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Original article

The relationship between tooth loss and pre-elderly nutritional status and quality of life

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ABSTRACT

Background: *Tooth loss leads to decreased masticatory function, which affects nutritional intake. Tooth loss accompanied by poor nutritional status affects quality of life both physically and psychosocially.* **Purpose:** *This study was conducted to identify the relationship between number of teeth lost due to nutritional status and quality of life.* **Methods:** *A study conducted at Gulai Bancah Primary Health Care in Bukittinggi. Participants were recruited using a non-probability purposive sampling technique. 178 pre-elderlies aged between 45 and 59 years took part in this study. Tooth loss was reported in the dental examination format while nutritional status and quality of life pertaining to dental and oral health were determined using the Mini Nutritional Assessment (MNA) and the Geriatric Oral Health Assessment Index (GOHAI). Pearson correlation and path analysis were utilized to analyze the data.* **Results:** *The Pearson correlation test indicated a moderate correlation between tooth loss and nutritional status (r = -0.549) and a strong correlation between the number tooth lost and quality of life (r = -0.742). Pathway analysis confirmed that the direct effect value (beta coefficient = 0.552) was greater than the indirect effect value (beta coefficient = 0.189). The findings indicated that, indirectly, the amount of tooth loss mediated with nutritional status had no significant relationship to quality of life.* **Conclusion:** *An increase in tooth loss leads to pre-elderly poor nutritional status and quality of life. However, nutritional status is not an intermediate factor between the number of teeth lost and pre-elderly quality of life.*

Keywords: *nutritional status; oral health related quality of life; pre-elderly; tooth loss*
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INTRODUCTION

Increases in life expectancy are the proof of successful health developments; however, this poses separate challenges. One challenge that occurs is that as people age, they will face declining physical condition. In the pre-elderly population, degenerative processes have already begun, both physiologically and biologically. The aging process is a cumulative change in the body that decreases functional capacity. The regenerative ability of the pre-elderly is limited, meaning that they are more susceptible to various diseases. If no prevention efforts to provide health services are carried out properly then there is a decline in body functions.[1,2]

Tooth loss is one of the oral health problems that occurs in the pre-elderly period. Tooth loss experienced by the pre-elderly due to the aging processes is associated with the changes of oral cavity tissue structure, which are stipulated by complex factors such as caries, periodontitis, and trauma.[3] In 2018, the prevalence of tooth loss in West Sumatra in adults between the ages of 45–54 years was 23.98%. Specifically in Bukittinggi town, the statistic reported was 19.68% and the prevalence of low nutritional status was 9.56%.[4]

The function of the oral cavity will be optimal if there is a sufficient amount of occlusion of the teeth or there are dentures that function as replacements for missing teeth.[5] Pre-elderly who experience significant tooth loss not supported by a sufficient number of dental occlusions will have difficulty chewing food, which can affect the quality of life. They will also experience difficulty in the mastication process, which will cause a negative impact

on the functional limitation scale on related quality of life dental and oral health. The impact on nutritional risk related to weight conditions will also interfere with psychosocial quality of life and cause discomfort.[6]

An adequate number of teeth can be expected to support the functions of the oral cavity, with the minimum number being 20 teeth. One previous study indicated that missing 16 or more teeth as a risk factor for malnutrition.[7,8] Tooth loss leads to decreased masticatory function, thereby reducing an individual's ability to digest solid and fibrous foods including meat, nuts and, fruits, which interferes with the mechanism of the nutritional absorption process. This alters the body's metabolism, which affects nutritional intake.[9,10]

The Mini Nutritional Assessment (MNA) is a clinical assessment tool for grading nutrient status and assessing the malnutrition threat in senior cases without necessitating a dietician or nutritionist. The MNA is a well-validated technique with high perceptivity, particularity, and trustability.[11] It has been cross-validated in a multicenter study and is grounded on anthropometric measures, a global assessment of general health status, a salutary questionnaire, and a subjective assessment of health and nutrition confines. It can also give veritably useful information for patients by indicating the factors that contribute to their altered nutrient status. Advancements in MNA scores have been observed after interventions have been performed.[12,13]

The Geriatric Oral Health Assessment Index (GOHAI) is a quality-of-life instrument related to dental and oral health that measures quality of life from the individual's perceptions, including including physical, psychosocial, and comfort dimensions. Affected physical quality of life includes chewing difficulties while social dimensions include communication disturbance. The GOHAI is a 12-point assessment primarily developed by Atchinson and Dolan in 1990 in the USA.[14] It covers a range of fields including functional (eating, speaking, and swallowing), psychological (concerns about oral health, dissatisfaction with appearance, tone-conscious about oral health, and avoidance of social connection because of oral problems), and pain or discomfort (medicines, gingival perceptivity, teeth perceptiveness, and discomfort when biting certain foods). The GOHAI has been restated and validated in many languages including Persian, Chinese, Arabic, German, and Indonesian.[15,16]

Tooth loss, especially anterior, affects psychosocial dimensions and comfort due to aesthetic and personal appearance deviations, whereas posterior tooth loss affects functional aspects that interfere with the masticatory process associated with nutritional status. Preventive and promotive activities could be started from the pre-elderly age to ensure that the health, nutrition, and psychosocial condition of the pre-elderly is maintained so that it remains productive.[17,18]

A preliminary study of the pre-elderly between the ages of 45 and 59 years (accounting for 58% of the population) discovered a tooth loss proportion among 8 out of 10 pre-elderly patients, which indicated frequent tooth loss in the Gulai Bancah Primary Health Care working area. This study was conducted to identify the relationship between tooth loss and nutritional status and quality of life, and to illustrate the indirect relationship between tooth loss on the Oral Health Related Quality of Life (OHRQoL) by using nutritional status.

MATERIALS AND METHODS

This study has been approved by the Research Ethics Commission of the Faculty of Dentistry, Universitas Gadjah Mada with certificate number 0019/KKEP/FKG-UGM/EC/2022. This is a quantitative study with a cross sectional design. The population in this research were pre-elderly patients served in the working area of the Gulai Bancah Primary Health Care. Purposive sampling with a non-probability technique was employed to recruit study participants based on inclusion and exclusion criteria.

Participants were pre-elderly and aged between 4 and 59 years, according to the World Health Organization (WHO),[19] willing to participate, able to communicate verbally, and had experienced tooth loss. The exclusion criteria were uncooperative patients and those using dentures or diagnosed with systemic diseases. The variables studied were tooth loss, nutritional status, and OHRQoL. The number of teeth lost was reported in the dental examination format.

Nutritional status was measured using the scores obtained from the MNA questionnaire. The scoring is as follows: good nutritional status if the score is 24–30, a risk of malnutrition if the score is 17–23.5, and malnutrition if the score < 17. The MNA consists of four assessment components: global health evaluation, food intake assessment, anthropometric assessment, and respondent perception.

Quality of life related to dental and oral health was appraised using the GOHAI. This questionnaire was completed for each subject by one investigator through the methodology of surveying and clinical examination. The responses from the participants were recorded on a 5-point Likert scale. Responses to statements points 3, 5, and 7 were rear-scored. The methodology used in this study was the accretive strategy, which corresponds to casting up the scores attained for each of the 12 GOHAI questions. The OHRQoL of each participant was determined as good if the score was 57–60, average when 51–56, and poor when < 50.

Bivariate statistical analysis in a form of Pearson correlation illustrates the relationship between variables, namely the relationship between the number of teeth lost with nutritional status and quality of life. A multivariate test using the path analysis test was employed in this study. The path analysis illustrated an indirect relationship between tooth loss on the OHRQoL by using nutritional status as the mediating variable.

RESULTS

There were 178 participants in this study who were all pre-elderly patients within the age range of 45–59 years. Their characteristics are presented in Table 1. The average age of the study participants was 51.6 years and 72% of them were female. The incidence of posterior tooth loss was higher than anterior teeth. A secondary level of education occupied the largest proportion among the participants' level of education.

The data in Table 2 presents the number of missing teeth, the average MNA score, and GOHAI index. It is inferred from the table that the highest number of teeth lost was four teeth with an average MNA score of 24.5, which indicates a good nutritional status, and a GOHAI score of 54.2, which indicates a moderate quality of life.

Participants who had lost six or more teeth were at risk of malnutrition with an average MNA score of between 17 and 23.5. Pre-elderly patients who had lost seven or more teeth associated with poor quality of life, which was indicated by a GOHAI score of less than or equal to 50.

Based on the MNA indicators shown in Table 3, 24.7% of the study participants experienced weight loss, 22.4% reported a lower food intake, 55% consumed two servings of protein per day, 79.7% did not consume fruit and vegetable daily, 10.6% had a BMI score of < 19, and 58.9% did not know their health status. The data in Table 4 presents the GOHAI score based on functional, psychosocial, and comfort dimensions. The data showed that participants in this study limit their type of food (5.6%), are concerned about their oral cavity (23.5%), and are unable eat comfortably (13.5%).

Table 1. Characteristics of the participants

Characteristics	Frequency		
	Average±SD	n	%
Age	51.6 ± 4.37		
Gender:			
Male		50	28
Female		128	72
Tooth loss:			
Anterior and Posterior		12	6.7
Posterior		166	93.3
Education:			
No education		10	5.6
Elementary School		51	28.7
High School		105	59
Higher Education		12	6.7

Table 2. Tooth loss distribution

Number of teeth lost	Frequency	Average MNA score	Average GOHAI score
1	22	27.1±1.5	58.3±1.4
2	28	26.2±2.1	56.9±2.7
3	19	25.5±1.6	55.7±3.6
4	29	24.5±2.4	54.2±4.0
5	23	24.6±2.2	52.8±3.3
6	26	23.5±2.2	50.1±4.0
7	14	22.7±2.3	48.3±3.6
8	9	22.1±1.9	43.4±4.9
9	7	23.8±3.4	47.4±4.8
10	1	19±0	43±0

Table 3. Respondents' answers based on the MNA questionnaire[20]

MNA questionnaire	Answer	n	%
Global Health Evaluation:			
Weight loss during in the last three months	Does not know	15	8.4
	Between 1–3 kg	44	24.7
	No weight loss	119	66.8
Mobility	Normal	178	100
Other disease problems	No	178	100
How to eat	Eat alone	178	100
Food Intake Assessment:			
Has food intake declined over the last three months due to loss of appetite, digestive problems, biting, or swallowing difficulties?	Severe	0	0
	Moderate	40	22.4
	No decrease	138	77.5
How many full meals does the patient eat daily?	1 time	10	5.6
	2 times	105	58.9
	3 times	63	35.3
Selected consumption markers for protein intake	1 protein intake	10	5.6
	2 protein intakes	98	55.05
	3 protein intakes	70	39.3
Consumes two or more servings of fruit or vegetables per day?	Yes	35	19.6
	No	142	79.7
How much fluid (water, juice, coffee, tea, milk) is consumed per day?	< 3 cups	15	8.4
	3–5 cups	129	72.4
	> 5 cups	34	19.1
Anthropometric Assessment:			
Body mass index	< 19	19	10.6
	19–21	33	18.5
	21–22	50	28.1
	23 or more	76	42.6

	< 21	5	2.8
Mid-arm circumference	21–22	19	10.6
	23	154	86.5
Calf circumference	< 31	7	3.9
	31	171	96.1
Respondent Perception:			
		9	5.1
	Views self as being malnourished		
Self-view of nutritional status	Is uncertain of nutritional state	84	47.1
	Views self as having no nutritional problem		
		85	47.7
In comparison with other people of the same	Not as good	5	2.8
age, how does the patient consider his/her	Does not know	105	58.9
health status?	As good	63	35.3
	Better	5	2.8

Table 4. Participants' response based on the GOHAI dimensions

Not	Question	Functional							
		Often		Sometimes		Seldom		Never	
		n	%	n	%	n	%	n	%
1.	Limit the kinds or amount of food	10	5.6	24	13.4	34	19.2	110	61.8
2.	Have trouble chewing food	9	5	30	16.9	36	20.2	103	57.9
3.	Able to swallow comfortably	0	0	1	0.6	24	13.4	153	86
4.	Prevention of speaking the way participants wanted	1	0.6	2	1.1	31	17.4	144	80.9
		Psychosocial							
1.	Limiting self due to oral conditions	0	0	13	7.3	89	50	76	42.7
2.	Unpleasant with the oral cavity condition	0	0	35	19.7	43	24.2	100	56.1
3.	Worry	0	0	42	23.5	89	50.1	47	26.4
4.	Panic due to teeth problems	1	0.6	2	1.1	31	17.4	144	80.9
5.	Uncomfortable eating in front of people	0	0	13	7.3	105	59	60	33.7
		Pain/discomfort							
1.	Unable to eat comfortably	0	0	24	13.5	57	32.0	97	54.5
2.	Use medication to relieve pain or discomfort	0	0	6	3.3	31	17.5	141	79.2
3.	Teeth or gums sensitive to hot, cold, or sweets	1	0.5	15	8.4	26	14.7	136	76.4

Table 5. Relationship between tooth loss and dependent variables

Variable	Correlation coefficient	p value
Nutritional status (MNA)	-0.549	0.00
Quality of life (GOHAI)	-0.742	0.00

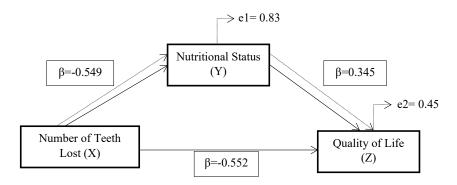**Figure 1.** Formulation of the path analysis model.

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Bivariate analysis was carried out to determine the pattern and relationship between dependent and independent variables, which were the association between tooth loss and nutritional status, and tooth loss and quality of life. The results of the Pearson correlation analysis are provided in Table 5. The bivariate analysis confirmed a significant relationship between the number of teeth lost and dependent variables, which includes nutritional status and quality of life, with a significance value of 0.00 (0.00 < 0.05). The MNA nutritional status indicated a moderate relationship with r = -0.549. In addition, the quality-of-life variable revealed a strong relationship with r = -0.742. The negative correlation represented higher tooth loss being associated with a worse nutritional status and lower quality of life related to dental and oral health.

Multivariate analysis was conducted using path analysis. The analysis illustrated an indirect relationship between the independent variables on the dependent variable by using the mediating variable. As the data retrieved in this study has a ratio and interval scale with normal data distributed based on a normality test, the multicollinearity test yielded no strong relationship between independent variables, which was recorded by the tolerance value and Variance Inflation Factor (VIF) value. In this test, there was no indication of multicollinearity, which was declared by tolerance > 0.01 and VIF < 10. It is inferred that all the assumption tests have met the requirements.

This study successfully designed and created a structural equation that represents the problem formulation. The test was carried out to identify the indirect relationship between variables through the mediating variable. Figure 1 illustrates a structural model that has been validated.

Based on the correlation between variables, there was a significant relationship between X and Y, X and Z, and Y and Z with p < 0.05. The indirect effect showed that the relationship analysis between the number of teeth lost mediated by nutritional status on quality of life, had a direct effect of x on y with 0.552, while the indirect effect of x mediated by y on z is the beta coefficient of 0.549 x 0.345 = 0.189. The calculation imposed that the direct effect was greater than the indirect effect and interpreted indirectly, tooth loss mediated by nutritional status did not have a significant relationship with patients' quality of life.

DISCUSSION

This study involved 178 participants who were in the working area of the Gulai Bancah Health Center, Bukitinggi City, West Sumatra. The results of this study indicate that there is a relationship between variables, but there is no indirect relationship between the number of teeth lost and quality of life through the mediating variable of nutritional status.

The study showed that there was a relationship between the number of teeth that had been lost and nutritional status as a greater number of lost teeth led to the individual's nutritional status being lower. The pre-elderly experienced chewing difficulties and were expected to choose types of food and determine the timing of eating. Other factors that influenced patient comfort was the food positioning in the oral cavity to the remaining teeth, which also affects nutritional status.[21]

There are other factors that affect the decreased nutritional status of the pre-elderly. Based on the results of the study, it was found that posterior tooth loss (93.3%) had a higher percentage than anterior teeth. Posterior tooth loss was more common and results in low nutritional intake. This was evidenced by participants with greater posterior tooth loss associating with having to choose foods types. The first loss of posterior teeth, especially mandibular molars was frequent.[22,23]

The analysis used to see the relationship between the amount of tooth loss and nutritional status was the Pearson correlation, which shows a relationship between the number of lost teeth and nutritional status with a moderate correlation. Tapsell et al.[24] state that many other factors affect nutritional status including the amount of food intake, diet, variety of food, nutritional content, and how to process food. Based on this statement, this moderate correlation indicates that other factors can affect nutritional status.

Having six or more lost teeth was reported to indicate a risk of malnutrition. However, this study, in contrast with Iyota et al.[7] which stated the minimum number of teeth for proper function as 20, did not discover any cases of malnutrition. The risk of malnutrition was demonstrated by the MNA results. The MNA not only presented an objective point of view, but also measured indicators based on the respondent's perception.

This study revealed that the level of tooth loss strongly correlated with quality of life. Rocha's study presented similar findings in that a greater number of lost teeth was linked to lower quality of life, indicated by a poor OHRQoL. The loss of posterior teeth, especially mandibular first molars, is very common and causes concern about dental and oral diseases.[25] Individuals over 40 years of age are also associated with an inability to chew so can be considered to have a fairly poor oral quality of life. This statement is supported by the research that revealed that oral health status influences OHRQoL, which can affect the GOHAI dimensions including functional, psychosocial, and discomfort dimensions.[26,27]

Poor quality of life was revealed to be associated with seven or more lost teeth. This study is incongruent with the findings of Khan et al.[18] which reported that patients aged between 30 and 45 years with three lost teeth experienced poor quality of life. The findings were associated with psychosocial aspects due to changes in aesthetics.

Quality of life was evaluated using the GOHAI, which assessed the participants' perceived dental and oral health problems. Based on the responses, it can be inferred that participants were concerned about their oral cavity. Psychosocial is an important aspect in addition to functional dimensions related to the masticatory process. The study

confirmed that participants have different responses based on their experiences and perceived health conditions.[21]

It is suggested the number of teeth lost had no significant effect on the quality of life if mediated by nutritional status. Nutritional status is not a particular contributor that links the number of teeth lost with quality of life. The findings presented Table 3 demonstrated that 6.7% of the participants experienced anterior tooth loss. According to Khan et al.[18] and Haag et al.[28], the loss of anterior teeth is correlated with aesthetics and associated with psychosocial aspects. Maxillary anterior teeth contributed to a lower OHRQoL compared to missing teeth from another quadrant. Individuals who had one anterior tooth loss had a lower GOHAI score compared to respondents who had lost two or three teeth in the posterior region with no further association to nutritional status.[18,28]

This research acknowledged that the mediating variable of nutritional status had no significant effect. Research conducted by Yin et al.[29] aimed to examine whether eating and communication mediated the loss of dental and functional difficulties among the elderly. The study concluded that eating and communication difficulties served as a mediating role, which infers that communication difficulties can be an indirect factor of tooth loss.

The scope of quality of life related to dental and oral health does not only measure functional dimensions related to the masticatory process but also discuss psychosocial aspects and pain/discomfort, therefore perceptions of aesthetic function and phonetic function will also affect quality of life. Respondents who have lost several teeth and do not use dentures will have affected perceptions. The research explains that the perception of the elderly who use removable dentures has a good category.[30] Based on the study, it was found that the psychosocial dimensions and a sense of discomfort also affect respondents' quality of life.

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