Indonesian Dental Association

Journal of Indonesian Dental Association

http://jurnal.pdgi.or.id/index.php/jida
ISSN: 2621-6183 (Print); ISSN: 2621-6175 (Online)

Research Article

Salivary Flow Rates in Various Occlusal Support Zones in Elderly Individuals

Kartika Indah Sari[1§], Askani Maulida[2], Sri Tjahajawati[1]

[1] *Department of Oral Biology, Faculty of Dentistry, Padjadjaran University, Indonesia*
[2] *Dental Profession Program, Faculty of Dentistry, Padjadjaran University, Indonesia*

Received date: January 11, 2021. **Accepted date:** March 25, 2021. **Published date:** April 30, 2021.

KEYWORDS

eichner index;
elderly;
mastication;
occlusal support zones;
salivary flow rates;
tooth loss,

ABSTRACT

Introduction: Elderly individuals experience many changes in the oral cavity, one of which is tooth loss. Tooth loss disrupts the relationships between the maxillary and mandibular occlusions, which is detrimental to mastication. Mastication influences salivary secretion due to the salivary-masticatory reflex. Pressure on the teeth during mastication activates mechanoreceptors in the periodontal ligament, which can also stimulate salivary secretion. **Objective:** This study aimed to describe the salivary flow rates in various occlusal support zones in the elderly based on the Eichner Index. **Methods:** The study was cross-sectional and used a descriptive research method. The sample population comprised 36 elderly subjects residing in the village of Lebak Gede, Indonesia. Occlusal support zones were classified using the Eichner Index and stimulated salivary flow rates were measured using the Saxon test. **Results:** The sample population's mean salivary flow rate was 1.35 ± 0.65 mL/min. The mean salivary flow rates for Eichner classifications A, B1, B2, and B3, were 1.56 ± 0.78 mL/min, 1.52 ± 0.56 mL/min, 1.18 ± 0.45 mL/min, and 0.95 ± 0.86 mL/min, respectively. **Conclusion:** The mean stimulated salivary flow rate tended to decrease as occlusal support zones decreased in Eichner classifications A, B1, B2, and B3.

§ Corresponding Author
E-mail address: kartika.sari@fkg.unpad.ac.id (Sari KI)

DOI: 10.32793/jida.v4i1.628

INTRODUCTION

According to Government Regulation no. 43 of the Republic of Indonesia (2004), an elderly individual is someone aged 60 years or older. Indonesia has entered the era of population aging, with the number of elderly citizens now exceeding 7% of the population.[1] In 2018, the number of elderly people in Indonesia reached 24.75 million, comprising 9.34% of the country's population, and this increase is predicted to continue until 2035.[1,2] This population growth necessitates a better understanding of how to treat the oral health issues that affect this community for a good quality of life.

As humans age our bodily functions deteriorate and other physical changes occur.[3] This aging process also affects the oral cavity.[4] Changes in the oral cavity that can occur in the elderly include thinning of the mucosa, decreases in salivary flow rate, attrition, and tooth loss.[3] Tooth loss in the elderly is caused primarily by dental caries and periodontal disease.[4,5] According to the Riskesnas (Indonesian Basic Health Research) (2018), tooth loss is one of the most common oral health problems affecting the elderly.[6] Teeth have a variety of functions: They are necessary for mastication, speech, and aesthetics.[3] Any reduction in the number of teeth disrupts the maxillary and mandibular occlusions, which in turn causes a deterioration of masticatory function.[4] Mastication is the process of chewing and preparing food to be swallowed and digested.[7] An important indicator in the objective evaluation of masticatory function is masticatory performance.[8] Factors affecting masticatory performance are number of teeth, bite force, and salivary flow.[9]

Saliva is a complex oral fluid, colorless, and secreted from the major and minor salivary glands to maintain homeostasis in the oral cavity. Saliva assists the digestion of food with enzymes, in addition to helping with mastication and the ingestion of food. It lubricates the tongue, it helps cleanse the oral cavity of food scraps, and it has antibacterial properties.[10] Its role in mastication is particularly important: The water in saliva soaks food particles and saliva mucin binds chewed food into a bolus for easy swallowing.[11]

Salivary secretion can be stimulated by various factors, such as the mechanical action of mastication, as well as chemical, neuronal, psychological, and pain stimulation.[10] Mastication increases salivary secretion due to the salivary-masticatory reflex. Pressure on the teeth during mastication activates mechanoreceptors in the periodontal ligament, which can stimulate salivary secretion.[12,13] The salivary secretion stimulated by mastication can be gauged by measuring the salivary flow rate.

In 1987, Hector and Linden proved that periodontal mechanoreceptors contribute to the salivary-masticatory reflex.[14] Ikebe et al proved that the salivary flow rate of the elderly in Eichner Index classification A, B, and C decreased despite they use removable dentures or fixed dentures. Fixed dentures were considered as natural teeth and stimulated salivary flow rate was measured by chewing paraffin wax.[15]

With an increasingly aging population, understanding age-related changes in salivary flow is important. Furthermore, decline in occlusal contact associated with reduction of masticatory performance in which saliva plays a role.[15] This study aimed to describe salivary flow rate in various occlusal support zones based on the Eichner Index without any protheses denture using Saxon test by chewing on tampon gauze.

MATERIALS AND METHODS

Ethical clearance for this study was granted by the Medical Research Ethics Committee of the Faculty of Medicine, Padjadjaran University (No. 1334/UN6.KEP/EC/2019). This study used a descriptive method with a cross-sectional study design and purposive sampling.

Participants

The sample population comprised elderly individuals (people aged 60 years or more) residing in the village of Lebak Gede, Bandung City, Indonesia. The Public Health Center runs a program in this village offering routine health checks for the elderly, carried out once per month. Every individual who agreed to take part in the study signed an informed consent document. They then completed questionnaires concerning their general and oral health for screening purposes. The dental examination and measurement of salivary flow rate were carried out on the same day for selected participants.

The sample size was determined using the central limit theorem for a sample population of 30 or more persons. The inclusion criteria were as follows: no subjective symptoms affecting the teeth or periodontal tissues that could interfere with mastication, no use of dentures (either removable or fixed), and no history of head or neck radiotherapy. Those individuals who met the criteria for Eichner classifications B4 or C were excluded because they did not have occlusal support zones, as shown in Table 1. Distribution of gender, age, systemic disease such as diabetes, hypertension and cardiovascular disease (yes or no), daily drug intake (no drug, one drug is consumed, two or more drugs are consumed) related to systemic medical history, and smoking habit (never, yes or no) was presented.

Occlusal Support Zones

Occlusal support zones were classified using the Eichner Index which divides occlusal support regions into four support zones, two in the premolar region and two in the molar region. An occlusal support is seen when pairs of opposite teeth in the maxilla and mandible have the same tooth number. A maximum of four supporting zones can exist, which must have at least one tooth in contact with antagonist in order to be counted. In this study the subjects were divided into six groups 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 zone), and C (no occlusal contact among the few remaining teeth) as presented at Table 1.[16]

Table 1. Eichner Index classifications[16]

Eichner Index	Example from typical patient' s denitition
A	7 6 5 4 3 2 1 1 2 3 4 5 6 7 7 6 5 4 3 2 1 1 2 3 4 5 6 7 7 6 5 4 3 2 1 1 2 3 4 5 6 7 7 4 3 2 1 1 2 3 4 5 6 7 7 4 3 2 1 1 2 3 4 6 7 6 5 4 3 2 1 1 2 3 4 5 6 7
B1	7 6 5 4 3 2 1 1 2 3 4 5 6 7 5 4 3 2 1 1 2 3 4 5 6 7
B2	5 4 3 2 1 1 2 3 4 5 7 6 5 4 3 2 1 1 2 3 4 5 6 7
B3	7 6 5 4 3 2 1 1 2 3 4 5 6 7 3 2 1 1 2 3 4
B4	7 6 5 4 3 2 1 1 2 3 4 5 6 7 3 2 1 1 2 3
C	7 6 5 4 3 2 1 1 2 3 4 5 6 7

Saliva Collection

Stimulated whole saliva was collected between 9 am and 3 pm. Subjects were asked to not eat anything or to drink anything except water for 1 hour prior to the collection of saliva. The saliva collection was carried out using the Saxon test as Kubota et al performed, but a gauze was chosen instead of gum.[17] A gauze can be found in any drugstore and is easy to prepare. A gauze was prepared to be a tampon gauze as followed: a sterile 10 x 10 cm gauze sheet and placed a thin sheet of cotton on top and folded triple. Subsequently, folded triple at 45° angle and the edges was folded in so that the folds was locked. The final size was approximately 3 x 3 x 3 cm. Place in each sterile 60 mL plastic bottle with a screw cap.

Saliva was collected with the following procedure: prepare a dry gauze tampon and bottle by weighing to get the initial weight using analytical scales AEG-80 SM electric analytical balance which is accurate to 10^{-4}. Subject were asked to sit relax in a chair and rinse their mouth. After swallowing all saliva in their mouth, then chewed on the tampon gauze as usual manner. Spit the saliva out into the same bottle while mouth was full of saliva. Chew again for exactly 2 minutes. After 2 minutes, saliva with a gauze tampon was spitted into the bottle. The weight of the saliva produced was measured by subtracting the weight of the bottle and the gauze tampon from the weight (in grams) of the bottle containing the saliva. The sample volume of saliva was determined gravimetrically, assuming a specific gravity of 1.0, the weighing (g/mL) converted into mL/min (1g=0.001 L).[18–20] The stimulated salivary flow rate was expressed as mL/min. This study was a preliminary study and gave an initial information to follow up. The data obtained were processed with Microsoft Excel and displayed in percentage, mean, SD and max-min values.

RESULTS

This study examined 36 elderly who met inclusion criteria. Demographic data of the elderly showed in Table 2. Most of the elderly aged 60-69 years (69.4%) and 30.6% aged ≥70 years. According to gender, most females (80.6%). Seventy five percent of elderly has systemic disease. Thirty three percent of elderly have no drug and 38.9% consumed two or more daily drug intake. Most of elderly never smoking habit (88.8%). Salivary flow rate was 1.35±0.65 mL/min and the mean number of teeth was 21.9±4.1.

We also presented salivary flow rates and the mean numbers of remaining teeth in the oral cavity based on Eichner Index classification in Table 3. Salivary flow rate decreases with reduced in occlusal support zones. Number of natural teeth also decrease with reduced in occlusal support zones. Furthermore, salivary flow rate decreases with reduced in number of natural teeth.

DISCUSSION

This study consisted of 36 elderly in the Village of Lebak Gede who still have occlusal support zones based on Eichner Index classification. Salivary flow rate decreases with reduced in occlusal support zones. It means salivary flow rate lowest in Eichner Index B3 classification and highest in A classification. Our results indicated that the salivary flow rates tended to decrease from Eichner Index A, B1, B2, and B3 categories. Our study differs with other studies conducted by Ikebe et al and Agren et al who study masticatory performance in

Table 2. Demographic characteristics

Demographic characteristics	N=35
Age (%)	
60-69 years	25 (69.4)
≥ 70 years	11 (30.6)
Gender (%)	
Women	29 (80.6)
Men	7 (19.4)
Systemic disease (%)	
Yes	27 (75.0)
No	9 (25.0)
Daily drug intake (%)	
No drug intake	12 (33.3)
One type drug	10 (27.8)
Two or more type drug	14 (38.9)
Smoking (%)	
Never	2 (5.6)
Yes	2 (5.6)
No	32 (88.8)
Salivary flow rate	
Mean±SD (mL/min)	1.35±0.65
Max-min	2.98-0.12
Number of teeth	
Mean±SD	21.9±4.1
Max-min	28-11

elderly with varying levels of tooth loss based on Eichner Index classifications with A, B, and C categories.[15,21] However, we presented in more detail with splitted B category into B1, B2, and B3 categories. The B4 and C categories excluded because they did not have occlusal support zones. Meanwhile, tooth contact need for mastication properly to generate a mechanical stimulate.

The average of salivary flow in this study was normal category (Table 3). This result was supported a literature study conducted by Tschoppe et al. It suggested that the normal salivary flow rate ranges between 0.5-3.5 mL/min.[22] We found only one person experiences hyposalivation with a salivary flow rate 0.12 mL/min and no body experiences hypersalivation. We referred to the value is less than 0.5 mL/min as hyposalivation, whereas hypersalivation if the value of stimulated salivary flow rate is more than 3.5 mL/min.[22]

A study by Vandenberghe-descamps et al reported that the stimulated salivary flow rates in the elderly compared to young adult groups were decrease significantly 2.47 ± 1.06 mL/min vs 1.52 ± 0.73 mL/min, $p < 0.05$.[18] Our study did not compare elderly group with the young adult group, but as we can see elder's salivary flow rate in our study still lower compared to young adult group in previous study by Vandenberghe-descamps et al[18] namely 1.35 ± 0.65 mL/min vs 2.47 ± 1.06 mL/min. These suggested that salivary flow rate decrease with age. Other factor that can influence the salivary flow rate such as sex, systemic disease, drug consumption and history of smoking.[10,13,22] Our data was limited so we can not explore those factors.

A study by Ikebe et al revealed a decrease in the stimulated saliva flow rates due to reduction of occlusal support zones based on the Eichner Index although they included the elderly wearing denture protheses. The stimulated salivary flow rates for the Eichner Index A, B, and C categories were 1.19 ± 0.16 mL/min vs 1.14 ± 0.18 mL/min vs 1.05 ± 0.22 mL/min, respectively.[15] Salivary flowrate in the previous study still lower compare with our study without denture prostheses in A, B1, B2 dan B3 categories (1.56 ±0.78 vs 1.52± 0.56 vs 1.18 ± 0.45 vs 0.95 ± 0.86) mL/min.

The reason that possible for explanation was the different of bite force or occlusal force. There is a role of masticatory-salivary reflex in the denture wearer. This reflex activates the mechanoreceptors of the periodontal ligament to stimulate salivary secretion.[22] The effect might be still minimum to stimulate salivary secretion between elderly wear denture prostheses as previous study by Ikebe et al[15] compare with the elderly with natural teeth as our study. Masticatory performance in individuals who use removable dentures is also not as good as that of individuals with remaining natural teeth.[15]

Table 3. Salivary flow rates and number of teeth based on Eichner Index classification

Eichner Index	N=36	%	Salivary flow rate (ml/min)				Number of teeth			
			Mean	SD	Max	Min	Mean	SD	Max	Min
A	11	30.6	1.56	0.78	2.98	0.55	25.8	1.5	28	24
B1	8	22.2	1.52	0.56	2.27	0.95	23.3	2.1	25	19
B2	13	36.1	1.18	0.45	1.97	0.58	20.1	1.9	23	17
B3	4	11.1	0.95	0.86	2.11	0.12	14.8	4.1	20	11

A study by Maheshwari et al suggested an increase in salivary flow rate after the elderly using complete dentures compare with before wearing denture (0.98 ± 0.07 vs 0.64 ± 0.03) mL/min. In elderly wearing denture, the role of saliva is wetting mechanism for create adhesion, cohesion and surface tension. Furthermore, it helps masticate the food.[23]

Our result was supported also by Agren et al stated that fewer occlusal support zones were associated with lower stimulated salivary flow rates. The salivary flow rates for Eichner classifications A, B, and C were 1.71 mL/min, 1.33 mL/min, and 1.30 mL/min, respectively.[21] This phenomenon might be due to the decrease in bite force caused by the reduction of occlusal support zones in the elderly.[24,25] Bite force is one of the factors that can stimulate salivary secretion. Decreased bite force in the elderly causes a decrease in the salivary flow rate, because the mechanical stimulation of the periodontal tissue mechanoreceptors during mastication is reduced.[26]

Ikebe et al., also measured bite force using pressure-sensitive sheets, reported that a reduction in occlusal support zones caused a decrease in bite force in the elderly. Their results revealed that the mean bite force for Eichner classifications A, B, and C were 530 ± 42 N, 397 ± 42 N, and 220 ± 35 N, respectively.[15] The previous study by Ikebe et al produced similar results with later. The mean bite force for Eichner classifications A, B, and C were 617.6 ± 15.2 N, 417.8 ± 14.4 N, and 218.0 ± 14.3 N, respectively.[25] Another study by Ikebe et al showed that the mean stimulated salivary flow rates decreased as bite force decreased. Bite force was measured using pressure-sensitive sheets and salivary flow was stimulated by chewing paraffin wax. Bite force was divided into weak (< 230 N), moderate (230–600 N), and strong (> 600 N) categories. The mean stimulated salivary flow rates for the three categories were 1.06 ± 0.89 mL/min, 1.41 ± 0.95 mL/min, and 1.57 ± 1.01 mL/min, respectively.[26]

Bite force during mastication is produced by the masticatory muscles, which are controlled by mechanoreceptors in the periodontal ligament. Reduced periodontal support can reduce the threshold level of the mechanoreceptor function, which in turn can cause changes in an individual's bite force. A literature study have suggested a relationship between reduced periodontal support and decreased bite force.[27]

Bite force can be influenced by several factors, including age. The strength of the jaw elevation muscle that moves and closes the jaw increases as we grow; bite force remains constant from the age of 20 years to 50 years, after which time it begins to decrease. The normal aging process can cause muscle strength to deteriorate. Bite force decreases with age, especially in women. However, the effect of age on bite force is relatively small.[27]

Our results showed the mean number of teeth in the elderly was 21.9 ± 4.1. This condition can indicate that elderly lost approximately six teeth while they got old. Tooth loss can be caused by several factors, such as caries, periodontal disease, trauma, and severe attrition. Anshary et al. reported that age affects the severity of tooth loss due to the increased risk of caries and periodontal disease.[5]

The World Health Organization has stated that it is necessary to maintain oral health by leaving 20 natural teeth without dentures. The results of this study confirm those of Yoshino et al[16] that patients with 20 remaining natural teeth have at least two occlusal support zones. Aging related changes in quantity and quality of saliva that impact to dry mouth condition, taste aberration, reduced nutrient, and affecting the quality of life.[28] It is important to maintain natural teeth for life. Specially for elderly who have impaired salivary secretion, undergoing head or neck radiotherapy, consume polypharmacy that cause hyposalivation, and have few remaining teeth.[10,24] The number of subjects in our study were limited. However, this study can provide an overview of the decrease in salivary flow rate based on Eichner Index classification more detail. We need more subjects for further study.

CONCLUSION

The stimulated salivary flow rates tend to decrease as occlusal support zones decreases in Eichner Index classifications.

CONFLICT OF INTEREST

There is no conflict of interest in this study.

REFERENCES

1. Kementerian Kesehatan Republik Indonesia. Analisis Lansia di Indonesia. Jakarta Selatan: Pusat Data dan Informasi Kementerian Kesehatan RI; 2017. pp. 1–2.
2. Kementerian Kesehatan Republik Indonesia. Data dan Informasi Profil Kesehatan Indonesia 2018. Jakarta: Pusat Data dan Informasi Kementerian Kesehatan RI; 2019. 5.
3. Ananda N, Sulistyani LD, Bachtiar EW. Pertimbangan penggunaan implan gigi pada lansia. Insisiva Dent J. 2017;6(1):47–8.

4. Ghozali TD. Kelainan gigi dan mulut pada usia lanjut. In: Martono HH, Pranarka K, editors. Buku Ajar Boedhi-Darmojo Geriatri (Ilmu Kesehatan Usia Lanjut). Edisi Kelima. Jakarta: Badan Penerbit FK UI; 2015. pp. 792–5.
5. Anshary MF, Cholil, Arya IW. Gambaran pola kehilangan gigi sebagian pada masyarakat desa guntung ujung kabupaten banjar. J Kedokt Gigi. 2014;2(2):138–43.
6. Kementerian Kesehatan Republik Indonesia. Laporan Nasional Riskesdas 2018. Jakarta: Badan Penelitian dan Pengembangan Kesehatan; 2019. p. 183.
7. Driscoll CF, Freilich MA, Guckes AD, Knoernschild KL, Mcgarry TJ. The glossary of prosthodontic terms 9th ed. J Prosthet Dent. 2017;117(5S):56.
8. Shiga H, Ishikawa A, Nakajima K, Tanaka A. Relationship between masticatory performance using a gummy jelly and food intake ability in japanese complete denture wearers. J Odontol. 2014;103(3):356–9.
9. Ikebe K, Matsuda KI, Kagawa R, Enoki K, Yoshida M, Maeda Y, et al. Association of masticatory performance with age, gender, number of teeth, occlusal force and salivary flow in japanese older adults: is ageing a risk factor for masticatory dysfunction? Arch Oral Biol. 2011;56(10):991–6.
10. Rahayu YC, Kurniawati A. Cairan rongga mulut. Edisi kedua. Yogyakarta: Pustaka Panasea; 2018. pp. 42–44.
11. Hand AR, Frank ME. Fundamentals of oral histology and physiology. Danvers: John Wiley & Sons; 2014. pp. 223–238.
12. Pedersen AML, Sørensen CE, Proctor GB, Carpenter G. Saliva and gastrointestinal functions of mastication, taste and textural perception, swallowing and initial digestion. J Oral Dis. 2018;24(8):1399–416.
13. Kasuma N. Fisiologi dan patologi saliva. Edisi pertama. Padang: Andalas University Press; 2015. p. 16.
14. Hector MP, Linden RWA. The possible role of periodontal mechanoreceptors in the control of parotid secretion in man. Q J Exp Physiol. 1987;72(3):285–301.
15. Ikebe K, Matsuda K, Kagawa R, Enoki K, Okada T, Maeda Y. Masticatory performance in older subjects with varying degrees of tooth loss. J Dent. 2011;40(1):71–6.
16. Yoshino K, Kikukawa I, Yoda Y, Watanabe H, Fukai K, Sugihara N, et al. Relationship between eichner index and number of present teeth. Bullet Tokyo Dent Coll. 2012;53(1):37–40.
17. Kubota C, Kanazawa M, Hama Y, Komagamine Y, Minakuchi S. Association between chewing-stimulated salivary flow under the effects of atropine and mixing ability assessed using a color-changeable chewing gum. J Prosthodont Res. 2017;61(4):387–91.
18. Vandenberghe-descamps M, Labouré H, Prot A, Septier C, Tournier C, Feron G, et al. Salivary flow decreases in healthy elderly people independently of dental status and drug intake. J Texture Stud. 2016;47(4):1–6.
19. Hildebrandt GH, Tantbirojn D, Augustson DG, Guo H. Effect of caffeinated soft drinks on salivary flow. J Caffeine Res. 2013;3(3):138-42.
20. Tenuta LMA, Fernández CE, Brandão ACS, Cury JA. Titratable acidity of beverages influences salivary pH recovery. Braz Oral Res. 2015;29(1):2–3.
21. Agren M. 30-year (1983-2013) trends in saliva flow rate and saliva buffer capacity, analyses from 10-year repeated , cross-sectional population samples in the jönköping area. Örebro University. 2015;1-16.
22. Tschoppe P, Wolgin M, Pischon N, Kielbassa AM. Etiologic factors of hyposalivation and consequences for oral health. Quintessence Int. 2010;41(4):321–5.
23. Maheshwari A, Maheshwari B, Khandelwal V. Salivary flow assessment in denture wearers. Natl J Med Dent Res. 2013;1(3):2–3.
24. Han P, Suarez-Durall P, Roseann M. Dry mouth : a critical topic for older adult patients. J Prosthodont Res. 2014;59(1):6–12.
25. Ikebe K, Nokubi T, Morii K, Kashiwagi J, Furuya M. Association of bite force with ageing and occlusal support in older adults. J Dent. 2005;33(2):131–7.
26. Ikebe K, Matsuda K, Morii K, Hazeyama T, Kagawa R, Ogawa T, et al. Relationship between bite force and salivary flow in older adults. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2007;104(4):510–4.
27. Koc D, Dogan A, Bek B. Bite force and influential factors on bite force measurements : a literature review. Eur J Dent. 2010;4(2):223–32.
28. Xu F, Laguna L, Sarkar A. Aging-related changes in quantity and quality of saliva: Where do we stand in our understanding? J Texture Stud. 2019 Feb;50(1):27-35.