Relationship Between Occlusal Support Zones and Temporomandibular Disorders in the Elderly Population

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Abstract

This study aims to analyze the relationship between loss of occlusal support zones (OSZs) and temporomandibular disorders (TMDs) and also among sociodemographic factors (gender, education level, and economic status) in an elderly population. This cross-sectional study included 100 elderly patients aged >60 years with complete dentition or loss of teeth without being replaced by dentures at Kramat Jati Health Center and Dental Hospital Faculty of Dentistry, Universitas Indonesia. Subjects were screened to collect OSZ data based on the Eichner index and interviewed using the Temporomandibular Disorder-Diagnostic *Index* (TMD-DI) questionnaire. No association was observed between OSZs and TMDs in the elderly people. However, there was an increase in the number of subjects experiencing TMDs as the OSZs decreased. The analysis test between OSZs and sociodemographic factors did not result in a significant difference, including the comparison between TMDs and gender and education level. However, there was a significant difference between TMDs and economic status. The loss of OSZs could increase the risk of TMDs among the elderly population at Kramat Jati Health Center and Dental Hospital Faculty of Dentistry of Universitas Indonesia, whereas sociodemographic factors appeared to have little impact on OSZs and TMDs.

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Introduction

The world's elderly population, aged ≥60 years, continues to grow. According to recent censuses, Indonesian elderly population is also rapidly growing. The increase in the elderly population and life expectancy may be accompanied by a lowered health status of the elderly people. Elderly people go through a transition period that is known as the aging process.[1–3] Aging process has an impact on decreasing the physical, cognitive, psychological, and social functions. Therefore, it can affect the quality of life and oral health status and can be a risk factor for tooth loss.[3–5]

Tooth loss can affect the stomatognathic system and decrease the ability of mastication, speech function, and aesthetic function. Tooth loss can also reduce the amount of occlusal support and cause an unbalanced occlusion.[6–9] Unbalanced occlusion can in turn cause initial changes in the neuromuscular pattern of jaw muscle activity and affect the stability of mandibular orthopedics.[7,8] When excessive loads are given in this condition, it could cause structural changes and damage to joints, teeth, and other supporting structures. Overloads on orthopedic instability can also change the movement of the mandible shifting in the position of the condyle and disk. This movement causes tightening and elongation of discal ligaments and also discus thinning.[8] It can trigger intracapsular changes and cause clicking, popping, and crepitus in the joints and other signs and symptoms of temporomandibular disorders (TMDs).[8,10] With an occlusion imbalance and a masticatory load imbalance, the system of mastication, and temporomandibular joint function becomes disrupted, which can thereby cause temporomandibular joint disorders.[6–8] Himawan et al. found that 68% of the Indonesian elderly population with an age

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range of 60–91 years had symptoms of TMDs.[11]

Several studies have demonstrated that the number of occlusal support zones (OSZs) affects occlusal forces, mastication systems, and temporomandibular joint function. A study by Mundt et al. showed that the number of support zones grouped based on the Eichner index was associated with TMDs.[12,13] Furthermore, according to Minh Son Nguyen et al., losing more OSZs will increase the significant changes occurring in the craniofacial structure. Changes in the craniofacial structure are associated with the onset of TMD signs in the elderly people.[6] However, to our knowledge, there have been no studies in Indonesia investigating the relationship between the number of OSZs and TMDs in the elderly population. Therefore, a study is needed to analyze the relationship between the number of OSZs using the Eichner index and TMDs in the elderly population in Indonesia.

Hence, the aim of this study was to analyze the relationship between OSZs and TMDs in an elderly population in Indonesia. This study was also aimed at analyzing this relationship among sociodemographic factors (gender, education level, and economic status) in the elderly population.

Materials and methods

This cross-sectional study was registered and approved by the Human Research Ethics Committee of Faculty of Dentistry of Universitas Indonesia. Subjects were collected by consecutive sampling (nonprobability sampling), targeting those aged ≥60 years with complete dentition or tooth loss without being replaced by dentures. The samples were collected from oral screening and TMD screening of elderly people at Kramat Jati Health Center and Dental Hospital Faculty of Dentistry of Universitas Indonesia.

Temporomandibular Disorder-Diagnostic Index

TMD screening was performed using 8 questions of the *Temporomandibular Disorder-Diagnostic Index* (TMD-DI).[14] The questions were answered with four frequency scales and were scored as follows: never (score 0), rarely (score 1), often (score 2), and always (score 3), resulting in a total score of 24. Then, all scores were summed up and divided into two groups. A TMD-DI score index ≤3 was categorized into groups that did not experience TMDs, whereas a TMD-DI score index >3 was categorized into the group experiencing TMDs. Data obtained from 100 subjects (35 males and 65 females) were analyzed in this study. All data were analyzed using a chi-square test.

OSZ Test

The OSZs were counted based on the Eichner index that describes the presence of each posterior contact area, including both premolar and molar regions, yielding a total of four supporting zones. The Eichner index was used to classify the respondents into 6 groups based on the distribution of the OSZs as follows: A (four supporting zones), B1 (three supporting zones), B2 (two supporting zones), B3 (one supporting zone), B4 (anterior tooth contact but no supporting zones), and C (no occlusal contact among the remaining teeth). In addition to that, there was a confounding variable that was considered for both OSZs and TMDs, which were sociodemographic factors such as gender, education level, and economic status. The demographic data were collected by asking their latest education and their expenses for living in a month. If the expenses are a part of household consumption, then the total household consumption was divided by the adult-equivalence scale that was defined as

$$e_h = (A_h + \alpha K_h)^{\theta}$$

to adjust the proportion and age structures of households. A_h is the number of adults in household h and K_h is the number of children aged <15 years with roughly half the cost of the adults (□ = 0.5). Then, the total individual consumption in this study was categorized into quartiles, ranging from the poorest (1st quartile) to the richest (5th quartile).

Statistical Analysis

Data were analyzed using the Statistical Package for the Social Sciences program. Univariate analysis was performed to describe the distribution and frequency of each variable. On the other hand, the relationship between the number of OSZs, and TMDs along with the confounding variables was evaluated using a

bivariate analysis. The analysis was a nonparametric hypothesis statistical analysis test, i.e., the chi-square test.

Results

Occlusal Support Zones (Eichner Index)	Non-TMD (%)	TMD (%)	p Value
A	64	36	
B1	46.7	53.3	
B2	46.7	53.3	
B3	35	65	0.473
B4	40	60	
C	47	60	

Table 1. Relationship Between Occlusal Support Zones (OSZs) based on the Eichner Index and Temporomandibular Disorders (TMDs) in the Elderly Population.
Non-TMD = non-temporomandibular disorders; TMD=temporomandibular disorders.

	Occlusal Support Zones Eichner Index (%)						p Value	Non-TMD	TMD	P Value
	A	B1	B2	B3	B4	C				
Gender										
Male	40	33.3	40	40	20	25		38.3	61.7	
Female	60	66.7	60	60	80	75	0.842	32.1	67.9	0.659
Education Level										
College/University	28		40	10		20		31.9	17	
High School	40	26.7	33.3	50		25		40.4	35.8	
Middle School	12		6.7	10		2`5		14.9	15.1	
Elementary School	16	33.3	13.3	25	20	20		10.6	20.8	
Not Graduated	4			5	60	10		2.1	11.3	
From Elementary School /Equivalent		26.7	6.7		0		0.709			0.133
		6.7			0					
					20					
Economic Status										
5th quintile (richest)	20	26.7	33.3	10		15		25.5	15.1	
4th quintile	28		0	40		15		29.8	11.3	
3rd quintile	24	13.3	20	10	20	30		17	18.9	
2nd quintile	4	6.7	26.7	15	0	20	0.615	10.6	22.6	0.04*
1st quintile (poorest)	24	20	20	25	0	20		17	32.1	
		33.3			40					
					40					

Table 2. Relationship Between Occlusal Support Zones (OSZs) based on the Eichner Index, Temporomandibular Disorders (TMDs), and Sociodemographic Factors in the Elderly Population.
Non-TMD = non-temporomandibular disorders; TMD = temporomandibular disorders.

The percentage of respondents in each of the six Eichner index groups is shown in Table 1. The highest percentage of respondents who did not experience TMDs was in group A, approximately 64%, in which the subjects still had 4 OSZs. There was an increase in the percentage of respondents experiencing TMDs according to the reduction of OSZs. TMDs were most experienced in the B3 of the Eichner index group. However, there was no relationship between OSZs and TMDs (P= 0.473). The test results between the OSZs and sociodemographic factors (gender, education level, and economic status) revealed no statistically significant differences (P = 0.842, P = 0.709, and P = 0.615, respectively). There were also no statistically significant differences between TMDs and gender (P = 0.659) as well as education level (P = 0.133). However, the analysis of the relationship between TMDs and the economic status in this study revealed a statistically significant difference (P = 0.04) (Table 2).

Discussion

Yoshino et al. reported that posterior teeth could lose before the anterior teeth when a person is aged around 60 years. The first missing teeth are the mandibular first molar and the second molar. Then, tooth loss is continued in the maxillary second molar and first molar.[15] In this study, several respondents not only lost the support zone in the molars but also lost the entire support zone. Meanwhile, most categories of the elderly people in this study were young elderly with an age range of 60–69 years (76%). This may have occurred because of their poor oral and dental health so that it can be a cause of tooth loss and OSZ reduction. In addition, patients with tooth loss caused by factors other than dental and oral disease did not become an exclusion criterion in this study. This might also cause respondents to lose several teeth, including losing the entire OSZ.

The percentage of respondents who experienced TMDs was slightly higher than the percentage of respondents who did not experience TMDs, which was 53%. This is in agreement with the studies of Himawan et al. and Ikebe and Schmitter, wherein subjects with fewer OSZs showed a higher potential for experiencing TMDs. It is known that tooth loss and OSZs can affect the stomatognathic and craniomandibular functions.[9,12,16] Changes in the craniofacial structure are associated with the onset of TMD

signs in the elderly people.[6] A lack of posterior teeth results in an adverse change in mandibular functional movements during mastication, with the headline being adapted to such dysfunction, which can cause TMDs. The present study showed that the loss of mandibular posterior teeth causes degenerative joint disease, which is one of the diagnoses of the subgroups with TMDs. Moreover, the stress level of the subject; the economic, social, and systemic conditions; and the functional activities can be considered as factors in the emergence of TMDs.[7,8,11,12,14]

The results of this study demonstrated no statistically significant difference between the OSZ based on the Eichner index and TMDs. However, similar to the results of a study conducted in Vietnam, a reduction in the OSZ can be one of the risk factors for TMDs.[6,13] This is illustrated by the distribution of respondents with TMDs based on the Eichner index, wherein there was an increase in the percentage of respondents experiencing TMDs as the OSZ decreased. The more the loss of the OSZ, the more the significant changes that occur in the mastication system, and the craniofacial structure. In this study, the absence of a significant relationship might be due to the unbalanced number of samples in each Eichner index group so that the difference between respondents who experienced TMDs did not appear significantly different.

Sociodemographic factors (gender, education level, and economic status) did not have a major influence on the OSZ in the Eichner index because there was no significant value among these three factors. However, there was a difference in the proportion or the number of OSZs based on gender. The loss of OSZ was more prevalent in the female sex. A study conducted by the Ministry of Health of The Republic of Indonesia affirmed that tooth loss, which also causes a reduction in the OSZ, is more common in women.[17] Hormonal changes in elderly postmenopausal women can cause an imbalance between the level of bone resorption, and bone formation. Decreased bone density and loss of bone mass can affect the number of teeth or occlusal support.[18,19] Meanwhile, there were no considerable differences between the number of OSZs and the education level and economic status. Compared with the study of Nato, a person who has a high education and economic status is considered to receive routine dental and oral care from the dentist, implying that patients with a high level of education have more teeth, whereas a person's lower income status has a higher chance of causing tooth loss or occlusal support.[19] However, the results of this study are similar to those of Van Der Velden's study. Education and economics do not have a major influence on tooth loss, but they can be a risk factor for tooth loss.[20] The difference in results can be due to the fact that all economic status groups in this study are low so that the patients do not have the costs for routine check-up with the dentist. Moreover, performing dental and oral care does not appear to be the priority of the subjects for maintaining their health. Another aspect that can cause the insignificant results is the distribution of unbalanced data in each group.

In the bivariate analysis between TMDs and confounding variables, it was observed that there was no association between gender and education level. However, the proportion of data shows that females experienced more TMDs than males. Some studies have demonstrated that TMDs among older people are more often experienced by women.[8,10,21,22] This is associated with the predisposing factors in women, namely postmenopausal hormone levels. Previous studies have suggested that sex hormones can predispose to TMJ dysfunction and cartilage damage. Estrogen hormone levels were found to increase in patients who had TMDs.[8,22] However, according to Mundt et al. and Al-Shulaiman, the signs of TMDs associated with tooth loss are more experienced by men.[7,12]

The results of this study revealed no association between TMDs and education, which is similar to the result reported by Mundt et al. However, the duration of education or a higher level of education can be a predisposing factor for TMDs because it can increase a person's stress level and cause an increase in the masticatory muscle tonicity.[23] A possible cause for the difference in the results of this study is the emergence of stress not only from educational factors but also from other factors so that TMDs based on education levels do not appear significantly different. However, regarding the economic status, the analysis test produced a statistically significant result with TMDs. It was observed that TMDs were more experienced by groups with the lowest economic status. This may be associated with the person's stress level

in meeting their daily needs. Stress can affect the body by activating the limbic system, the reticular system, the HPA (hypothalamic-pituitary-adrenal) axis, and the sympathetic nerve. This can lead to an increase in excessive muscle tonicity, thereby providing an excessive force or load on the jaw and result in TMDs.[8] Furthermore, the scope of this study was limited, and other factors that may cause tooth loss or TMDs were not considered well. Therefore, the results of this study cannot be generalized to evaluate the profile of Indonesian society, and further studies are necessary in this regard. Future researchers are advised to consider other factors that can affect TMDs, such as trauma, systemic conditions, and psychological conditions. Moreover, an objective examination of TMDs, wider area, and even distribution of data are suggested for the future study so that the entire population, and the distribution of data can be better represented.

Conclusions

There was no association between the number of OSZs and TMDs at Kramat Jati Health Center and Dental Hospital Faculty of Dentistry of Universitas Indonesia. Sociodemographic factors such as gender, education level, and economic status appeared to have little impact on OSZs and TMDs, even though there was an association between TMDs, and socioeconomic factors at Kramat Jati Health Center and Dental Hospital Faculty of Dentistry of Universitas Indonesia.

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Declaration of Interest

The authors reported no conflicts of interest related to this study.

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