 (28.0)	1818 (72.0)		
Diploma (D1/D2/D3) graduated	77 (23.3)	254 (76.7)		
Higher education graduated	161 (27.4)	426 (72.6)		
Occupation				
Unemployed	1763 (31.4)	3850 (68.6)		0.814
Academicians	27 (34.6)	51 (65.4)		
Government employees	115 (29.1)	280 (70.9)		
Private employees	161 (22.4)	557 (77.6)		
entrepreneurs	741 (29.5)	1769 (70.5)		
Farmers	1671 (32.5)	3474 (67.5)		
Fishermans	30 (30.9)	67 (69.1)		
Laborers/drivers/housekeepers	470 (29.5)	1122 (70.5)		
Others	287 (30.3)	660 (69.7)		
Have you ever been diagnosed with diabetes mellitus?				
Yes	329 (35.6)	595 (64.4)	0.001*	
No	4936 (30.5)	11235 (69.5)		
Have you ever been diagnosed with heart disease?				
Yes	234 (37.3)	393 (62.7)	0.000*	
No	5031 (30.6)	11437 (69.4)		
Have you ever been diagnosed with hypertension?				
Yes	1018 (34.4%)	1944 (65.6%)	0.001*	
No	2685 (31.1%)	5949 (68.9%)		
Have you ever been diagnosed with a stroke?				
Yes	148 (37.5%)	247 (62.5%)	0.004*	
No	5117 (30.6%)	11583 (69.4%)		
Have you ever been diagnosed with cancer?				
Yes	28 (37.8%)	46 (62.2%)	0.189	
No	5237 (30.8%)	11784 (69.2%)		

Table 2. Comparison of a social-determinant and chronic condition on self-reported tooth loss.
 *) p value < 0.05, chi squared test.

Characteristic	Coefficient Influence	p-value	OR	95% CI
Socio-determinant				
Sex	0.000	0.992	1,000	0.937-1.068
Age	-0.261	0.000*	0.770	0.720-0.824
Residency	-0.080	0.016*	0.923	0.865-0.985
Education level	0.073	0.000*	1.076	1.052-1.101
Occupation	0.003	0.684	1.003	0.990-1.015
Chronic conditions				
Have you ever been diagnosed with diabetes mellitus?	0.230	0.001*	1,259	1.096-1,446
Have you ever been diagnosed with heart disease?	0.303	0.000*	1.354	1.147-1,597
Have you ever been diagnosed with cancer?	0.395	0.190	1.370	0.855 – 2.193
Have you ever been diagnosed with hypertension?	0.149	0.001*	1.160	1.062 – 1.268
Have you ever been diagnosed with a stroke?	0.305	0.004*	1.356	1.103 – 1.667

Table 3. Influence of social-determinant and chronic disease on the self-reported tooth loss. *) p-value<0.05; simple logistic regression.

Characteristic	Coefficient Influence	p-value	Exp (B)	95% CI
Age	-0.218	0.000	0.804	0.751-0.861
Level of education	0.064	0.000	1.066	1.042-1.090
Have you ever been diagnosed with diabetes mellitus?	0.232	0.001	1,261	1.096-1,450
Have you ever been diagnosed with heart disease?	0.280	0.001	1.323	1.121-1,563

Table 4. Multiple logistic regression of social determinants and chronic disease on self-reported tooth loss. Based on table 4, the risk factors that influence self-reported tooth loss in the middle-aged and elderly were age group, education level, history of diabetes mellitus, and heart disease.

Declaration of Interest

The authors report no conflict of interest.

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