

# Prediction of Tooth Loss in the Elderly based on Dental and Oral Health Behavior Factors

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## Abstract

Background: Tooth loss in the elderly is a condition that often occurs in the world caused by several factors. Risk factors for tooth loss, one of which is dental and oral health behaviour which includes: smoking habits, reasons for going to the dentist when sick, frequency of visits to the dentist, and last visit to the dentist. This study aimed to produce a mathematical equation based on risk factors that have proven to be influential in predicting tooth loss in the elderly. Method: This type of research is a non-experimental study with a cross-sectional design. Ten calibrated dental health surveyors carried out data collection through training. The sample is the elderly in the age group of 45-75 years who meet the inclusion criteria of being physically healthy, which means they can carry out activities independently. The research sample was 2,000 people from 5 Villages, Mangkubumi, Tasikmalaya. Results: The chi-square test analysis showed that the variables of smoking habit, the reason to go to the dentist when sick, and the last visit to the dentist were associated with tooth loss in the elderly ( $p = 0.136, 0.000$  and  $0.000$ ). The variable frequency of visits to the dentist was not associated with loss to the elderly ( $p = 0.674$ ). The multiple logistic regression analysis results of the variable last visit to the doctor have the most significant contribution to tooth loss in the elderly (OR/Exp (B) = 5.447). Conclusion: The variables of smoking habits, reasons for going to the dentist when sick, and the last visit to the dentist are related to tooth loss in the elderly. The last visit to the dentist variable has the most significant contribution to tooth loss in the elderly.

**Keywords:** Smoking Habits, Reasons to Go to the Dentist When Sick, Frequency of Visits to the Dentist, Last Visit to the Dentist, Tooth Loss, Elderly

## 1. Introduction

The aging population has become a global phenomenon. Almost every country in the world is experiencing a very drastic increase in the elderly population—globally, 727 million people aged 65 years or over in 2020. The number is projected to be 1.4 billion in 2030 and 2.1 billion in 2050 and could rise to 3.2 billion in 2100 (World Health Organization, 2022). Based on (World Health Organization (2023), in the Southeast Asia Region, the elderly population is 8% or around 142 people.

Teeth have an essential role in the oral cavity, which plays a role in chewing, speech, and esthetics. Loss of teeth can disrupt daily activities, such as chewing disorders, causing emotional problems and loss of self-confidence (Yarmohammadi., 2015). Dental health conditions and supporting tissues also determine overall oral health. Poor oral conditions due to missing teeth will interfere with masticatory, esthetic, and speech functions and oral cavity activities, so they can affect nutritional status and impact the quality of life of the elderly (Roohafza., 2015).

Dental and oral health problems that often occur in

the elderly are tooth loss. Loss of teeth results in functional aesthetic and social disturbances, which can reduce the quality of life of individuals and are indicators of dental and oral health. The World Dental Federation (FDI) and the World Health Organization (WHO) set Global Oral Health Goals for 2020, in which one of the targets is to reduce the percentage of functional tooth loss in the age group 35-44 and 65-74 years (Gabiec et al., 2022).

Losing teeth in the elderly (elderly) can result in disruption of daily activities and an increased incidence of serious illnesses (Okamoto et al., 2019). The results of the 2015 Inter-Census Population Survey (Supas) data show that the number of elderly people in Indonesia is 21.7 million or 8.5% consisting of elderly women, 11.6 million (52.8%), and 10.2 million (47.2%) ) elderly male. This shows that Indonesia is one of the countries that will enter the era of the aging population because the population aged 60 years and over has exceeded 7.0%. (Badan Pusat Statistik, 2019).

The prevalence of tooth loss tends to increase according to individual age groups (Silva et al., 2019). The incidence of tooth loss increases with age,

especially over 70 (Gabiec et al., 2022). A large number of missing teeth may indicate a risk of death from pneumonia in the elderly population because oral bacteria multiplying in the periodontal area can travel to the lungs and can increase the risk of pneumonia. (Suma et al., 2018).

The results indicated that dental caries and periodontal disease were the leading causes of permanent tooth removals. Age is one of the factors that contribute to tooth loss (Haworth., 2018). As we age, caries and tooth loss are significant indications of adult oral health. Dental and oral health quality decreases due to tooth decay and loss (Dye et al., 2015).

Tooth loss in the elderly is a worldwide condition caused by several factors (Zhou et al., 2020). Tooth loss in the elderly is a multifactorial process involving dental caries, periodontal disease, and various other factors, namely social and environmental factors such as socioeconomic status, education level, income, race, access to services, insurance status, and general health status (Tiwari et al., 2016). Tooth loss is also influenced by attitude, dental hygiene behaviour, culture, and accessibility to dental services (Silva et al., 2019).

## 2. Method

This type of research is a non-experimental study with a cross-sectional design. Data collection was carried out by 10 surveyors of dental health workers calibrated through training ( $\kappa$  0.886-1.000), which meant that the examiners had an almost perfect understanding. The sample is the elderly in the age group of 45-75 years who meet the inclusion criteria of being physically healthy, which means they can carry out activities independently. The research was conducted in 5 sub-districts spread across Mangkubumi District, Tasikmalaya City, with the majority of the livelihoods of labourers and farmers and poor conditions regarding access to dental health services. The data collected are risk factors for tooth loss, namely behaviour which includes: smoking habits, last visit to the dentist, reasons for going to the dentist, frequency of visits to the dentist using a research instrument in the form of formula filling, and tooth loss in the elderly using a mouth mirror diagnostic tool, tweezers and probes.

The sample size to prove several risk factors for tooth loss in the elderly was calculated using the Balanced design with the high odds ratio method using a power calculation of  $98.2+0.42\%$ , two-sided and a significance level of  $p < 0.05$ . The result of the calculation is that 1818 samples are rounded up to 2000 people whose selection is done by random sampling (Hsieh et al., 1998).

The independent variables measured in this study were dental caries, periodontal disease, tooth brushing habits, smoking, reasons for going to the dentist, dental insurance, gender, family income, education level and age. The dependent variable is tooth loss.

## 3. Results

The characteristics of the 2000 respondents are

presented in table 1.

Variable	Sex	
	f	%
Male	66	31,42
Female	144	68,58
	Age	
45-59 (midle age)	135	64,28
60-74 (elderly)	75	35,72

Table 1 shows that the majority (68.58%) of the respondents in this study were female, and the majority were aged 45-59 years (64.28%).

The chi-square test analysis results showed a significant relationship between the variables of smoking habits, the reasons for going to the dentist when sick and the last visit to the dentist with tooth loss in the elderly. The relationship between smoking habit and tooth loss in the elderly is presented in table 2.

Variable	Lost		p-Value
	Yes	No	
Smoking Habits	Yes	492	0.136
	No	1258	

Table 2 shows a significant relationship between smoking habits and tooth loss in the elderly group, which can be seen from the value of  $p = 0.136$  ( $p$  less than 0.05).

The relationship between the reasons for going to the dentist when you are sick and losing teeth in the elderly is presented in table 3.

Variable	Lost		p-Value
	Yes	No	
Reason to go to the dentist	Ya	1563	0.000
	Tidak	187	

Table 3 shows a significant relationship between the reason fo going to the dentist and tooth loss in the elderly group, which can be seen from the value of  $p = 0.000$  ( $p$  less than 0.05). The relationship between the variables of the last visit to the dentist and tooth loss in the elderly is presented in table 4.

Variable	Lost		p-Value
	Yes	No	
Last visit to the dentist	<1 year	174	0.000
	>1 year	1576	

Table 4 shows a significant relationship between the last visit to the dentist and tooth loss in the elderly group, which can be seen from the value of  $p = 0.000$  ( $p$  more than 0.05). The results of the chi-square test analysis showed that the variable frequency of visits to the dentist did not have a significant relationship with tooth loss in the elderly. The relationship between the frequency of visits to the dentist and

tooth loss in the elderly is presented in table 5.

**Table 5. The relationship between the frequency of visits to the dentist and tooth loss in the elderly**

Variable	Lost		p-Value	
	Yes	No		
Frequency of visits to the dentist	Yes	127	20	0.674
	No	1623	230	

Table 5 shows that there is no significant relationship

**Table 6. Contribution of risk factors to tooth loss in the elderly**

Independent Variable	B	Exp (B)	p	95% CI	
				Lower	Upper
Constant	-.275	.760	.041		
Smoking Habits (X1)	.370	1.447	.041	1.016	2.061
Reason to go to the Dentist (X2)	1.364	3.910	.000	2.626	5.822
Last visit to dentist (X3)	1.695	5.447	.000	3.662	8.101

Based on Table 6, the following mathematical equation is obtained:

$$\hat{Y} = \beta_0 + \beta_1X_1 + \beta_2X_2 + \dots + \beta_nX_n$$

Note :

$\beta_0$  = Constant

$\beta_1 - \beta_n$  = Independent variable regression coefficient value

$X_1 - X_n$  = independent variable value

Based on table 6 and the mathematical equation formula, the following mathematical equation is obtained:

$$\hat{Y} = -.275 + .370X_1 + 1.364X_2 + 1.695X_3$$

According to Lemeshow (2000), the ability to estimate the probability of the elderly having tooth loss is based on the values of several predictive variables with the following formula:

$$p = \frac{1}{1 + e^{-(a + b_1X_1 + b_2X_2 + \dots + b_kX_k)}}$$

Note :

e = 2,71828

Based on the mathematical equation above, a probability formula is obtained to predict tooth loss in the elderly in the future. The probability formula is listed below.

$$p = \frac{1}{1 + e^{-}}$$

Note :

p = Probability Value

e = Constant Value with a value of 2.71828

The mathematical equation and the probability formula results show that the variable of the last visit to the dentist has the most significant contribution to tooth loss in the elderly. It can be seen from the value (OR/Exp (B) = 5.447), which means that the variable of the last visit to the dentist has 5.447 times on tooth loss in the elderly.

between the frequency of visits to the dentist and tooth loss in the elderly group, which can be seen from the value of  $p = 0.674$  ( $p$  more than 0.05). The results of multiple logistic regression analysis showed that the factors contributing to tooth loss in the elderly were smoking habits, the reason for going to the dentist when sick, and the last visit with a  $p$ -value  $< 0.05$ . The contribution of risk factors to tooth loss in the elderly is presented in table 6.

### 4. Discussion

The characteristics of the research subjects showed that most respondents were female and aged 45-59 years. Most respondents had the behaviour of visiting the dentist for more than 1 year, the frequency of visits to the dentist was irregular, and the reason for going to the dentist was when they were sick.

The results of the chi-square statistical analysis showed a significant relationship between smoking habits, the reason for going to the dentist when sick, and the last visit to the dentist with tooth loss in the elderly. The variable frequency of visits to the dentist showed no significant relationship with tooth loss.

Natto et al. (2014) and Gabiec et al. (2022) showed that the factors that contribute to tooth loss in the elderly, namely smoking (RR = 0.314, OR = 1.92,  $p = 0.000$ ), can increase the number of missing teeth. According to Adegboye dkk. (2010) showed that smoking is a risk factor for tooth loss. Smoking habits are also a significant risk factor for tooth loss at the age of 65-74 years (Bian et al., 2019). Smoking is a risk factor for the number of teeth less than 20 at an older age (Ishikawa et al., 2019). Different opinions are shown from the results of the research conducted by Silva et al. (2019) showed that the smoking habit was not related to tooth loss. This can be caused because the female sex dominates the respondents. Silva et al. (2019) showed that the behavioural factor of checking teeth affected tooth loss in the elderly (RR = 2.72  $p = 0.004$ ). This is due to examining the teeth in a condition already severe and can be maintained again, and finally, the dentist carries out a tooth extraction.

Factors last visit the dentist associated with tooth loss in the elderly. This research is supported by the opinion of Foiles Sifuentes et al. (2020) regarding the relationship between aging, complete tooth loss, and visits to the dentist in the last 12 years; they stated that the prevalence of tooth loss was higher in the elderly with less frequent visits to the dentist during the last 12 months, thereby increasing the risk of tooth loss. Begum et al. (2016) visit to the dent

significantly impacts tooth loss. Tiwari et al. (2016) stated that tooth loss was significantly related to the length of time since the last visit to the dentist. Different opinions were expressed by Silva et al. (2019) that the last visit to the dentist was not associated with the incidence of tooth loss. This is because the visit to the dentist was already in a sick and severe condition, so even though the last visit was less than one year, the relationship was meaningless.

The results of the statistical analysis of the chi-square test showed that the frequency of visits to the dentist did not have a significant relationship with the occurrence of tooth loss in the elderly. The statistical analysis of the chi-square test showed that the variable frequency of visits to the dentist had no significant relationship to tooth loss in the elderly. This is because the female sex dominated respondents, as many as 1318 (65.9%). According to Okamoto, men contribute more to tooth loss than women based on nutritional status. The variable frequency of dentist visits is unrelated to tooth loss. This is due to a lack of awareness of the use of dental health services. Menurut Silva et al. (2019) Lack of utilization of health services related to tooth loss. This means that more frequent and regular use of health services will result in earlier detection of dental and oral health diseases to prevent more serious illnesses.

Variables with a significant relationship will be continued to the multivariate analysis stage with the Multiple Logistic Regression test. The analysis results show that the factors contributing to a loss in the elderly are smoking habits, reasons to go to the dentist when sick, and last visit to the dentist. These factors will form a mathematical equation, the reference for the probability formula for predicting tooth loss in the elderly. The last visit to the dentist variable has the most significant contribution to tooth loss in the elderly. It can be seen from the value (OR/Exp (B) = 5.447), which means that the variable of the last visit to the dentist has 5.447 times the occurrence of tooth loss in the elderly.

## 5. Conclusion

- Smoking habits, reasons for going to the dentist when sick and last visit to the dentist is related to tooth loss in the elderly.
- Frequent visits to the dentist are not associated with loss in the elderly.
- The last visit to the dentist has the greatest contribution to tooth loss in the elderly and can predict the strongest tooth loss in the future.

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