Differences in the salivary flow rate, buffer capacity, and pH, based on the length of inhalants usage in bronchial asthma patients

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ABSTRACT

Introduction: Asthma or bronchial asthma is a chronic respiratory tract inflammation process involving many cells, including their elements, and can cause severe and plentiful responses from the respiratory tract. Administration of inhalation drugs is the primary medication in treating bronchial asthma. Inhalants are given appropriately with dosage and usage period based on the severity level of bronchial asthma. This research aimed to analyse the differences in the salivary flow rate, buffer, and pH, based on the length of inhalants usage in bronchial asthma patients. **Methods:** The research was descriptive-comparative involving 40 bronchial asthma patients (6 male and 34 female) from the Community Lung Health Center of Bandung, taken as samples using the central theorem limit sampling method. The subjects were ordered to collect their saliva in the saliva collection cups with a draining method. Then, the salivary flow rate, buffer, and pH were examined. Data distribution was tested, resulting in normally distributed data; thus, a parametric independent t-test with a significant level of 0.05 was applied. **Results:** Subjects in the group of inhalant usage for more than ten years had low and very low categories of salivary flow rate, buffer, and pH. There were significant differences in the salivary flow rate, buffer, and pH of the bronchial asthma patients based on their length of inhalants usage (1-5 years; >5 years–10 years; >10 years; $p<0.05$). **Conclusions:** There are differences in the salivary flow rate, buffer, and pH based on the length of inhalants usage in bronchial asthma patients. The longer the usage period, the lower the salivary flow rate, buffer, and pH.

Keywords: bronchial asthma; inhalants usage periods; salivary flow rate; salivary pH; salivary buffer capacity

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INTRODUCTION

Asthma or bronchial asthma is a disease of the respiratory tract which involves chronic inflammation. It causes serious and plentiful responses from respiratory tract such as bronchi muscles contraction, constriction, edema, and gland hypersecretion which then limits air flow going through the respiratory tract.[1,2] Based on the National Health Research (Riskesdas) Indonesia in

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2018, the prevalence of bronchial asthma reaches 2.4% of Indonesia's population, indicating around 6,360,000 people suffering from the disease.[3] The mortality rate of bronchial asthma in Indonesia is still considered quite high. The World Health Organization (WHO) and Global Asthma Network (GAN) predicted the number of bronchial asthma patients is up to 334 million people in the world. A further 100 million may be affected by 2025.[4,5,6]

The treating bronchial asthma through the respiratory tract or inhalation directly is the most effective way cause high concentration of the medication can reach the respiratory tract with minimal systemic effect. A study by Rozaliani A et al suggested that the working period of bronchodilator faster compared to oral medication.[7] Meanwhile the use of ß2-agonist and corticosteroids can affect the oral salivary flow directly by blocking the nervous system and inhibiting saliva secretion, thus creating an optimal environment for bacterial growth.[12,13]

Long period usage of inhalants, such as ß2-agonist and corticosteroids, and without proper cleaning technique of the oral cavity has several complications.[25,26] The problems caused by bronchial asthma medication could result in dental and oral mucosa health problem, such as xerostomia, oral candidiasis, oral lesions, and periodontal disease.[8,9,10,11,12,13,27] Salivary flow and composition have a fundamental role in oral health due to saliva protects from microorganisms, lubrication for mastication, and protection for tooth structures. The previous studies showed that in a few minutes after the first inhaler usage, there was a reduction in salivary flow rate and pH.[12,25] It suggested that a defense mechanism may impaired in the bronchial asthmatic patients.12 There is no a salivary flow reduction in three studies that examined the effect of beta-2 short acting agonists in 7 days period of usage. However a study of 15 patients with moderate persistent bronchial asthma twice daily demonstrated salivary flow reduction for a month period of usage.[12]

Systemic diseases and medication can affect the condition of saliva in the oral cavity.[25] Any cause that reduces the quality and quantity of saliva can have a negative impact on oral health include salivary flow rate, salivary pH, and salivary buffer capacity.[25]

Among the several side effect of corticosteroids and ß2-agonist, its effect on saliva has not been studied fully, especially in Indonesia. This study aimed to analyse the differences of salivary flow rate, buffer, and pH based on usage period of inhalants on bronchial asthma patients.

METHODS

This study used a descriptive-comparative method with a cross-sectional approach. The study was done in the Community Lung Health Center of Bandung (Balai Besar Kesehatan Paru Masyarakat Bandung/BBKPM Bandung), Indonesia. The study was completed in 2 months, from November 2019 until January 2020. The population of this study was patients aged 18-70 years who had a history of bronchial asthma disease and were using inhalants at Community Lung Health Center of Bandung. The sample was divided into 3 categories based on the duration of using inhaled drugs, usage periods in 1-5 years, 5,5-10 years, and >10 years. As many as 40 patients had been using inhalants for at least a year, and all of them did not use any prosthesis and orthodontic appliances, did not smoke nor have systemic diseases and were not pregnant. The research started from 08.00 a.m until 12.00 p.m. Previously, the patient's medical records had been checked by the nurse under the inclusion criteria.

Subjects were priorly given informed consent about the examination. Subjects were asked some questions as complementary information in the examination, and then they were instructed to gargle water first. Examinations were done by collecting the subjects' saliva in saliva-collection cups for 5 minutes with a draining method. All of the collected saliva were examined and measured using Saliva-Check Buffer Kit from GC shortly after the sample was collected. Measurements were made by dropping saliva on litmus papers and buffer strips with indicators.

The criteria for normal salivary flow rate were >5 ml at the highest, 3.5-5 ml for the low level, and <3.5 ml at the lowest. Salivary pH was determined by looking at the color change on litmus paper first, then the color change was adjusted to the color indicator paper. The green to blue shade means a high saliva pH, while the yellow to red shade indicates a low saliva pH.

Buffer measurement was done by looking at the color change in the three buffer strips. Green strip means 4 points, bluish-green means 3 points, blue means 2 points, reddish-blue means 1 point, and red means 0. With the criteria of 10-12 points for normal, 6-9 points for low, and 0-5 points for very low, all points obtained were summed up.

The final results were presented in tables and analyzed by using the parametric analysis method, t-independent test with significant level 0,05 from SPSS application. Number of Ethic Commission Approval: 1377/UN6.KEP/EC/2019 by the Health Research Ethic Committee of Universitas Padjadjaran.

RESULT

Table 1. Subject Characteristic based on Gender, Age, Dry Mouth Condition, and Daily Habit of Mouth Breathing and consuming sweet foods and drinks

Characters	n	(%)
Gender		
Male	6	15
Female	34	85
Age		
16-25 years old (late teenager)	1	2,5
26-35 years old (early adult)	1	2,5
36-45 years old (late adult)	3	7,5
46-55 years old (early eldery)	17	42,5
56-65 years old (late eldery)	13	32,5
>65 (oldest)	5	12,5
Mouth feels dry		
Yes	24	60
No	16	40
Breathe through mouth		
Yes	9	22,5
No	31	77,5
Habit of eating and drinking sweets		
Yes	26	65
No	14	35

The total number of subjects was 40 people involved 85% was female. The age group 46-55 years was dominant. As many as 24 subjects or 60% had complained a dry mouth conditions and 22.5% had the mouth-breathing daily habit. Sixty five percents had eating and drinking sweets habit.

Table 2. Bronchial Asthma Disease Characteristic of Subjects based on Usage Period of Inhalation Drug, Period of Having Bronchial Asthma, Bronchial Asthma Hereditary History, Inhalation and Tablet Drug.

Characters	n	(%)
Usage period of inhalation drug		
1-5 years	25	62,5
5,5-10 years	7	17,5
>10 years	8	20
Period of having asthma		
1-5 years	16	40
5,5-10 years	6	15
>10 years	18	45

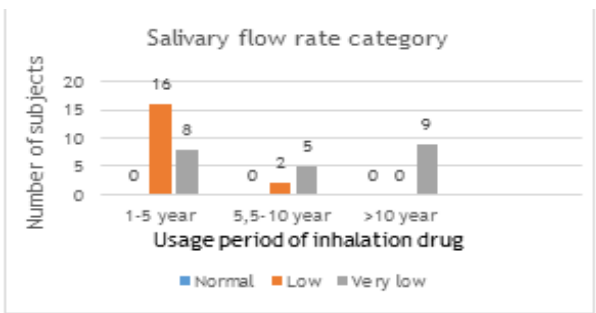
Asthma hereditary history		
Yes	27	67,5
No	13	32,5
Inhalant		
Seretide	14	35
Symbicort	12	30
Seretide + Berotec	9	22,5
Symbicort + Ventolyn	5	12,5
Drugs		
Salbutamol	3	7,5
Teosal/Ketaphyl	4	10

Table 2 showed that 62,5% of all subjects have usage inhalation drug during the period of 1-5 years. Table 2 also describes that 20% of them have usage inhalation drug during the period of >10 years. There was 45% of subjects had been suffering from asthma for >10 years, and as many as 27 people (67.5%) had a hereditary history of asthma.

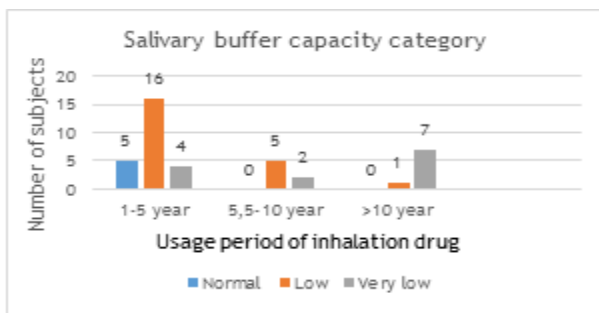
Table 2. Bronchial Asthma Disease Characteristic of Subjects based on Usage Period of Inhalation Drug, Period of Having Bronchial Asthma, Bronchial Asthma Hereditary History, Inhalation and Tablet Drug.

Salivary flow rate, butter capacity, and pH comparison	Salivary flow rate p value	Salivary pH p value	Salivary butter P value
5 years vs 5,5 years - 10 years	0.046	0.013	0.033
>10 years	0.000	0.000	0.000
5,5 years vs >10 years	0.032	0.037	0.017

Based on the table above, it is known that the p-value obtained in each test group is <0.05. This indicates that there were significant differences in salivary flow rate, pH, and buffer capacity in patients with bronchial asthma based on the period of inhalant usage in each test group.



A



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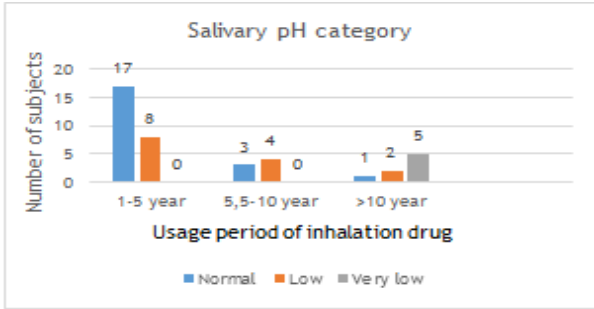

C

Figure 1. Salivary Flow Rate (A), pH (B) and Buffer (C) Category

The figure above showed that long-term use of inhaled drugs can result in changes in salivary conditions. The decrease in the salivary flow rate directly caused a decrease in the salivary buffer capacity of the subjects. The decrease in the salivary buffer capacity will also cause a decrease in the salivary pH. The three results indicate that the pH of the subject with the use of inhaled drugs under 5 years was in a state of normal pH meanwhile the average pH of saliva in subjects with the use of inhaled drugs over 5 years had decreased.

DISCUSSION

The average of the subjects were mostly females and had already passed puberty. This finding is in line with the research done by Fuseini et al.[14], which stated that bronchial asthma prevalence in male was higher than females during childhood (16:9) and after puberty, bronchial asthma prevalence in male decreased, while bronchial asthma prevalence in females increased. Developments in a man's lungs capacity and function was said to promote a decrease in bronchial asthma incidents.[14,15]

Most of the subjects complained about dryness in their mouth and mouth-breathing habits. Moreover, most of the subjects also complained about difficulties in inhaling and exhaling. These complaints could happen as a clinical manifestation of bronchial asthma. However, according to several studies, these complaints occur due to the use of inhaled drugs for years as a side effect.[16,17] The existence of respiratory tract inflammation due to bronchial asthma caused difficulties for subjects to inhale and exhale through their noses so they conveyed to mouth-breathing instead. High dosage and long duration of inhalation therapy has been closely linked with several adverse effects on the oral. This situation is further exacerbated by alimentary habits or lifestyles such as consuming sweet food and drinks.[18,19,20]

Xerostomia were the most common oral manifestations found due to the usage effects of combination inhalation drug corticosteroid and ß2-agonist. Therefore, methods to prevent and minimalize oral manifestation were needed. Preventive actions such as gargling with water and brushing teeth with bicarbonate and fluoride toothpaste with the correct techniques can be done by bronchial asthma patients to help prevent a decrease in the salivary flow rate. Salroos et al.[11] stated that the most effective gargling method is to gargle until the water reached the posterior or the back part of the mouth and gargle around the hard palate for 5 seconds each and spit out the water. They also stated that gargling water only once allows 80% of the inhalation drug residues to adhere to the mucosal tissue.[11,26]

Most of the subjects had suffered from bronchial asthma for more than 10 years and had used inhalants for less than 5 years. Some of the subjects stated that they had been living with symptoms such as breathing difficulty since they were teenagers or even younger but only to be diagnosed with asthma in adulthood. This statement can be connected with the research done by Osman which stated that bronchial asthma symptoms appear at the age before puberty and gradually disappear during puberty.[15] The changes in symptoms make subjects less attentive toward their bronchial asthma development which leads to relapses in the future. This studies also showed that most of the subjects had a hereditary history of bronchial asthma disease. Some study stated that one of the triggering factors or etiology of bronchial asthma is the interaction of genetic or hereditary factors and environmental factors. A genetic or hereditary factor from one of the family members could increase the risk of contracting asthma 2 to 6 times.[21]

The inhalants commonly used were a combination of corticosteroid and ß2-agonist in the form of DPI (Dry Powder Inhaler) and MDI (Metered Dose Inhaler). Godara et al.[20] stated that bronchial asthma medication that contained ß2-agonist caused changes in the salivary composition and flow rate. This condition was caused by the reaction of ß2-agonist and ß2-adrenoceptor in a sinus of the saliva gland. It affected sympathetic nerves, which led to the bronchodilatation effect of respiratory smooth muscles and vasodilatation of blood vessels, thus changing the saliva composition. Moreover, vasoconstriction of blood vessels caused the decrease of blood flow in salivary glands and decreased the salivary flow rate.[20] Salivary flow allows a mechanical cleansing against food debris or microbial agents, and oral

clearance is related to the rate of secretion. Saliva is involved in maintaining a neutral pH in the oral cavity depending on different types of buffering systems.[12] This condition explains the aforementioned issues among the subjects. Some of the subjects were also prescribed tablets if the bronchial asthma medication with inhalation drugs was not enough.

Previous study on the usage of inhaled bronchial asthmatic medication elaborated on changes inside the oral cavity especially after more than 1 year of usage. This study was carried out to investigate the side effects of using inhalants with corticosteroid and ß2-agonist for more than a year on bronchial asthma patients, whether it decreased the subjects' salivary flow rate, pH, and buffer capacity.[22,23,24]

The lowest salivary flow rate and pH were found in subjects who had been using inhalants for more than 10 years. Some changes were found in the salivary buffer. Long-period usage of inhaled bronchial asthmatic medication could cause changes in the properties of saliva. A decline in salivary flow rate directly decreased a subject's saliva buffer capacity. When less saliva was produced, there would be fewer electrolytes contained in the saliva, hence the ability of saliva to maintain a normal pH condition of the oral cavity became reduced. The decrease of salivary buffer capacity would also decrease the salivary pH.[24] Study by Laurikainen et al.[16] and Sag et al.[17] also discovered that the decrease of salivary flow rate precipitated by long-term usage of inhalants ß2-agonist and combination causes xerostomia or formerly known as dry mouth. The decrease of salivary flow rate would lower the saliva's bicarbonate concentration, hence the salivary buffer capacity to neutralize acidic conditions in the oral cavity, as well as salivary self-cleansing processes, would be disturbed.[16,17]

Alteration of salivary flow rate, buffer capacity, and pH caused by the usage of inhaled bronchial asthmatic medication happened linearly in general. Differences could be observed by looking at results in Table 3 which showed how the alterations in salivary buffer capacities were not linear. These conditions may be caused by individual physiologic salivary gland condition, individual immune system, individual lifestyle, age, and frequency of drug usage.

CONCLUSIONS

There are differences in the salivary flow rate, buffer, and pH based on the length of inhalants usage in bronchial asthma patients. The longer the usage period, the lower the salivary flow rate, buffer, and pH.

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