Vol 9, Special Issue 2, 2017

INTERNATIONAL JOURNAL OF APPLIED PHARMACEUTICS

ISSN - 0975-7058

Research Article

SALIVARY PROFILE AND XEROSTOMIA ON THE ELDERLY IN DEPOK, WEST JAVA, INDONESIA: ANALYSIS OF DEMOGRAPHIC FACTORS AND SYSTEMIC DISEASE

LUTFI LAILI N[1], FEBRINA RAHMAYANTI[2,3]*, AFI SAVITRI SARSITO[2]

[1]Undergraduate Program, Faculty of Dentistry, Universitas Indonesia, Jakarta, Indonesia. [2]Department of Oral Medicine, Faculty of Dentistry, Universitas Indonesia, Jakarta, Indonesia. [3]Department of , Cluster of Oral Sciences Research Center, Faculty of Dentistry, Universitas Indonesia, Jakarta, Indonesia. Email: febrina_r@ui.ac.id

Received: 16 September 2017, Revised and Accepted: 3 October 2017

ABSTRACT

Objective: The objective of this study is to determine the profiles of saliva between sexes, age groups, types of systemic disease, medications, and xerostomia on an elderly population in Depok.

Methods: The study was observational analytical with a cross-sectional study design. Sampling was through a consecutive sampling technique in subjects aged ≥60 years living in Depok. Subjects were examined for their saliva's volume, stimulated and unstimulated salivary analysis, pH, and buffer capacity. Subjects answered fox questionnaires about xerostomia and questionnaires about systemic diseases and medications.

Results: Gender had a significant difference in salivary flow rate but was not significant to pH or buffer capacity. There were no significant differences between types of salivary profile among age, systemic diseases, and medications. The correlation coefficient between xerostomia and stimulated flow rate was higher (0.426) than the unstimulated flow rate (0.303).

Conclusion: The unstimulated and stimulated flow rates exhibited a significant difference between men and women but did not differ significantly between age groups, systemic diseases, or medications. The pH and buffer capacity was not significantly different between sexes, age groups, type of systemic diseases, or medications. Xerostomia was associated with salivary flow rate.

Keywords: Elderly, Salivary profile, Xerostomia, Systemic disease, Medication.

 DOI: http://dx.doi.org/10.22159/ijap.2017.v9s2.45

INTRODUCTION

There is an upward trend in the size of the elderly population in Depok, West Java. In 2014, the number of elderly residents in this city was 105,933 with the largest age group between 60 and 64 years old [1]. The aging process has directly and indirectly caused these groups to have increased susceptibility to diseases in the oral cavity. Changes that occur in the oral cavity include jaw, periodontal tissue, oral mucosa, tongue, and salivary gland [2]. The prevalence of dental and oral diseases in Depok in 2013 was 17.11, with a higher prevalence existing in many subdistricts such as Sukmajaya, Bojongsari, Cimanggis, Cinere, Cilodong, and Beji [3]. There is a reciprocal relationship between general health and oral health. Poor oral health conditions can become the focus of systemic infections or worsen existing health conditions. In contrast, systemic disease and its medication can manifest itself in the oral cavity, one of the symptoms being changes in the quality and quantity of saliva [2]. Examination of the quality and quantity of saliva is very important because salivary condition is a risk factor of various dental and oral diseases. However, until now, there has been no research on oral health held in Depok with elderly subjects.

METHODS

This research was observational analytic using a cross-sectional study design. The sampling technique used non-probability sampling which is consecutive sampling. In this study, 96 elderly participants met the inclusion criteria of age and domicile. The subjects were briefed about the intent and purpose of the study and given an information sheet about the research. We next asked the subjects to provide their personal data (name, age, and sex) and answer the interview questions about xerostomia, systemic disease, and any medications they were consuming. Then, samples of saliva were taken, both unstimulated and stimulated, through a spitting technique. Volume was measured, along with a subsequent measurement of the degree of acidity (pH) and buffer capacity using a GC Saliva kit.

The data obtained were statistically analyzed using SPSS 22 software. First, data were processed using univariate data analysis to look at the frequency distribution and presentation of each variable in a population of research subjects. Then, the data were analyzed using bivariate analysis with unpaired non-parametric comparative analysis test, Kruskal–Wallis, and Mann–Whitney test to discover the differences between each variable with a significance value of 5% and Spearman correlation test to examine the relationship between variables. The result is significant if the value of $p \leq 0.05$ and not significant if $p \geq 0.05$.

RESULTS AND DISCUSSION

The first analysis was to compare the unstimulated salivary flow rates. The test result showed a significant difference in salivary flow rates between men and women ($p>0.05$), but there was no significant differences in pH and buffer capacity (Table 1).

The comparative Kruskal–Wallis test was used to analyze the salivary profiles in three age groups. The results showed no significant difference, $p>0.05$ (Table 2).

A Mann–Whitney test was conducted to find any difference in salivary profile between types of systemic disease. The results showed no differences between the types of salivary profiles of systemic diseases (Table 3).

Mann–Whitney U analysis was used to test whether there were significant differences in salivary profile between the xerogenic and non-xerogenic medications consumed by subjects (2 types of groups).

This study found no significant difference of salivary profile between the types of medication (Table 4). Based on non-parametric Spearman correlation test between unstimulated salivary flow rates with medication, the value of the correlation coefficient is −0.023, which means that the relationship between both is inverse and extremely weak. In the Spearman correlation test between stimulated salivary flow rates with medication, the value of the correlation coefficient is 0.094, which means that the relationship between the two variables is parallel but very weak.

The Mann–Whitney comparative test was used to see the differences in stimulated and unstimulated salivary flow rates between subjects who complained of xerostomia and subjects without xerostomia. The resulting p<0.05, which meant that there were significant differences in stimulated and unstimulated salivary flow rates between subjects with and without xerostomia (Table 5). When tested using the Spearman correlation test, the resulting correlation coefficient between unstimulated salivary flow rates with xerostomia was 0.303, which meant that the correlation was positive but still low. The

Table 1: Differences of salivary profile between genders

	Median (minimum-maximum)	p
Unstimulated flow rate		
Women	0.20 (0.0–0.8)	0.009*
Men	0.35 (0.1–2.7)	
Stimulated flow rate		
Women	0.65 (0.2–1.7)	0.000*
Men	1.30 (0.0–2.3)	
Acidity level		
Women	6.4 (5.2–7.6)	0.840*
Men	6.0 (5.4–7.6)	
Buffer capacity		
Women	9 (0–12)	0.097*
Men	12 (2–12)	

Mann–Whitney test analysis, p<0.05

Table 2: Differences of salivary profile between age groups

	Median (minimum-maximum)	p
Unstimulated flow rate		0.834**
Young old	0.2 (0.0–2.7)	
Older old	0.2 (0.1–0.9)	
Oldest	0.3 (0.0–0.8)	
Stimulated flow rate		0.906**
Young old	0.7 (0.0–1.7)	
Older old	0.7 (0.3–1.9)	
Oldest	0.7 (0.4–2.3)	
Acidity level		0.764**
Young old	6.2 (5.2–7.6)	
Older old	6.5 (5.2–7.4)	
Oldest	6.6 (5.6–7.2)	
Buffer capacity		0.214**
Young old	10 (0–12)	
Older old	8 (4–12)	
Oldest	12 (6–12)	

Kruskal–Wallis analysis

Table 3: Differences of salivary profile between types of systemic disease

	Median (minimum-maximum)	p
Unstimulated flow rate		
No systemic disease	0.20 (0.0–2.7)	0.335**
Cardiovascular disorder	0.20 (0.1–1.1)	
Endocrine disorder	0.25 (0.2–0.3)	
Asthma	0.25 (0.1–0.4)	
GIT disorder	0.20 (0.1–0.3)	
Cardiovascular and endocrine disorder	0.25 (0.2–0.3)	
Cardiovascular and GIT disorder	0.65 (0.4–0.9)	
Cardiovascular and musculoskeletal disorder	0.50 (0.1–0.7)	
Stimulated flow rate		
No systemic disease	0.70 (0.3–1.7)	0.760**
Cardiovascular disorder	0.70 (0.2–2.3)	
Endocrine disorder	1.20 (0.7–1.7)	
Asthma	0.85 (0.7–1.0)	
GIT disorder	0.70 (0.3–0.8)	
Cardiovascular and endocrine disorder	0.35 (0.3–0.4)	
Cardiovascular and GIT disorder	1.25 (0.6–1.9)	
Cardiovascular and musculoskeletal disorder	0.70 (0.0–1.2)	
Acidity level		
No systemic disorder	6.0 (5.2–7.6)	0.119**
Cardiovascular disorder	5.8 (5.2–7.2)	
Endocrine disorder	6.6 (5.8–7.4)	
Asthma	6.6 (6.0–7.2)	
GIT disorder	6.8 (5.8–7.2)	
Cardiovascular and endocrine disorder	5.9 (5.4–6.4)	
Cardiovascular and GIT disorder	7.0 (6.6–7.4)	
Cardiovascular and musculoskeletal disorder	7.1 (6.6–7.6)	
Buffer capacity		
No systemic disease	10 (2–12)	0.380**
Cardiovascular disorder	10 (2–12)	
Endocrine disorder	8 (4–12)	
Asthma	11 (10–12)	
GIT disorder	9 (8–12)	
Cardiovascular and endocrine disorder	6 (4–8)	
Cardiovascular and GIT disorder	11 (10–12)	
Cardiovascular and musculoskeletal disorder	10 (8–12)	

Mann–Whitney analysis, GIT: ???

Table 4: Differences of salivary profile between types of medication

???	Median (minimum-maximum)	p
Unstimulated flow rate		0.841*
Xerogenic	0.2 (0.1–1.1)	
Non-xerogenic	0.2 (0.0–2.7)	
Stimulated flow rate		0.416*
Xerogenic	0.6 (0.2–1.9)	
Non-xerogenic	0.7 (0.0–2.3)	
Acidity level		0.538*
Xerogenic	6.4 (5.6–7.6)	
Non-xerogenic	6.2 (5.2–7.6)	
Buffer capacity		0.393*
Xerogenic	8 (0–12)	
Non-xerogenic	10 (2–12)	

Mann–Whitney analysis

Table 5: Differences of salivary profile between people with and without xerostomia

???	Median (minimum-maximum)	p
Unstimulated flow rate		
Xerostomia	0.2 (0.0–0.9)	0.009*
No	0.3 (0.0–2.7)	
Stimulated flow rate		
Xerostomia	0.5 (0.0–1.9)	0.001*
No	0.8 (0.2–2.3)	

Mann–Whitney analysis

correlation coefficient between the stimulated salivary flow rate and xerostomia was 0.426, indicating the correlation was positive and strong enough.

There were 76 elderly persons in our salivary flow rate sample, in whom we found 12 subjects diagnosed with unstimulated hyposalivation and 32 subjects diagnosed with hyposalivation with stimulated salivary flow rate. However, among 32 subjects diagnosed with stimulated hyposalivation, 21 had normal unstimulated salivary flow; that is, if the stimulated saliva output was minimal, the unstimulated saliva output should be less. This might have been caused by some participant misunderstanding the instructions from the operator. It was possible that the saliva, which should have been collected and transferred to the tube every minute, was instead swallowed.

Comparative test results in both stimulated and unstimulated salivary flow rates between male and female subjects showed a significant difference. Our study had more women than men, which might skew our results. Furthermore, women are more likely to experience hyposalivation. It was suggested that this may be because women take more medications than men, but it has been found that even non-medicated women have a higher prevalence of xerostomia [2].

There are other theories to explain this difference. According to Patricia *et al*., several factors influence salivary flow rate, including sex [3]. Women tend to have smaller salivary glands. In addition, hormonal patterns such as menopause may contribute to the decrease the salivary flow rates [3]. One hormone that plays a role on oral mucosa and salivary glands is estrogen. Estrogen has two subtypes of receptors, ERα and ERβ.

However, ERα is not found in oral mucosa, gingival epithelium, or the salivary glands. On the other hand, ERβ is abundant in oral cavity tissue, especially in the keratinocyte, salivary gland acinar cells, and duct cells. Estrogen has a role in regulating epithelial maturation; thus, the decreased level of estrogen hormone such as found in post-menopausal women contributes to reduced epithelial cell maturation, leading to a thinning epithelium and atrophy. Thus, it is common to find post-menopausal women who suffer from discomfort in oral mucosa and reduced saliva secretion [4].

The acidity level comparative test between males and females yielded no significant differences. Even though 22 females were presented with high acidity level, only 10 males were so identified. However, a mean comparison revealed lower acidity among females than with males −6.2 and 6.3, respectively. These results were similar to a previous study that found lower acidity levels on female participants [5].

Buffer capacity comparative test results also revealed no significant difference between men and women, despite a lower median found in female participants (9 and 12, respectively). The results were in line with prior literature proving that buffer capacity among women was low [5]. Neither stimulated nor non-stimulated salivary flow rates revealed significant differences when adjusted for age.

This finding is also backed by the previous literature which states that even if there were histological changes in the salivary glands with age, they still have adequate capacity for morphological change [6]. Similar results also appeared with acidity level and saliva buffer capacity, where no significance was revealed when adjusted for age. The same study found that 26 participants from a young old group had high acidity levels (5.0–5.8), while fewer (16 participants) had normal acidity levels (6.8–7.8). Six of seven participants from the oldest group had normal buffer capacity (10–12).

Several medications induce complaints of oral dryness, along with altered salivary flow rate and/or saliva composition [7]. These medications include antidepressants, antihypertensives, diuretics, and antihistamines, among others. Those medication may cause interaction with the muscarinic cholinergic system of the salivary gland (especially, antidepressants and antihistamines). Diuretics may affect bodily salt composition, change water balance, and inhibit electrolyte transport on the salivary gland. This theory contradicts the results of both stimulated and unstimulated correlation tests between salivary flow rates, revealing a very weak correlation with a history of medication. It might be caused by the small number of subjects, and medications are taken without being recorded in the medical record. Drug doses and number of medications, on the other hand, also had an influence on the resultant effects (new risk factor). Drugs in low doses contributed to a smaller xerogenic effect. In this study, however, the author did not consider drug doses consumed by participants.

On the other hand, 75% of the participants (n = 57) did not take any medication. Medication consumed by subjects was not supported by valid data while not every subject recognized the drug classes they consumed.

Similar to the salivary flow rate, comparative tests on acidity level and buffer capacity among medications revealed no significant differences. According to Kharevich *et al*., few patients during the phase of early medication therapy were able to sustain pH at a nearly neutral level or between 6.5 and 7 [8].

Spearman correlation test between both stimulated and unstimulated salivary flow rates with systemic disease revealed a very weak correlation. Only Sjogren's syndrome was significantly correlated with hyposalivation [9]. Duration and severity of disease may be a factor affecting salivary gland changes, although this study did not consider subjects' disease duration or severity [8]. The most common ailments found among subjects were cardiovascular diseases such as hypertension, hypotension, history of myocardial infarction, stroke, and dyslipidemia, among which 22 participants suffered from hypertension.

This result is similar to that of a study conducted by Kagawa *et al*., which stated that there was no significant relationship between hypertension and salivary flow rate [10,11].

No significance was found between either acidity level and buffer capacity, adjusted with systemic disease. However, 17 participants were known to have high acidity levels while 13 of them suffered from cardiovascular disease. Our present study was different from previous ones that showed significant association of hypertension with salivary pH [11]. No significance between buffer capacity and systemic disease was found, even though 9 participants with variable systemic disease were known for very low buffer capacity, 11 participants with systemic disease were known for low buffer capacity, and 25 participants with systemic disease had normal buffer capacity.

Hyposalivation and xerostomia are two different conditions. Xerostomia is a subjective perception of dryness in the oral cavity while hyposalivation is connected with a decrease in salivary flow rate [12]. Perception of xerostomia was represented by four questions in the questionnaire, with the first, second, and third questions asking about unstimulated salivary flow rate, while the fourth question asked about stimulated salivary flow rate. In this study, the objective measurements to depict similarities with subjective perception were conducted. Subjects were diagnosed with xerostomia if they answered "often" in the relevant question item.

Data processing between questions regarding unstimulated and stimulated salivary flow rates were not done separately since subjects diagnosed with xerostomia were few in number. Thus, the data were considered unrepresentative. Spearman correlation test resulted in a low relationship between unstimulated salivary flow rates with xerostomia perception. However, the relationship between stimulated salivary flow rate and xerostomia perception was positive and quite strong. This result agrees with a study conducted by Suh *et al.*, which stated that the effect of oral dryness on daily life was significantly related with stimulated salivary flow rate [13]. Similar results were also found in a study conducted by Farsi, which stated that measurements of stimulated salivary flow rates were indicated for or diagnosis of dry mouth [14]. Among patients with dry mouth condition accompanied by very low salivary flow rate, a stimulated salivary flow rate reflected a more representative functional capacity as a glandular function capacity indicator [13].

CONCLUSION

The salivary profile of 96 studied elderly people in Depok was as follows: Unstimulated salivary flow rates were normal (≥0.2 mL/min), stimulated salivary flow rates were normal (≥0.7 mL/min), acidity levels were moderate, and buffer capacity was normal. The result of the salivary volumetric flow rate examination was positively related to the subjective perception of xerostomia with a higher significance on stimulated salivary flow rate. The stimulated or unstimulated salivary flow rates showed significant differences between men and women but did not differ significantly between age groups, systemic diseases, or medications consumed. The pH and buffer capacity were not significantly different among genders, age groups, types of systemic diseases, and types of medications consumed by the subjects. To obtain better data, further research is needed with a larger number of subjects and saliva measurement instructions that are clearly understood by all subjects.

ACKNOWLEDGMENT

The publication of this manuscript is supported by Universitas Indonesia.

REFERENCES

1. Shinta FD, Dinar N, Susanto H, Agustina D. Unstimulated salivary flow rate corresponds with severity of xerostomia: Evaluation using xerostomia questionnaire and groningen radiotherapy - induced xerostomia questionnaire. J Dent Indones 2014;21:5-10.
2. Niklander S, Veas L, Barrera C, Fuentes F, Chiappini G, Marshall M, *et al.* Risk factors, hyposalivation and impact of xerostomia on oral health-related quality of life. Braz Oral Res 2017;31:e14.
3. de Almeida Pdel V, Grégio AM, Machado MA, de Lima AA, Azevedo LR. Saliva composition and functions: A comprehensive review. J Contemp Dent Pract 2008;9:72-80.
4. Tsinti M, Kassi E, Korkolopoulou P, Kapsogeorgou E, Moutsatsou P, Patsouris E, *et al.* Functional estrogen receptors alpha and beta are expressed in normal human salivary gland epithelium and apparently mediate immunomodulatory effects. Eur J Oral Sci 2009;117:498-505.
5. Prodan A, Brand HS, Ligtenberg AJ, Imangaliyev S, Tsivtsivadze E, van der Weijden F, *et al.* Interindividual variation, correlations, and sex-related differences in the salivary biochemistry of young healthy adults. Eur J Oral Sci 2015;123:149-57.
6. Cassel C. Geriatric Medicine: An Evidence-Based Approach. 4th ed. New York: Springer; 2002. p. 56-70.
7. Scully C. Drug effects on salivary glands: Dry mouth. Oral Dis 2003;9:165-76.
8. Kharevich O, Shipman B, Goldman BM, Nahon M. Salese to buffer saliva in elderly patients with xerostomia: A pilot study. J Prosthodont 2011;20:135-8.
9. Torres SR, Pedrazas CH, Correia MP, Azevedo MN, Zamprogno T, Silva A Junior, *et al.* Drugs or disease: Evaluating salivary function in RA patients. Braz Oral Res 2016;30:e106.
10. Kagawa R, Ikebe K, Enoki K, Murai S, Okada T, Matsuda K, *et al.* Influence of hypertension on pH of saliva in older adults. Oral Dis 2013;19:525-9.
11. Nimma V, Talla H, Poosa M, Gopaladas M, Meesala D, Jayanth L, *et al.* Influence of hypertension on pH of saliva and flow rate in elder adults correlating with oral health status. J Clin Diagn Res 2016;10:ZC34-6.
12. Kunavina K. Oral Health Assesment of Elderly People Living in The Arkhangelsk Region. Russia: University of Oulu; 2016.
13. Suh KI, Lee JY, Chung JW, Kim YK, Kho HS. Relationship between salivary flow rate and clinical symptoms and behaviours in patients with dry mouth. J Oral Rehabil 2007;34:739-44.
14. Farsi NM. Signs of oral dryness in relation to salivary flow rate, pH, buffering capacity and dry mouth complaints. BMC Oral Health 2007;7:15.