

## Relationship between the Number of Teeth, Occlusal Pairs, Oral Lesions, and Body Mass Index: A Study of Institutionalized Independent Elderlies in Jakarta

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### Abstract

There exists a reciprocal relationship between oral health and body mass index (BMI), with the latter reflecting the nutritional status of elderly individuals. However, the relative importance of oral health versus that of nutritional status in government-institutionalized elderlies in Jakarta remains unclear.

The present study aimed to evaluate the relationship between the number of remaining teeth (NRT), the number of occlusal pairs (OP), the presence of oral lesions, and BMI in institutionalized elderlies. It is a cross-sectional study with consecutive sample of 231 elderlies (90 males and 141 females) aged  $\geq 60$  years residing at institutions in Jakarta. A questionnaire was employed to collect sociodemographic and behavioral data on the study group.

BMI was determined based on weight and height data. The NRT, OP, and the presence of oral lesions causing painful sensations were observed and recorded. Logistic regression analysis was used to evaluate the risk factors contributing to an inadequate BMI. The percentage of edentate respondents was higher in the underweight group (31.5%) than in the normal or overweight groups (17.8% and 21.2%, respectively).

Percentage of respondents without occlusal pairs was high (58,9%). The types of oral lesions found were ulcerations, abscesses, and atrophic tongue. Underweight elderlies tended to present with more oral ulcerations and abscesses (11.2% and 4.5%, respectively). Edentulousness and present of systemic complaints were the factors influencing underweight condition in this population.

This study shows that edentulousness had influence on the underweight condition, while the number of occlusal pairs and present of oral lesions had shown no influence on BMI. It is important to retain suggested number of teeth in increasing the chance of having an adequate body mass index in this population.

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### Background

An increase in life expectancy combined with a decline in birth rate has led to rapid growth in the elderly population worldwide, as compared with the population growth of other age groups.<sup>1</sup> The global number of people aged  $>60$  years is increasing by 3% each year.<sup>2</sup> In Indonesia, which has a total population of  $>260$  million, elderly

people account for approximately 8.7% of the total population.<sup>3</sup> Indonesia is a developing country, and health problems in elderlies pose a challenge for the government in terms of social, economic, and political issues.<sup>4</sup>

The most common health problems among Indonesian elderlies have transitioned from infectious to chronic diseases.<sup>4</sup> Major health problems in the general population include hypertension, arthritis, stroke, chronic obstructive pulmonary disease, and diabetes mellitus.<sup>5</sup> Not only does oral health play an important role in general health by affecting the function of the stomatognathic system and indirectly affecting nutrition. It also plays a key immunological role as well as entrance to a high number of antigens which interact with immune system components

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and play lead to infections and to further deterioration of health and nutritive status.<sup>6-8</sup>

According to a recent definition, oral health includes not only mechanical functions, such as chewing and swallowing, but also the ability to express oneself without pain or discomfort of the craniofacial complex.<sup>9</sup> The use of dentures, tooth loss, and the number of remaining teeth are factors representing oral health status; these have been reported to be associated with body mass index.<sup>10-12</sup> There is a high risk of oral and nutritional problems in institutionalized elderlies, resulting in a high rate of morbidity and mortality in elderly residents at care facilities.<sup>13,14</sup> Further studies regarding the association of oral health with nutritional status in institutionalized elderlies is required. Another study revealed a reciprocal relationship between oral health and body composition, with the latter reflecting the nutritional status of elderlies.<sup>15</sup> Body composition, which is usually based on the measurements of anthropometrical parameters, and BMI index provide useful data for assessing nutritional status, the outcomes of nutritional interventions, and the effects of nutrition-related disease progression.<sup>16</sup>

The present study aimed to evaluate the relationship between the number of teeth, occlusal pairs, oral lesions, and body mass index of institutionalized elderlies in Jakarta.

## Methods

This cross-sectional study was conducted between May and October 2017 at five government institutions for elderlies in Jakarta, Indonesia. The initial population was 1185 elderlies, 450 elderlies from two locations in East Jakarta, 533 elderlies from West Jakarta, and 202 elderlies from institution located in South Jakarta. Total respondent was calculated using G-Power version 3.1 with statistical power 95% and  $\alpha$  5%, result was 145 subjects. However, in this study, respondents were recruited according to the consecutive sampling method adjusted with the inclusion criteria which defined as elderlies who were aged  $\geq 60$  years, independent, able to communicate, residing at a government institution, and willing to participate. Dependent and independent respondents  $< 60$  years and dependent respondents were excluded in addition to those who were wheelchair bound, unable to stand on their own, or unwilling to participate. This study had the ethical approval

by the Committee of Ethics in Research of Faculty of Dentistry Universitas Indonesia (protocol no. 050280417) and all respondents were provided written informed consents.

Sociodemographic and behavioral data were collected via an interview; the questions were read aloud to the respondents. The following data were collected: age, gender, educational history, smoking history, snacking habits, and ongoing oral complaints. Oral and body composition examinations were conducted by trained and calibrated dentists. The dental status of each respondent was determined by observing the number of remaining teeth (NRT), the number of occlusal pairs (OP) was clinically determined by counting antagonist teeth in occlusion, and the number of lesions in the oral cavity using the criteria and classification of the World Health Organization (WHO).<sup>17</sup>

Height of the subjects was measured in centimeters using a wall-mounted portable stature meter. Body weight was measured in kilograms using a tetra polar personal body composition scanner (InnerScan Body Composition Tanita BC554<sup>®</sup>, Tanita, Japan). The results of the body height and weight measurements were recorded. BMI was calculated according to the following formula:  $\text{weight (kg)} / \text{height}^2 (\text{m}^2)$ , and grouped based on WHO BMI classification

**Data analysis.** Descriptive and analytical statistics were performed using the IBM<sup>®</sup> SPSS<sup>®</sup> Statistics 22.0 software. To describe the distribution and frequency, the variables were classified into different groups. NRT was scored and divided into four groups according to the WHO classification: edentulous, 1–9 remaining teeth, 10–19 teeth, and  $> 20$  natural teeth. With respect to the number of occlusal pairs (OPs), the subjects were divided into two groups: those who had no occlusal pairs and those who had at least one occlusal pair.

The respondents were divided into three groups according to BMI (measured in  $\text{kg}/\text{m}^2$ ). A BMI  $< 20$  was considered underweight, 20–25 was considered normal, and  $> 25$  was considered overweight.

Sociodemographic and behavioral data included information regarding age, gender, and educational history. Current medical history was noted based on self-reported history and reviewed recorded medical history, which incorporated diseases, such as diabetes,

hypertension, arthritis, and respiratory diseases, as well as present subjective systemic complaints.

Kolmogorov-Smirnov<sup>a</sup> test was used to evaluate the normality distribution of data, continuous variables then tested with Kruskal-Wallis test. To evaluate the distribution and significant differences between categorical variables, Chi-square test and Fisher Exact's test were performed. In order to test the study hypothesis, all independent variables that showed association with  $p < 0.25$  were used to generate logistic model according to the Enter method. The odds ratios (OR) are shown with their respective 95% confidence intervals (95% CI).

### Results

Of the 1185 elderlies living in the government institution, only 760 were independents. 231 (141 females and 90 males) respondents provided informed consent, fit our inclusion criteria and willing to participate in the examinations. The respondent's ages ranged from 60 to 94 years, median of age was 70 years, with majority aged 60–70 years old (45%). The frequency distribution of demographic variables is presented in figure 1. More than 50% of the population had a history of low-level education, with the percentage of respondents who had never been schooled being the highest (38.5%).

The number of dentate respondents was high ( $n = 176$ ), with mean NRT of 8.17, however, a majority of these respondents had no occlusal pairs ( $n = 136$ ). Oral lesions causing pain sensations were found to be ulcerations (6.9%), abscesses (3.0%), and atrophic tongue (6.5%). Figure 2 presents the dental and oral health statuses of the respondents.

The percentage of underweight male respondents was higher (51.2%) than that of males with a normal or high BMI. The percentage of female respondents with an inadequate BMI was higher (61.0%) than that of female respondents with a normal BMI (39.0%). The highest number of underweight respondents occurred in the group aged 70–79 years ( $n = 41$ ). Although there were no significant differences in BMI ( $p > 0.05$ ) in respondents with behavioral history (smoking and non-smoking, snacking and not snacking) and systemic complaints (having systemic complaints or no systemic complaints), respondents with a behavioral history of smoking, snacking, and systemic complaints were more highly distributed in the group with an inadequate BMI than a normal BMI.

There was a statistically significant difference between the BMI and NRT, as revealed by the Chi-square test ( $p < 0.05$ ). The percentage of edentate respondents was higher in the underweight group (31.5%) than in the normal or- overweight groups (17.8% and 21.2%, respectively).

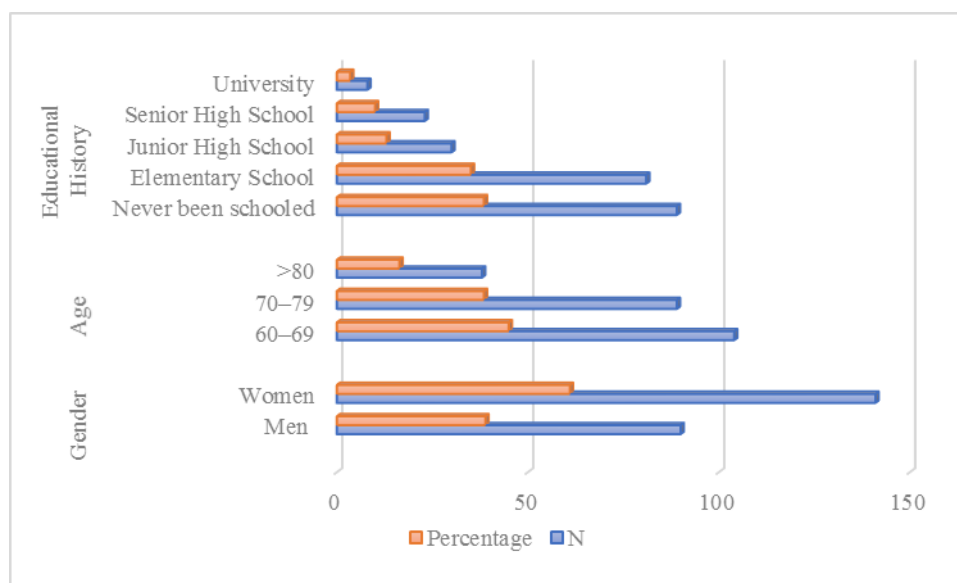
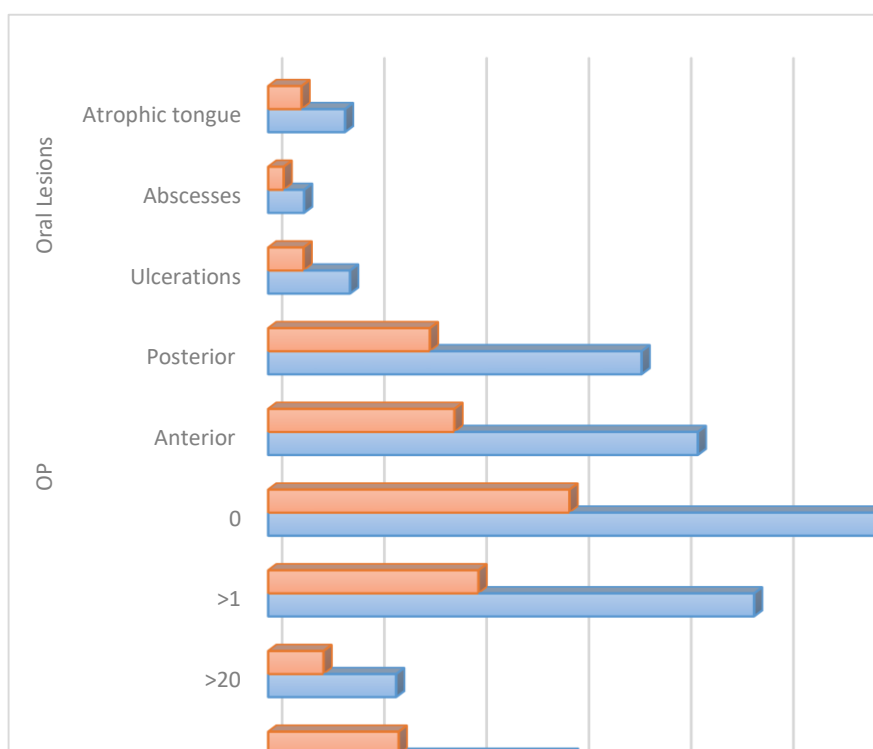


Figure 1. Main demographic data of study population.



**Figure 2.** Frequency distribution of the number of remaining teeth (NRT), the number of occlusal pairs (OP), and the presence of oral lesions in institutionalized elderly

	Underweight	Normal	Overweight	p
Age median (years)	73	68.5	70	0.054 <sup>a</sup>
Female	43 (30.5%)	55 (39.0%)	43 (30.5%)	0.019 <sup>b*</sup>
History of smoking	42 (42.4%)	16 (16.2%)	41 (41.4%)	0.132 <sup>b</sup>
Snacking habit	64 (37.4%)	41 (23.9%)	66 (38.6%)	0.651 <sup>b</sup>
Present of systemic complaint	35 (32.1%)	48 (44.0%)	26 (23.8%)	0.154 <sup>b</sup>
Never been schooled	30 (33.7%)	35 (38.9%)	25 (48.1%)	0.241 <sup>b</sup>
Oral Status				
Ulceration	10 (11.2%)	2 (2.2%)	4 (7.7%)	0.058 <sup>b</sup>
Abscesses	4 (4.5%)	3 (3.3%)	0	0.316 <sup>b</sup>
Atrophic tongue	5 (5.6%)	7 (7.8%)	3 (5.8%)	0.309 <sup>b</sup>
Without occlusal pairs	51 (57.3%)	55 (61.1%)	30 (57.7%)	0.858 <sup>b</sup>
Edentulous	28 (31.5%)	16 (17.8%)	11 (21.2%)	0.027 <sup>b*</sup>
1-9 teeth	37 (41.6%)	39 (43.3%)	16 (30.8%)	
10-19 teeth	17 (19.1%)	21 (23.3%)	21 (40.4%)	
>20 teeth	7 (7.9%)	14 (15.6%)	4 (7.7%)	

<sup>a</sup>Kruskall-Wallis Test, <sup>b</sup>Chi-Square Test

\*Chi-square test, significant at  $p < 0.05$

**Table 1.** Characteristics of respondents with respect to body mass index

Variable	Estimated OR and 95% confidence interval for underweight		Estimated OR and 95% confidence interval for overweight	
	univariate OR (95% CI)	bivariate OR (95% CI)	univariate OR (95% CI)	bivariate OR (95% CI)
Female	0.42 (0.24-0.73)	2.87 (1.59-5.19)*	4.35 (1.93-9.78)	0.24 (0.10-0.52)*
Never been schooled	0.69 (0.40-1.21)	1.09 (0.57-2.89)	1.61 (0.85-3.03)	1.04 (0.52-2.08)
Systemic complaints	0.59 (0.35-1.02)	2.17 (1.21-3.91)*	1.04 (0.56-1.95)	0.75 (0.38-1.47)
History of smoking	1.33 (0.78-2.28)	1.23 (0.57-2.61)	0.49 (0.25-0.97)	1.04 (0.45-2.39)
Present of ulceration	2.87 (1.05-8.19)	0.33 (0.11-1.04)	1.22 (0.37-3.98)	0.69 (0.19-2.41)
Edentulous	1.95 (1.06-3.61)	0.47 (0.25-0.89)*	0.88 (0.41-1.86)	1.13 (0.52-2.47)

\* $p < 0.05$

**Table 2.** Estimated OR and 95% confidence interval for factors associated with body mass index (BMI)

Respondents with a normal BMI were more highly distributed in the group of respondents with 1–9 remaining teeth ( $n = 92$ ) than in the group of respondents with  $>10$  remaining teeth or those who were edentulous. No significant difference in BMI by number of OP ( $p > 0.05$ ) was found. The percentage of respondents who had no OP was the highest (58.9%), with the majority of these being distributed in the group of respondents with a normal BMI (61.1%).

The number of respondents with oral ulcerations and abscesses was greater in the underweight group ( $n = 10$  and  $n = 4$ , respectively) than in the overweight or normal BMI groups. Table 1 presents the frequency distribution of BMI by the NRT, the number of OP, and the presence of oral lesions, also variables which independently associated with underweight and overweight conditions.

Respondents with present of systemic complaint (OR = 2.17; CI = 1.21 - 3.91), female (OR = 2.87; CI = 1.59-5.19), edentulous (OR = 0.47; CI = 0.25-0.89) were likely to be in underweight condition, while the overweight condition in this population is likely to occur in female (OR = 0.24 (0.10-0.52)). The estimated OR for factors associated with inadequate BMI is presented in Table 2.

## Discussion

The present study was conducted at government institutions for elderlies. The residents were mostly former homeless people who had no access to medical or dental care prior to admission and had a history of low-level education. The percentage of edentate elderlies (23.9%) was similar to that reported in a study conducted in 2003 describing the prevalence of edentulousness in elderlies in selected countries throughout the world.<sup>18</sup> However, the findings of the present study likely do not represent the prevalence of edentulousness among elderlies in Indonesia, because it was conducted in a limited population in Jakarta. In the present study, the percentage of dentate elderlies was high (76.1%), but most dentate subjects had only 1–9 natural teeth remaining. The questionnaire used in the present study gathered information

regarding the use of dentures; however, the majority of the subjects did not wear dentures.

BMI has long been used to classify anthropometric characteristics of groups using height and weight as parameters in population-based studies.<sup>19</sup> In previous studies associating the risk of diabetes and cardiovascular disease, the cutoff for overweight and obesity with respect to the body mass index in an Asian population was suggested to be lower than the existing WHO cutoff; however, further studies need to be conducted.<sup>20</sup> In the present study, underweight conditions were more common than overweight conditions.

Weight loss in elderlies has crucial consequences, because it is directly related to mortality rates and functional status.<sup>21</sup> A previous study reported that elderlies with a BMI  $<20$  kg/m<sup>2</sup> have a higher risk of mortality and a poorer functional status.<sup>21</sup> Another study noted that it was important to perform body weight screening in elderlies to detect unintentional weight loss accompanied by starvation, sarcopenia, and cachexia.<sup>22</sup> The same study reported that starvation can lead to protein–energy deficiency, which in turn can result in increased frailty, loss of strength, and reduced physical function in elderlies.<sup>22</sup> It was noticeable in this population, that the underweight condition was more frequently found in elderlies aged  $\geq 70$  than in younger elderlies, and females were more vulnerable to the development of an inadequate BMI. This is in accordance with a previous study performed in Malaysia, in which there was a significant difference in anthropometric measurements observed between the 60–69 and  $\geq 80$  age groups, with the latter having a much lower BMI.<sup>23</sup>

Dentate elderlies were more highly distributed in the normal BMI group than in the inadequate BMI group. This result was in accordance with a previous study regarding the relationship between oral health and BMI conducted in the UK.<sup>12</sup> It is also consistent with the findings of another study that reported that the NRT affects food intake and choice.<sup>6</sup> A Japanese study involving adults aged  $\geq 45$  years and older reported that to avoid chewing difficulties, at least 24 functional teeth, 13 posterior functional teeth, or 8 units of natural teeth were needed.<sup>24</sup> The mean NRT in the



majority of the respondents of the present study was 8.7, which may explain why the body weight of most of the subjects was normal. It is possible that the elderlies in the present study consumed the food provided by the institution, ignoring any oral discomfort, including edentulousness. The change in the elderly residents' circumstances (i.e., from homelessness to institutionalized) may also account for changes in behavioral aspects of eating, for instance, the development of snacking habits. In the present study, elderlies who had snacking habits were mostly distributed in the group of subjects with a high BMI, with the most common snacks consumed by the elderlies being sweets and fried food. This may increase the chances of having a greater number of decayed teeth and further tooth loss.<sup>25</sup>

The types of oral lesions recorded in the present study were those causing pain sensations and creating subjective complaints that may influence mastication comfort. Of the numerous lesions that may be found in elderlies, lesions associated with denture wearing are frequently reported as the most common one.<sup>26,27</sup> In the present study, almost none of the elderlies wore dentures; however, oral ulcerations of unknown causes were common. Questionnaire about use of denture was included in the interview with a yes or no answer and additional information regarding type and present condition of the denture, only 21 subjects have unused denture because of the condition of the denture, only 4 subjects still wear dentures. The systemic conditions of the elderlies were suspected to be associated with the presence of oral lesions, because the percentage of the elderlies who had systemic complaints was high in this population.

Elderlies with present of systemic complaints (OR = 2.17; CI = 1.21 - 3.91) were likely to be underweight; however, no statistically significant difference was observed among the BMI groups ( $p > 0.05$ ) in the Chi-square analysis. Other factors found to increase the risk of underweight condition were the edentulousness and gender. Overweight condition was likely to occur in female, with no other factor increase the risk. The main limitation of the present study was the fact that the systemic complaints were self-reported, meaning that the data recorded were based on the subject's point of view. Diagnosis by a physician would result

in more objective results; however, the present study supports the evidence reported in previous studies that systemic complaints and BMI in elderlies are reciprocally related.<sup>28-30</sup>

## Conclusions

The present study describes the relationship between the number of teeth, the number of occlusal pairs, the presence of oral lesions, and body mass index, in accordance with the reciprocal relationship between oral health and nutritional status in elderlies. In this population, edentate elderlies are more likely to have an inadequate BMI. Results of this study may add information to the government in constructing public health policies especially for institutionalized elderlies. It is necessary for dental and nutritional professionals to increase the consciousness of keeping good oral health from earlier decade of life. This study shows a consistent result about the importance of maintaining teeth in increasing the chance of having better nutritional status in elderlies.

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## Conflict of Interest

None.

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