PAPER • OPEN ACCESS
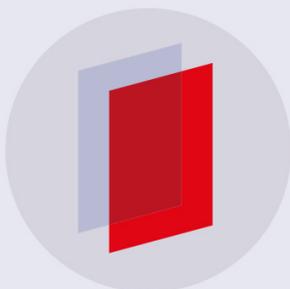
Relationship between oral health status and masticatory performance with nutritional status in the elderly

View the article online for updates and enhancements.

IOP ebooks™

Bringing you innovative digital publishing with leading voices to create your essential collection of books in STEM research.

Start exploring the collection - download the first chapter of every title for free.

Relationship between oral health status and masticatory performance with nutritional status in the elderly

G G Yuniendra[1], A Rahardjo[1], M Adiatman[1*], D A Maharani[1] and P A V Thuy[2]

[1]Departement of Dental Public Health and Preventive Dentistry, Faculty of Dentistry, Universitas Indonesia, Jakarta, 10430, Indonesia
[2]Department of Periodontology, Faculty of Odonto-Stomatology, Universitas of Medicine and Pharmacy, Ho Chi Minh City 70000, Vietnam

*E-mail: melle_gigi@yahoo.com

Abstract. The greatest component in the decay–missing–filled teeth index is tooth loss, which occurs mostly in the elderly. Tooth loss can affect the ability to chew food, resulting in a lack of nutritional intake. A cross-sectional study was performed at four community health centers in Central, South, and East Jakarta of 93 elderly (age ≥60) subjects who underwent intraoral examination, anthropometric measurement (body mass index [BMI]) and interview using the Mini Nutritional Assessment (MNA). Of the subjects, 53.8% had ≥20 natural teeth and 55.9% were at risk for malnutrition. Correlation testing showed that the total number of natural, decayed, missing, and filled teeth and masticatory performance ($p > 0.05$) were not significantly correlated with nutritional status (BMI and MNA). There is no relationship between oral health status, masticatory performance, and nutritional status in the elderly.

1. Introduction

Indonesian people often experience oral problems. According to data from the Basic Health Research, the decay–missing–filled teeth (DMFT) index in Indonesians is 4.6, with values of decayed teeth (DT) = 1.6, missing teeth (MT) = 2.9, and filled teeth (FT) = 0.08 [1]. The MT index has the highest score among the three components, showing that MT is the greatest oral health problem for Indonesian people. In Indonesia, most patients with MT are elderly (≥65 years old according to the World Health Organization [WHO]) and have approximately 17 teeth per person.

Mastication is the process by which food is crushed and broken into pieces by chewing, and the pieces are eventually swallowed. In dentistry, the components of mastication consist of a masticatory performance, occlusal force, and chewing limit parameter [2]. Previous studies in some countries have demonstrated the effectiveness of several methods of measuring masticatory performance, using a food test. Foods used to assess masticatory performance should not have a sticky texture or be difficult to chew and contaminated by saliva. The food also should remain stable during storage at room temperature. Examples are gummy jelly tests, color-changing chewing gum tests, and tests using an artificial test food, such as Optosil dan Optocal.

The process of aging impacts various aspects of life. MT in the elderly can cause decreased masticatory function and affect food selection. The decreased masticatory function may lead to difficulty in chewing, which then causes decreased oral health status and affects food/nutrient intake

[3]. The elderly face significant challenges in obtaining adequate nutritional intake. With age, the risk of decreased nutritional status in the elderly also increases.

Nutrition has an important role in health because good nutritional intake is important in maintaining and protecting health. Masticatory performance can influence the selection of food and determining the nutrients obtained. People who cannot chew comfortably tend to avoid high-fiber foods, such as bread, vegetables, fruit, and meat, which can lead to a lack of nutrients. If nutritional status is not well maintained, malnutrition can develop [4]. Untreated malnutrition can cause an increased incidence of disease, especially in the elderly.

Nutritional status in the elderly can be assessed through various methods. The body mass index (BMI) has an important role in representing nutritional conditions in general [5]. Ikebe et al. [3] reported that subjects with low masticatory performance tended to have a low BMI (<20 kg/m^2).

Oral health problems in Indonesian elderly are dominated by difficulties with masticatory function due to various factors, such as MT, poor oral health status, and poor denture status. This causes a change in the food consumed, which affects nutritional status. We examined the relationship between oral health status, masticatory performance, and nutritional status in the elderly by considering some demographic factors, such as age and sex.

2. Methods
This cross-sectional study consisted of clinical examination, anthropometric measurement of height and weight, and a questionnaire regarding nutritional status. Data were collected from elderly subjects (age >60 years) at four community health centers in three municipal areas (Central, South, and East Jakarta) between September and October 2016. The population was obtained by the convenience sampling method. Indicators of mastication ability were analyzed using a chewing gum test tool (color-changing chewing gum.

Data processing and analysis were done using Software SPPS Statistics v.16 (SPSS, Inc., Chicago, IL, USA). The data processed were presented in the following forms: (1) analysis of frequency distribution from subjects, (2) comparative analysis using the χ^2 test to determine the proportion between sex and individual perception of oral health with nutritional status category based on the Mini Nutritional Assessment (MNA) questionnaire, and (3) correlation analysis using Spearman's test to determine the relationship between the frequency of consuming sweet foods and beverages with dental caries, MT, FT, and the DMFT index, as well as the relationship between age, number of permanent teeth, and chewing gum score with nutritional status based on the MNA questionnaires.

3. Results
The 93 study subjects included 62 females (66.7%) and 31 males (33.3%) from Central Jakarta (Gambir District Health Center, $n = 7$ and Menteng District Health Center, $n = 25$), South Jakarta (Cilandak District Health Center, $n = 34$), and East Jakarta (Pasar Rebo District Health Center, $n = 27$; Table 1).

Table 1. Social and demographic status

Demography variables	*n*	%
Sex		
Male	31	(33.3%)
Female	62	(66.7%)
Age		
60–69	61	(65.6%)
≥70 years	32	(34.4%)

Oral health status was evaluated using two instruments (WHO form and WHO questionnaire). Of the 93 patients, four (4.3%) were edentulous, whereas 89 still had teeth. The average number of permanent teeth in these 89 subjects was 18.9 ± 8.1 (Table 2).

Table 2. Number of permanent teeth in 93 subjects

Number of teeth	n (%)
None	4 (4.3)
1–9	14 (15.1)
10–19	25 (26.9)
≥20	50 (53.8)

Table 3 shows subjects' oral health status. Mean incidence of bleeding on probing per person was 8.9, 9.9, and 9.5 teeth in males, females, and overall, respectively. Average DMFT index was 15.6 ± 8.1. This score was included in the high category based on the WHO classification.

Table 3. Oral health status in 89 subjects

	Males (30) Average (SD)	Females (59) Average (SD)	Total
Sum of permanent teeth	18 (9.6)	19.4 (7.3)	19 (8.1)
Bleeding on probing	8.9 (6.8)	9.9 (5.4)	9.5 (5.9)
DT	2.9 (2.8)	3.9 (3.4)	3.6 (3.3)
MT	12.6 (9.3)	10.8 (7.5)	11.4 (8.1)
FT	0.5 (1.4)	0.6 (1.9)	0.7 (1.7)
DMFT	16 (9.4)	15.4 (7.4)	15.6 (8.1)

Nutritional status was evaluated using BMI measurement and MNA questionnaire (Table 4). Mean BMI score for the 93 subjects was 24 ± 4.1, which was considered the normal weight category.

Table 4. BMI scores in 93 subjects

BMI category	Males (n = 32) (%)	Females (n = 61) (%)	Total (n = 93) (%)
Underweight	9.4	8.2	8.6
Normal weight	56.2	50.8	52.7
Overweight	34.4	29.5	31.2
Obese	0	11,5	7.5

MNA scores consisted of three classifications: malnourished (total score, <17), risk of malnutrition (total score, 17–23.5), and normal nutritional status (total score, 24–30). Average total MNA value in the 93 subjects was 22 ± 3.2 (Table 5).

Tabel 5. MNA scores in 93 subjects

MNA Category	Males (n = 32) (%)	Females (n = 61) (%)	Total (n = 93) (%)
Malnourished	6.2	4.9	5.4
Risk of malnutrition	46.9	60.7	55.9
Normal nutritional status	46.9	34.4	38.7

No relationship was found between oral health status (including the remaining number of teeth, DT, MT, and FT) and BMI categories. For data analysis, MNA categories were classified into two categories (normal nutritional status and risk of malnutrition/malnutrition). The χ^2 test was performed

to determine the difference in sex and self-perception of oral health according to MNA categories. Spearman's correlation test was performed to determine the relationship between age, number of permanent teeth, oral health status, and colored changing chewing gum score with MNA categories (Table 6). The results showed no significant association of any of these variables with nutritional status (MNA in two categories).

Table 6. Relationship between oral health status variables and MNA categories

Variables	Normal (n = 36)	Risk of malnutrition/ malnourished (n = 57)	p score
Age	66.7 ± 5	68.5 ± 6	0.2‡
Sex			0.2§
Male	15 (41.7%)	17 (29.8%)	
Female	21 (58.3%)	40 (70.2%)	
Sum of permanent teeth	18.4 ± 9.8	18 ± 8.2	0.5‡
Number of teeth			0.9‡
1–9	9 (25.7%)	5 (9.3%)	
10–19	5 (14.3%)	20 (37%)	
≥20	21 (60%)	29 (53.7%)	
Bleeding on probing	8.8 ± 6.4	9.3 ± 5.9	0.6‡
DT	2.9 ± 2.6	3.8 ± 3.6	0.3‡
MT	12.4 ± 10	12.3 ± 8.4	0.7‡
FT	0.6 ± 1.6	0.7 ± 1.7	0.8‡
DMFT	15.9 ± 9.8	16.7 ± 7.8	0.4‡
Color-changing chewing gum score	6.8 ± 2.4	6.9 ± 2.4	0.9‡
Self-perception of gum health			0.9§
Satisfied until very satisfied	14 (38.9%)	23 (40.4%)	
Not satisfied until very dissatisfied	22 (61.1%)	34 (59.6%)	
Self-perception of teeth health			0.8§
Satisfied until very satisfied	13 (36.1%)	22 (38.6%)	
Not satisfied until very dissatisfied	23 (63.9%)	35 (61.4%)	

§χ^2 test results

‡Spearman's correlation test between categories.

4. Discussion

This study was conducted in October 2016 on 93 active elderly subjects in different areas of DKI Jakarta Province who did not live in social institutions. Dental examinations were performed according to the WHO examination standards and included the number of remaining teeth, DMFT score, and periodontal tissue examination. Of the independent elderly examined, 53.8% still had ≥20 teeth. In 2008, De Marchi et al. [21] reported that most independent elderly (44.3%) examined in Brazil had no permanent teeth and only 23% had more than eight teeth. In four subjects aged ≥80 years, the average number of remaining teeth was 15. The average number did not reach the target set by the WHO (at least 20 teeth at age 80) [22,23].

The DMFT score in our study was 1.6, which was lower than the DMFT rate according to RISKESDAS in 2013 (18.9 for the age group ≥65 years) [1]. MT showed the highest proportion of DMFT scores, with an average of 11.4 teeth per individual. This number was low compared with the data of RISKESDAS (17.1) [1]. This is due to the characteristics of the subjects, which are independent elderly with good general health condition, so they still have enough remaining teeth.

Nutritional status in this study was assessed using BMI measurements categorized on the basis of WHO classification and MNA questionnaires. The MNA questionnaire was used because it combines anthropometric measurements, including BMI measurements, physical and psychologic condition assessments, and individual views on nutritional status. This questionnaire was filled via interview method, so that the intention of each question could be well understood by the subject. Mean BMI score for the 93 subjects in this study was 24, which included overweight categories. Average total MNA score was 22 ± 3.2.

Correlation testing of oral health status in each BMI category revealed no relationship between oral health status (including the number of remaining teeth, DT, MT, and FT) with BMI category. This finding is consistent with that of Adiatman et al. [5] who studied dependent elderly in nursing homes in 2012 and found no relationship between the remaining teeth and BMI category. However, in 2003 Marcenes et al. [4] demonstrated a relationship between the number of remaining teeth and BMI score in independent elderly in the United Kingdom.

When the MNA was classified into two categories (normal and risk of malnutrition/malnourished), Spearman's correlation test of age and the χ^2 test of sex showed no correlation of age, sex, and number of permanent teeth with the MNA categories. This result was similar to that of El Hélou et al. [24] in 2014, who found no relationship between age, sex, and nutritional deficiencies. In 2013, Adiatman et al. [5] demonstrated no relationship between the number of remaining teeth and MNA. In 2014, Melia [25] also found no relationship between tooth loss and nutritional status (using the MNA categories).

In this study, masticatory performance was measured using color-changing chewing gum. This method is easy and effective for evaluation of masticatory performance. Chewing gum has advantages as a test for masticatory performance because it simulates natural and stable chewing [14]. Spearman correlation test results showed no relationship between masticatory performance and nutritional status in elderly in this study. This result was similar to that of Ikebe et al. [3] in an independent elderly population in Japan in 2006, who found no relationship between occlusal pressure or mastication ability and nutritional status as measured using BMI [3]. Earlier studies performed by Shakina [26] in 2014 reported no relationship between masticatory performance or tooth loss and nutritional status measured by BMI [26].

The WHO examination questionnaire included questions about self-perception of teeth and gum health, dichotomizing each perception as (1) satisfied until very satisfied and (2) not satisfied until very dissatisfied. The χ^2 comparative test showed no relationship between self-perception of teeth and gum health and nutritional status in the elderly in our study. However, in 2012, Kshetrimayum et al. [27] found a relationship between self-perception of oral health and nutritional status in dependent elderly; that is, subjects who had a bad perception or were not satisfied with the state of dental health also had a low MNA score.

Our findings indicated that poor oral health status does not affect food intake in the elderly. Some subjects with few teeth still pay attention to food intake and choosing the type of food to be consumed. Some of them say they will choose soft or easy-to-chew foods.

This study had several limitations, namely, the proportion of male-to-female sex and also the proportion of ages were not balanced. Most subjects were 60–69 years old. Also, not enough sociodemographic data existed, including economic and educational levels, and no data existed on the history of food and systemic diseases suffered. Besides, examination of masticatory performance using chewing gum was the only visual method used and we did not stick gum to the glass plates. The number of strokes in patients with teeth and those using dentures also was not distinguished. Further research is needed with larger sample size and more demographic socioeconomic factors, such as economic and educational status. Many subjects who have lost their teeth and do not use dentures are at risk for malnutrition. Therefore, more massive education is needed to always maintain oral health and food intake with adequate nutrition for the elderly.

5. Conclusion

On the basis of our results with several variables of oral health that can affect the nutritional status of the elderly, we concluded the following: (1) The average age of 93 elderly subjects (≥ 60 years) in DKI Jakarta was 67.8 years, with the largest proportion aged 60–69 years (65.6%). (2) There was no

relationship between number of DT, MT, FT, and number of periodontal problems with nutritional status in the elderly. (3) There was no relationship between masticatory performance and nutritional status of the subject. (4) Statistically, there was no relationship between age, sex, and self-perception of dental health and gums with nutritional status of the elderly.

References

[1] Badan Penelitian dan Pengembangan Kesehatan 2013 Kementerian Kesehatan RI. Riset Kesehatan Dasar

[2] van der Bilt A 2011 Assessment of mastication with implications for oral rehabilitation: a review *J. Oral. Rehabil.* **38** 754-80

[3] Ikebe K, Matsuda K, Morii K, Nokubi T and Ettinger R L 2006 The relationship between oral function and body mass index among independently living older Japanese people *Int. J. Prosthodont.* **19** 539-46

[4] Marcenes W, Steele J G, Sheiham A and Walls A W 2003 The relationship between dental status, food selection, nutrient intake, nutritional status, and body mass index in older people *Cad. Saude. Publica.* **19** 809-16

[5] Adiatman M, Ueno M, Ohnuki M, Hakuta C, Shinada K and Kawaguchi Y 2013 Functional tooth units and nutritional status of older people in care homes in Indonesia *Gerodontology* **30** 262-9

[6] Maryam R, Ekasari M, Rosidawati, Jubaedi A and Batubara I 2008 Mengenal Usia Lanjut dan Perawatannya (Jakarta: Salemba Medika)

[7] Razak P, Richard K, Thankachan R, Hafiz K, Kumar K and Sameer K 2014 Geriatric oral health: a review article *J. Int. Oral. Health* **6** 110-116.

[8] Friedman P 2014 Geriatric dentistry: caring for our aging population (USA: Wiley Blackwell) p 4-11

[9] Bazrafshan E, Kamani H, Kord Mostafapour F and Mahvi A 2012 Determination of the decayed, missing, filled teeth index in Iranian Students: A case study of Zahedan City *Health Scope.* **1** 84-88

[10] Organization W 2013 *Oral Health Surveys: Basic Methods* 5th ed. (Geneva: World Health Organization)

[11] Okeson J P 2008 *Management of Temporomandibular Disorders and Occlusion* (St. Louis, Mo; London: Mosby)

[12] Soboļeva U, Lauriņa L and Slaidiņa A 2005 The masticatory system--an overview *Stomatologija* **7** 77-80

[13] Hama Y, Kanazawa M, Minakuchi S, Uchida T and Sasaki Y 2014 Properties of a color-changeable chewing gum used to evaluate masticatory performance *J. Prosthodontic Res.* **58** 102-106

[14] Hama Y, Kanazawa M, Minakuchi S, Uchida T and Sasaki Y 2014 Reliability and validity of a quantitative color scale to evaluate masticatory performance using color-changeable chewing gum *J. Med. Dental Sci.* **6** 1-6

[15] Supariasa, D N, Bakri B and Fajar I 2001 *Penilaian Status Gizi* (Jakarta: Penerbit Buku Kedokteran EGC) P 87

[16] Palmer C A 2003 Diet and Nutrition in Oral Health. *Upper Saddle River NJ* (London: Prentice Hall) p 164-172

[17] Henderson L and Gregory J 2002 *The National Diet & Nutrition Survey: Adults Aged 19 to 64 Years* (London: TSO)

[18] WHO expert consultation 2004 *Appropriate Body-Mass Index for Asian Populations and its Implications for Policy and Intervention Strategies* (The Lancet) 157-163

[19] Guigoz Y 2006 The Mini Nutritional Assessment (MNA) review of the literature--What does it tell us? *J. Nutr. Health Aging.* **10** 466-85

[20] Soini H, Routasalo P and Lagström H 2004 Characteristics of the Mini-Nutritional Assessment in elderly home-care patients *Eur. J. Clin. Nutr.* **58** 64-70

[21] De Marchi R, Hugo F, Hilgert J and Padilha D 2008 Association between oral health status and nutritional status in south Brazilian independent-living older people *Nutrition* **24** 546-553

[22] WHO Expert Committee 1992 *Recent advances in oral health* (Geneva, Switzerland: World Health Organization (WHO))

[23] Stock C, Jürges H, Shen J, Bozorgmehr K and Listl S 2015 A comparison of tooth retention and replacement across 15 countries in the over-50s *Community Den. Oral. Epidemiol.* **44** 223-31

[24] El Hélou M, Boulos C, Adib S and Tabbal N 2014 Relationship between oral health and nutritional status in the elderly: A pilot study in Lebanon *Journal of Clinical Gerontology and Geriatrics* **5** 91-95

[25] Melia 2014 Hubungan kehilangan gigi dan pemakaian gigi tiruan terhadap status nutrisi. Universitas Indonesia. 41-42.

[26] Shakina T, Masulili C and Indrasari M 2014 Hubungan antara kemampuan mastikasi dan Indeks Massa Tubuh (IMT) Thesis (Jakarta: Departemen Prostodonsia, Fakultas Kedokteran Gigi Universitas Indonesia) p 20

[27] Kshetrimayum N, Reddy C, Siddhana S, Manjunath M, Rudraswamy S and Sulavai S 2012 Years and above in Mysore City, India Oral health related quality of life and nutritional status of institutionalized elderly population aged 60 *Gerodontology*. **30** 119-125.