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Research Report

The influence of functional tooth units on body mass index in the elderly of the Jember Regency

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ABSTRACT

Background: Tooth loss can disrupt the mastication process. Mastication disorders limit the amount of food a person consumes, affecting nutrition. The number of functional tooth units (FTUs) can affect nutritional status, measured using the body mass index (BMI). **Purpose:** *The purpose of this study is to analyse the effect of the number of FTUs on the BMI in the elderly.* **Methods:** *This research was conducted in four villages in the Jember Regency. The number of subjects was 189, aged 45 years and over. The number of FTUs was calculated based on the anterior and posterior teeth that have contact with the antagonist and the BMI using the BMI formula. The data was analysed using a linear regression test; the level of significance is 0.005.* **Results:** *A simple linear regression test showed that there was significant correlation between FTU and BMI (p=0.366).* **Conclusion:** *The number of FTUs affects BMI; the higher the number of FTUs, the greater the BMI.*

Keywords: BMI; elderly; FTU; mastication

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INTRODUCTION

An elder is someone who has reached the age of 60 years.[1] In 2017, the elderly population of the world amounted to 962 million people, double that of 1980. This number is expected to double by 2050 to around 2.1 billion.[2] Most elders aged ≥ 65 years have a health problem that is an effect of the aging process. This situation shows that the elderly deserve special attention in terms of health, including oral health.[3]

The aging process is partly caused by the failure of body cells to function normally or produce new cells to replace dead or non-functioning cells.[4] In biological terms, the aging process is related to the gradual accumulation of various molecular and cellular damage. Over time, this damage causes a gradual decrease in physiological reserves, an increased risk of disease and a general decline in the capacity of individuals, which ultimately results in death.[5]

In general, the aging process is associated with physical changes that make individuals more susceptible to chronic diseases. These changes can also be observed in the oral cavities of the elderly. In the oral cavity of an elder, there are changes in the structure of the teeth, oral mucosa, periodontal tissue, salivary glands and salivary secretions.[3] There are degenerative changes in both major and minor salivary glands and also a decrease in salivary secretions.[6] Various changes that occur in the oral cavity of an elder can lead to tooth loss. The most significant factor that can cause tooth loss is caries and periodontal disease.[7] According to the World Health Organization (WHO), elders aged 65 years and over in Indonesia have tooth loss problems, with an average of 17 teeth per individual.[8]

A large amount of tooth loss in the elderly can disrupt the mastication process, which can affect the absorption of nutrients. This condition shows that tooth loss can cause a decrease in the quality of life of an elder.[9] This includes decreased chewing ability, which makes people reluctant to enjoy food with family or friends (e.g. psychological domains, social relationships and the environment) and

may interfere with one's relationships. Chewing ability is also likely to affect general health – when the ability to masticate is reduced, the selection of food that is consumed is affected.[10]

The ability to masticate is influenced by the number of teeth that come in contact with the antagonist. The pair of teeth that come into contact with the antagonist are called the functional tooth units (FTUs). These FTUs are used to assess the ability of a person's mastication because teeth that do not have contact with their antagonist do not achieve good masticatory functions.[11]

Research on FTUs was conducted by Indrasari et al.[11] and Naka et al.[12] regarding the effect of the number of FTUs, especially posterior teeth, on the ability to masticate. The results of the studies showed that the number of FTUs positively affected the ability to masticate.[10,11] Similar research conducted by Shakina et al.[13] and Adhiatman et al.[14] states that there is no a significant relationship between tooth loss and nutritional status.

The difference between the previous study and this study is that the previous study only used posterior teeth, while this study used both anterior and posterior teeth. In addition, there is still little research on FTUs, especially in Indonesia. The purpose of this study was to analyse the effect of the number of FTUs on the body mass index (BMI) in the elders of the Jember Regency.

MATERIALS AND METHODS

This study is an observational analysis with a cross-sectional study approach. It was conducted between January and February 2020 in four villages representing Jember Regency: 1) Coastal area: Kecamatan Puger and Desa Puger Wetan; 2) Mountainous area: Kecamatan Jelbuk and Desa Sucopangepok; 3) Urban area: Kecamatan Sumbersari and Kelurahan Kebonsari and 4) Agricultural area: Kecamatan Sumberbaru and Desa Sumberagung.

Data was collected in the village hall of each village using total sampling, which is the examination the entire population. The study used the cluster-sampling technique. Jember Regency consists of four regions: urban, agricultural, coastal and mountainous areas. Each of the four regions consists of several districts and one district was chosen as a research location. Each district consists of several villages where one village was chosen as the research location, so the total number of villages used as research subjects to represent Jember Regency was four. Jember was chosen as the research location because the researcher is located in the regency.

The subjects of the study were divided into three age groups of the WHO: 1) Middle-aged: 45–59 years; 2) Elderly: 60–74 years; 3) Old: ≥75 years.[15] The variables in this study consisted of the independent variable that is FTU and the dependent variable that is BMI. Age, gender, eating frequency, physical activity, tooth brushing frequency and plaque index were obtained with a questionnaire.

The Turesky-Gilmore-Glickman plaque index was used. The elders were instructed to brush their teeth and were then given a disclosing agent in order to see the plaque remaining in the oral cavity. The plaque that was assessed was plaque found on the facial and lingual parts of the teeth. The plaque index is calculated by dividing the total plaque score by the number of tooth surfaces examined.[16] Inclusion criteria were an age of 45 years and over, willingness to be responsive and cooperative and to be at the research site (village hall) at the time of the study. The exclusion criterium was diabetes mellitus.

The FTUs in the study used anterior and posterior teeth. Each pair of anterior teeth in the upper and lower jaw were assessed as one FTU, so six FTUs were complete anterior teeth. Each premolar pair in the upper and lower jaw was assessed as one FTU, so the four FTUs were complete premolar teeth. Each pair of molar teeth in the upper jaw and lower jaw was assessed as two FTUs, so eight FTUs were complete molar teeth. A maximum of 18 FTUs in the oral cavity were complete teeth.[17]

The teeth that were counted as FTUs were as follows: natural teeth or dentures with implants and crowns restoration, permanent crown restoration, bridge dentures and removable dentures (i.e. teeth that can still function for chewing, restored teeth and carious teeth, which includes enamel caries, dentin caries and caries that have reached the pulp but have not caused severe crown damage). Criteria for teeth that are not counted as FTU are: natural crowns lost due to caries, teeth with third-degree mobility and pain during percussion tests, teeth with severe natural crown damage (to be extracted), root-residual and M3 teeth, as not all individuals have M3 teeth.[18–21]

BMI is calculated using the following formula: weight (in kilograms) divided by the square of the height (in meters). Then, the BMI score is classified into several WHO categories (Table 1). Body weight was measured using a weight scale, while height was measured using a microtoise – from the highest point of the head, called the vertex (crest of the head), to the lowest point of the calcaneus bone (calcanei tuberosity), called the heel.[22]

The results of the examination of the number of FTUs and the BMI were then recorded on the examination form. This form is complemented by the identity of the subjects

Table 1. Distribution of the elderly according to BMI

Classification	BMI (kg/m^2)	Age group (n)			Total
		45-59	60-74	>75	
Underweight	< 18.5	6	7	7	20
Normal	18.5 – 24.9	26	57	15	98
Pre-obesity	25.0 – 29.9	19	27	4	50
Class I obesity	30.0 – 34.9	4	7	0	11

and the questions were used as supporting data, which are eating frequency, physical activity, tooth brushing frequency, and plaque index score. The results were then tabulated and analysed using a simple linear regression test. This research has received ethical clearance from the research ethics commission of the Dentistry Faculty of Gadjah Mada University, with reference number 00353/KKEP/FKG-UGM/EC/2020.

RESULTS

This cross-sectional study approached 189 subjects aged 45 years and over. Of these, 10 people were excluded because of the exclusion criteria, so the total number of research subjects included was 179.

The participants were grouped by gender and age group. The percentage of women is 83.8%, while the percentage of men is 16.2%. The percentage of elderly people between 45 and 59 years of age is 31%, 55% are between 60 and 74 while those 75 years and over make up only 14% (Table 2).
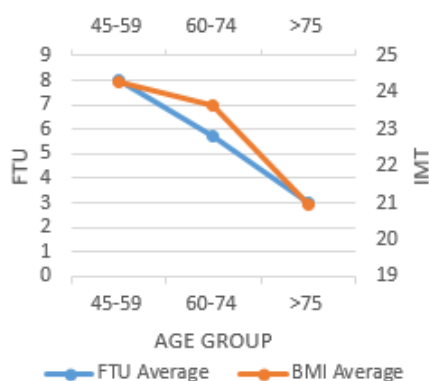
Tooth loss can affect the number of FTUs. The average number of lost teeth shows an increase with age. The results indicate that average tooth loss is lowest between 45 to 59 years and highest at 75 years and over (Table 3).

Table 4 shows that, on average, the elderly brush their teeth twice a day. However, only 12% have a plaque index score of 0 (no residual plaque), while most received scores of 2 and 3 (Table 4).

Table 5 shows that the average elder eats three times a day, while most eat two or three times. The number of those that eat once a day or more than three times a day is very small (Table 5).

The BMI results were divided into four categories. The percentage of those with a normal BMI is 54.74%, 11.17% are in the underweight category, 27.93% are pre-obese and 6.14% are grade I obese. Elders with class II or class III obesity were not found in this study (Table 1).

The average number of FTUs decreases with age, as does the average BMI. This is shown in the graph in Figure 1. Although average BMI decreases with age, the BMI of the elders in all of the age categories is normal. The average number of FTUs increases with increasing BMI (Figure 1).

Figure 1. The average number of FTUs and BMI according to age group.

Table 2. Elderly distribution according to age and gender

Age group	Σ Females	Σ Males	Σ Total
Middle-aged (45-59 th)	52	3	55
Elderly (60-74 th)	84	14	98
Old (>75)	14	12	26
Total	150	29	179

Table 3. Average and standard deviation of tooth loss

Age group	Tooth loss average ± SD
45-59	10 ± 7.6
60-74	14 ± 9.7
>75	20 ± 8

Table 4. Tooth brushing frequency and plaque index score

Age group	Tooth brushing frequency/day		Plaque index score						No tooth brushing
	<2x	≥2x	0	1	2	3	4	5	
45-59	1	54	12	6	23	12	2	0	0
60-74	4	74	6	4	33	16	5	0	20
>75	0	17	0	6	3	6	2	0	9
Total	5	145	18	16	59	34	9	0	29

Table 5. Eating frequency

Age group	Eating frequency/day			
	1x	2x	3x	>3x
45-59	0%	29.09%	69.09%	1.81%
60-74	0%	34.69%	63.26%	2.04%
>75	0.5%	30.76%	65.38%	0%
Total	0.5%	32.4%	65.36%	1.68%

Table 6. The average and standard deviation of FTUs, BMI and tooth loss

Age group	Average ± SD		
	BMI	FTU	Tooth loss
45-59	24.25 ± 4.2	8 ± 5.2	10 ± 7.7
60-74	23.65 ± 4.2	6 ± 5.4	14 ± 9.8
>75	20.93 ± 3.9	3 ± 2.8	20 ± 8

Table 7. Linear regression test result

model	R	R^2	Adjusted R^2	Error estimation Std.	Sig.
1	0.366	0.134	0.129	0.40754	0.00

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Also, average BMI is inversely related to average tooth loss; therefore, tooth loss decreases with increasing BMI (Table 6).

Tooth loss affects the number of FTUs. The relationship between tooth loss and FTU was tested using a linear regression test for each age group; test results from each age group showed a significant correlation. The correlation coefficient of tooth loss and FTU shows a negative value, which means that the relationship is inverse. This means that the less the tooth loss, the greater the number of FTUs (Table 6).

The relationship between age and FTUs was tested using the Pearson correlation test and a weak correlation was the result. Likewise, the relationship between age and BMI has weak correlation.

This study uses a simple linear regression test. The data was first tested using assumption tests to find out whether the data could be tested using linear regression. The simple linear regression test provided a significance value of 0.000. This value indicates that the number of FTUs influences the BMI. Value R in the linear regression test is 0.366, which is moderate. Value R^2 is 0.134, which means that the effect of the number of FTUs on the BMI is 13.4% (Table 7).

DISCUSSION

As people age, their number of FTUs decreases (Figure 1). This statement is in accordance with the average tooth loss in Table 3, which shows that the older the person, the higher the number of lost teeth. Research conducted by Bashiru and Oyenashia[7] also explains that the number of lost teeth increases with age. This increasing tooth loss causes the number of FTUs to decrease (Table 1). The inverse relationship between FTU and the amount of tooth loss can be caused by the more number of tooth loss, the less likely the teeth to come in contact so the fewer the number of FTUs. Based on the results of the correlation test, age category shows that the number of lost teeth is related to the number of FTUs; the number of FTUs is also influenced by other factors. The position of the teeth that are in contact also affects FTUs. When a tooth does not come into contact with its antagonist, it does not count as an FTU. The difference between anterior and posterior teeth also influences the number of FTUs. Posterior teeth, especially molars, were considered to have a larger role than anterior and premolar teeth in the masticatory function; therefore, molar teeth have a value of 2 FTUs, while anterior and premolar teeth have a value of 1 FTU.[7,17]

This study shows that 96.67% of the elderly brush their teeth ≥2 times a day, but many still have a plaque index score of ≥2 after brushing their teeth (Table 4). This shows that the average elder still does not brush their teeth properly. A lack of knowledge about how to brush teeth properly can result in remaining residual plaque or debris after brushing teeth. The accumulation of plaque attached to the tooth surface is likely to persist if it is not cleaned properly, dissolving enamel or dentin. If caries occur over time, a tendency for tooth loss can occur. Tooth loss in the elderly is also related to the aging process, where changes occur within the soft and hard tissues. The aging process has an impact on dental and oral hygiene, including the increase in dental caries and periodontal disease. These, if not treated, can result in a decrease in alveolar bone density over time, which causes tooth loss.[23,24]

In this study, 54.74% of the elderly had a normal BMI, 11.17% were classified as underweight and the remaining 34.07% were pre-obese or obese (Table 1). This shows that most had a normal BMI and only a few were underweight. Therefore, the average elder has fairly good nutritional status, and few have poor nutritional status. The average normal BMI can be related to the number of meals eaten a day. Most eat three a day, which is 65.36%, and the rest eat less than three times a day (Table 5). Obesity and pre obesity can be associated with physical activity. As people age, their physical activity decreases, which leads to weight gain or increased BMI.[25]

The average elder has a normal BMI. The BMI results shows that with age, BMI decreases (Table 6); this is related to the aging process. Body weight and muscle mass tends to decrease above 60 years of age.[26]

The relationship between the number of FTUs and BMI can be seen in the graph in Figure 1. In the graph, declining FTU is directly proportional to decreasing BMI. Table 6 also shows that mean BMI increases with increasing FTU. In addition, the results of the statistical tests indicate that there is an influence of the independent variable, which is the number of FTUs on the dependent variable, which is BMI. The effect of FTUs on BMI was 13.4% and the rest was influenced by other factors. Other factors that can influence BMI are age, physical activity, gender, variety of diet, genetic factors and the presence of systemic diseases.

The influence of FTUs on BMI is supported by research conducted by Indrasari et al.[10] that explains that FTUs are related to the ability to masticate – the higher the FTU value, the better the ability to masticate and vice versa. Good mastication is obtained when the minimum number of FTUs in the oral cavity is 7.5.[11] The increasing number of FTUs in the elderly affects their ability to masticate. If an elder has good mastication ability, they are not too worried about their choice of food. Conversely, elderly people with mastication disorders consume fewer fruits, vegetables and fibrous foods than those with normal mastication.[27] This can ultimately affect nutritional status. Based on research conducted by Samnieng,[17] a low number of FTUs is associated with a poor ability to masticate and low fibre intake, so it can ultimately lead to poor nutritional status.

This study has some limitations. It used a cross-sectional approach, so the distribution of research subjects in each group was uneven. Also, it did not analyse the variables that have the potential to become a confounding factor. These variables, such as eating frequency, plaque index score

and tooth brushing frequency, are only used as supporting data. This study also did not examine whether dentures or natural teeth influenced BMI, so the number of FTUs was only calculated in total. Future studies are suggested to include the analysis of other factors that can affect BMI. The conclusion of this study is that the number of FTUs influences BMI moderately. The greater the FTU value, the better the mastication, resulting in a better BMI.

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