ORIGINAL ARTICLE

Relationships Between Tooth Loss and Masticatory Performance, Nutrition Intake, and Nutritional Status in the Elderly

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Abstract

Objective: To analyze the associations between posterior tooth loss and masticatory performance, nutrition intake, and nutritional status in the elderly. **Material and Methods:** A total of 158 subjects aged 60 years and older from Depok, West Java, Indonesia were enrolled in this cross-sectional study. Posterior teeth contacts were assessed and the subjects were divided into two groups based on Eichner Index; group A2–B3 and group B4–C3. The masticatory performance test was conducted using color-changeable chewing gum. A semi-quantitative food-frequency questionnaire was used to measure nutritional intake in the form of total calories, and the Mini-Nutritional Assessment-Short Form was used to measure nutritional status. Mann Whitney U test was used to determine differences in masticatory performance, nutrition intake, and nutritional status between the two groups. **Results:** Seventy-four percent of participants were female, and 26% were male. A significant difference in the mean masticatory performance score (p<0.001) was noted between Eichner group A2–B3 (5.66 ± 1.80) and B4–C3 (3.20 ± 1.25). However, no statistically significant difference in nutritional status and calorie intake were found between the two groups (p>0.05). **Conclusion:** Despite the adequacy of nutrition intake and nutrition status in this population, tooth replacement is necessary to improve masticatory performance in both groups.

Keywords: Stomatognathic System; Masticatory Muscles; Nutrition Assessment.

Introduction

The number of people aged 65 and older is expected to grow from 524 million in 2010 to 2 billion by 2050 [1]. Poor oral hygiene is common among the elderly because aging affects the oral structures, and the practice of good oral hygiene is infrequent in this population [2]. Tooth loss is another common problem encountered among the elderly, affecting their ability to eat and, as a result, their quality of life [3]. Disruption of mastication can affect the type of food selected, and therefore influence the nutritional status [3,4].

Impaired mastication and limited food selection are more likely to be associated with posterior tooth loss, which are required for chewing [3,4]. The number of occluding pairs of posterior teeth determines the nutritional status in the elderly with a reduction in the number of posterior teeth has been associated with lack of nutritional intake [3]. Malnutrition in the elderly weakens the immune system, reduces physical function, and increases both morbidity and mortality rates. Therefore, it is important to replace missing teeth [5-8].

One alternative for restoring tooth functions is the use of dentures [4,9]. Research shows that nutritional status increases after 1, 6, and 12 months of denture use [10]. Studies on the associations between tooth loss, denture use, and nutritional status have presented with variable results [11,12]. One study in Indonesia reported the presence of a significant relationship between the number of functional tooth units and nutritional status [11], whereas in another study, a significant relationship was noted between dental status and macronutrients, but not micronutrients [12].

Further studies to elucidate the relations between tooth loss, mastication, and nutrition among the elderly in Indonesia are necessary. The present study aimed to analyze the associations between posterior tooth loss and masticatory performance, nutrition intake, and nutritional status in the elderly.

Material and Methods

Study Design and Sample

This cross-sectional study involved participants from three different districts in Depok, one of the urban cities in West Java, Indonesia. The total subjects of this study were 158 participants. Males and females aged 60 years and above, who were able to communicate verbally, willing to undergo the assessments and agreed to sign the informed consent were included in the study. Subjects wearing removable dentures were excluded.

Tooth Loss Classification

Tooth loss was assessed using the Eichner Index, a classification system based on the presence or absence of occlusal contact in the posterior area. The region was divided into four support zones, two in the premolar and two in the molar regions. Based on the Eichner Index, tooth loss can be classified into three main categories as follows: A (four support zones posteriorly), B (one

to three support zones posteriorly or the presence of occlusal contacts anteriorly), and C (no occlusal contact on the remaining teeth). Category A is further divided into three subcategories as follows: A1 (no tooth loss), A2 (tooth loss in one support zone), and A3 (tooth loss in two support zones). Category B is divided into four subcategories: B1 (three support zones), B2 (two support zones), B3 (one support zone), and B4 (only occlusal contacts in anterior). Similarly, category C is further divided into the three following subcategories: C1 (presence of remaining teeth in both arches but no occlusal contact), C2 (remaining teeth in one arch, no occlusal contact), and C3 (completely edentulous) [13]. The subjects were divided into two groups: (Eichner A2– B3 and Eichner B4–C3) based on the difference in masticatory performance.

Masticatory Performance Test

The masticatory performance test was conducted using color-changeable chewing gum (Xylitol, Lotte Co., Ltd., Tokyo, Japan). The subjects were instructed to chew the gum for 60 chewing cycles in 60 s. Afterward, the gum was flattened between clear glass slabs and the color was measured visually using a color scale (score 1-11) [14]. A higher score indicates better masticatory performance.

Nutrition Intake Assessment

A food-frequency questionnaire (FFQ) is the most practical and economical method used for collecting nutrition intake data based on food commonly consumed by individuals [15]. Semi-quantitative FFQ allows for the measurement of nutrient and total energy intake. In the present study, the participants recalled their food consumption for the last one month and the total energy intake by each subject was calculated. Nutrient intake (kcal) was calculated by multiplying the frequency of each food with its nutritional value (single portion). The Nutrition Adequacy Rates recommended by the Indonesian Ministry of Health are 1900 kcal and 1525 kcal for males aged 65–80 years and over 80 years, respectively; and for females, the recommended rates for the same age groups are 1550 kcal and 1425 kcal, respectively [15,16].

Nutritional Status Assessment

Mini-Nutritional Assessment (MNA) is a measuring tool used to assess the nutritional status of the elderly. MNA is often used to detect the presence of malnutrition and consists of anthropometric measurements such as weight and height measurements to calculate the body mass index along with questionnaires about the patient's physical and psychological condition, diet, type of food intake, and self-review on his/her health and nutrition. The two types of MNA include full MNA and MNA-Short Form (MNA-SF). This study used the MNA-SF [17], which consists of six questions with a maximum total score of 14. The results can be grouped into three categories as follows: malnutrition (score 0–7), risk of malnutrition (score 8–11), and normal (score 12–14) [17,18].

Data Analysis

Data were analyzed using IBM SPSS Statistics Software, version 22 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to calculate the absolute and relative frequencies, minimum and maximum value, mean, median and standard deviation. Mann Whitney U test was used to determine differences in masticatory performance, nutrition intake, and nutritional status between the two groups (Eichner Index A2–B3 and Eichner Index B4–C3). The level of statistical significance was set at $p < 0.05$.

Ethical Aspects

This study was approved by the Ethical Committee of the Faculty of Dentistry, Universitas Indonesia (No.5/Ethical Approval/FKGUI/II/2018). All participants signed an informed consent document before the start of data collection.

Results

A total of 158 subjects comprised of 41 males and 117 females with an average age of 67 years were evaluated. Concerning to tooth loss, most of the participants belonged to Eichner group B2 (n = 42/26.6%), and the least number were seen in Eichner group C3 (n = 2/1.3%). In the present study, subjects were divided into two groups based on the Eichner Index i.e., Eichner Index A2–B3 (participants with at least one posterior support zone) (n = 114) and Eichner Index B4–C3 (participants with no posterior support zone) (n = 44) (Table 1).

Table 1. Sample distribution by gender and Eichner Index.

Variables	N	%
Gender		
Male	41	25.9
Female	117	74.1
Eichner Index		
A2	18	11.4
A3	12	7.6
B1	19	12.0
B2	42	26.6
B3	23	14.6
B4	27	17.1
C1	10	6.3
C2	5	3.2
C3	2	1.3

A significant difference in mean masticatory performance (p<0.001) between the two groups (Table 2) was found.

Table 2. Relationships between Eichner Index and masticatory performance.

Eichner Index	Masticatory Performance			
	N	Minimum-Maximum	Median	p-value
A2–B3	114	1–10	6	<0.001
B4–C3	44	1–6	3	

However, no significant differences in nutrition intake (p=0.874) (Table 3) and nutritional status (p=0.161) (Table 4) were observed between the groups.

Table 3. Relationships between Eichner Index and nutrition intake.

Eichner Index	Nutrition Intake (kcal)			
	N	Minimum-Maximum	Mean ± SD	p-value
A2–B3	114	494.56–2945.41	1684.50 ± 601.08	0.874
B4–C3	44	458.75–2985.49	1656.15 ± 616.28	

Table 4. Relationships between Eichner Index and nutritional status.

Eichner Index	Nutritional Status			
	N	Minimum-Maximum	Median	p-value
A2–B3	114	3–14	12	0.161
B4–C3	44	8–14	12	

Discussion

In the present study, associations between posterior tooth loss and masticatory performance, nutrition intake, and nutritional status were evaluated in the elderly. The collected data were grouped based on the number of occlusal contacts. The subjects were divided into two groups: (Eichner A2 – B3 and Eichner B4 – C3) based on the difference in masticatory performance. Safeguarding the occlusal contacts of unilateral (B3) premolars is critical for masticatory performance, hence the grouping [13]. In line with previous studies, a statistically significant difference in masticatory performance was observed between the two groups in the present study [19,20]. A previous study reported that masticatory performance was influenced by the number of occlusal pairs [19], while other authors demonstrated a correlation between masticatory performance and the number of residual teeth in the oral cavity [20].

Although there is significant difference in masticatory performance score between the two groups (score six for group A2 – B3 and three for group B4 – C3) the masticatory performance score of all the participants, including ones with one or two posterior occlusal contacts, are well below the maximum score of 11. The use of the Shortened Dental Arch concept for tooth replacement of this elderly population needs to be further investigated. Clinically, a prosthodontics treatment strategy that can better improve masticatory performance might be selected for them.

The nutrition intake recommended by the Indonesian Ministry of Health for 65–80 years old individuals is 1900 kcal for males and 1550 kcal for females [16]. In the current study, nutrition intake was 1684.50 ± 601.08 kcal for A2 – B3 group and 1656.15 ± 616.28 kcal for B4 – C3 group. No significant difference in nutrition intake between the two groups. Since most of the participants were female, this finding shows that the recommended nutrition intake was achieved. It has been shown that food intake was not significantly influenced by the number of occlusal units [21]. Similarly, no significant differences between dietary intake and the number of present teeth were

noted [22]. Alternatively, some authors reported that the number of teeth in the oral cavity had only a minor influence on dietary intake in 80-year-old subjects [23].

Many authors agree that the elderly can cope with masticatory problems by cooking food for longer periods or cutting the meat and vegetables to smaller pieces [23,24]. In the present study, the most commonly consumed carbohydrate was rice, which is one of the staple foods in Indonesia. The consumption of noodles and sweet potatoes was relatively less. Other findings from the FFQ questionnaire included the sources of both plant and animal proteins for this population are egg, chicken, fish, milk, and beans. Many of the subjects in Eichner group B4 – C3 did not eat beef or goat/lamb, and none of them consumed pork due to religious reasons. The least consumed vegetables were spinach and cassava leaves, and the most commonly eaten vegetable was long beans which do not cause food retention. Many participants in this study complained of food retention in interdental spaces after eating leafy vegetables.

No statistically significant difference in nutritional status was noted between the two groups in this study. The result shows that the nutritional status for both groups was normal. This is similar to the previous study conducted in Indonesia [4]. However, contradictory results have been reported in other studies. The dental literature reveals that for an optimal nutritional status, the elderly should have at least five posterior occlusal pairs [24]. In addition, an association between tooth loss and nutritional status has been previously described [25]. Likewise, tooth loss was found to be associated with nutrient intake, especially fibers and vitamins, a lack of which could lead to inadequate nutritional status [26]. The dissimilarity in results between the current study and those reported previously may be attributed to the unbalanced numbers of subjects in the two groups; moreover, the intake of each nutrient was not calculated in the present study. Further assessment into the intake of each nutrient might help to identify which nutrients are lacking.

The FFQ relies on memory recall, and subjects might not exactly remember what they ate over the past month. The use of a cross-sectional design is also one of the limitations of this study. A prospective study design might better elucidate the relationships between tooth loss and masticatory performance, nutrition intake, and nutritional status.

Conclusion

These findings indicate that the number of tooth loss in the elderly may be associated with mastication, but not with their nutritional status nor intake. Taking into account the masticatory performance score in this population, although nutrition intake in this population is adequate, replacement of tooth loss is necessary to improve masticatory performance.

Authors' Contributions: All authors contributed to the design of the study. PS, NA and MH performed the data collection. PS, NA and MI wrote the manuscript, performed data analysis and interpretation. All authors reviewed the manuscript. All authors declare that they contributed to critical review of intellectual content and approval of the final version to be published.

Conflict of Interest: The authors declare no conflicts of interest.

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