



Salivary Profile and Its Correlation Towards Candida Colony Count in Elderly Patients

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ABSTRACT

Physiologically, elderly people undergo deterioration in various organ functions, such as salivary secretion and pH, which may influence their health. These alterations can lead to various problems, including Candida infections. Therefore, this study aimed to examine the relationship between salivary flow rate and pH with Candida colony counts in the oral cavity of elderly individuals. This is an analytical cross-sectional study that included 105 elderly patients visiting the Pancur Batu Health Center. Saliva was collected from each participant using the spitting method for 5 minutes to measure the salivary flow rate and pH. Then, the samples were cultured in Saboraud Citrus agar for 24-48 hours to observe the growth of Candida colonies, and the number was counted. Chi-square tests were conducted to analyze the data and determine the relationship between salivary flow rate and pH with Candida colony count. The result showed a significant relationship between salivary flow rate and excessive Candida colony count, as indicated by $p\text{-value} = 0.03$. However, there was no significant relationship between salivary pH and Candida colony count ($p=0.59$). In conclusion, the result of this study showed that the reduction in salivary flow rate may increase the risk of Candida infections in elderly people. Therefore, preventive measures have to be taken to maintain good oral hygiene and overall health of the elderly.

Keywords: Candida; Elderly; Flow Rates; Salivary; pH

ABSTRAK

Secara fisiologis, lansia mengalami penurunan pada beberapa fungsi organ yang dapat berefek pada kesehatan, salah satunya penurunan sekresi dan pH saliva. Perubahan ini dapat mengakibatkan berbagai masalah kesehatan salah satunya infeksi Candida. Tujuan penelitian ini adalah untuk melihat hubungan antara laju alir saliva dan pH saliva terhadap jumlah koloni Candida pada rongga mulut lansia. Penelitian ini merupakan penelitian analitik dengan desain potong lintang. Subjek penelitian adalah 105 orang lansia yang datang mengunjungi Puskesmas Pancur Batu. Setiap subjek diminta untuk mengumpulkan saliva dengan menggunakan metode *spitting* selama 5 menit untuk menghitung laju alir saliva dan mengukur pH saliva. Lalu sampel saliva dikultur pada media agar Saboraud Citrus selama 24-48 jam untuk melihat pertumbuhan koloni Candida, kemudian jumlah koloni dihitung. Uji chi kuadrat digunakan untuk menganalisis hubungan antara laju alir saliva dan pH saliva dengan jumlah koloni Candida. Hasil penelitian menunjukkan terdapat hubungan yang signifikan antara laju alir saliva dengan pertumbuhan koloni Candida yang berlebihan ($p=0,03$). Namun, tidak ditemukan adanya hubungan antara pH saliva dengan pertumbuhan koloni Candida ($p=0,59$). Kesimpulan dari penelitian ini ialah penurunan laju alir saliva dapat meningkatkan risiko infeksi Candida pada pasien lansia, untuk itu perlu dilakukan tindakan pencegahan untuk memelihara kesehatan rongga mulut dan tubuh lansia.

Keyword: Candida; Lansia; Laju Alir ; Saliva; pH



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1. Introduction

Aging is a process that leads to changes in human physiology, including the oral cavity [1]. These changes can manifest as oral mucosal lesions, decreased saliva production, and taste sensitivity [2]. In addition, the increasing life expectancy in the world contributed to the growth of the elderly population, thereby making age-related changes in the oral cavity increasingly prevalent.

Salivary changes in the elderly can manifest both subjectively and objectively. Subjectively, many elderly individuals experience a sensation of dry mouth or xerostomia that can be measured by a Summated Xerostomia Inventory (SXI-ID) questionnaire to detect both xerostomia and salivary gland hypofunction [3]. This subjective feeling of dryness can lead to discomfort, difficulty in speaking, and impaired taste perception [4]. Objectively, there are measurable changes in salivary composition and function, such as decreasing flow rate with age, resulting in reduced saliva production. Additionally, alterations in salivary pH levels can be objectively observed, potentially affecting oral health [5].

These subjective and objective changes both emphasize the importance of monitoring and addressing salivary issues in the elderly population to maintain their oral health. Saliva plays an important role in protecting oral tissue from bacterial, fungal, and viral infections, as well as preserving the integrity of oral hard and soft tissues [6]. Decreased saliva secretion and changes in salivary pH can result in oral discomfort, pain, an increased risk of cavities, oral infections, and an increase in microorganisms like *Streptococcus mutans* and *Candida albicans* [1].

Candidiasis is an oral infection caused by the fungal genus *Candida*, particularly *Candida albicans*, which is a normal flora of the oral cavity but can become pathogenic in individuals with weakened immunity [7, 8]. The thinning of oral mucosal epithelium and decreased saliva secretion makes it easier for *Candida albicans* to colonize the oral cavity and invade the mucosa, leading to candidiasis [7].

A previous study showed the impact of virulence factors on the development of *Candida* colonies in the oral cavity of the elderly [9]. Other studies demonstrated the occurrence of oral candidiasis in the elderly with low saliva flow rate and pH [7,10,11]. Therefore, this study aimed to explore the relationship between salivary pH and flow rate with the number of *Candida* colonies. The result is expected to contribute to improving oral health in the elderly, as oral health is a significant factor in enhancing quality of life.

2. Methods and Materials

2.1 Source of Data

A total of 105 participants were included in this study by purposive sampling technique based on determined inclusion and exclusion criteria. The study participants were taken from the elderly patients attending Pancur Batu Public Health Center in Medan. Patients above the age of 60 are considered elderly, and those who have been on corticosteroids and/or antibiotics within the previous 3 months, denture wearers, and uncooperative were excluded from the study.

2.2 Ethical Clearance

The study plan was approved by the Institutional Ethical Board Committee with registration No.1002/KEPK/USU/2022 and participants were fully informed through verbal and written explanations. Furthermore, written consent was obtained from the participants after understanding the nature of the study.

2.3 Saliva Collection Method

Participants were instructed not to eat, drink (excluding water), smoke, or perform oral hygiene for 1 hour before saliva collection. The unstimulated saliva was collected by allowing its accumulation within the oral cavity for 5 min and then spitting it into a sterile, graduated container. The measurement only included the liquid component of the saliva, and salivary flow rate (SFR) was calculated in milliliter/minute (ml/min). Hyposalivation was defined as an SFR of less than 1 ml/min. The samples were transported to the laboratory in ice packs within 2 h.

2.4 Salivary pH Measurement

The salivary pH from each sample was measured using a Digital pH meter, namely a Mettler Toledo Seven Multi pH-meter with an electrode in Lab®413, and the accuracy of measurement was 0.002. The device is calibrated every day with its tip inserted into a neutral solution (pH=7) and subsequently dried using a dry paper towel before each measurement. The saliva pH measurement was expressed as acidic, neutral, or alkaline depending on the pH of the saliva. A pH value of less than or equal to 6.9 was designated 'acidic', 7 as 'neutral', and > 7 as 'alkaline'.

2.5 Culture Method

Saliva samples were centrifuged for 2 min and 0.1 ml was inoculated on Sabouraud Citrus chloramphenicol agar culture plates and incubated at 37° Celsius for 24–48 h. The creamy white-colored, smooth colonies with yeasty odor indicated the growth of *Candida*. After 48 h, the *Candida* colonies formed were counted as number of CFUs/ml (manually/4 quadrant). A cutoff point was established for colony counts with 100 or greater CFU/ml being considered a high CFU count.

2.6 Statistical Analysis

All data were tabulated, and the results were analyzed using Chi-Square tests to determine the relationship between SFR and pH with *Candida* colony counts. A p-value of <0.05 was considered statistically significant.

3. Results

From a total of 105 patients included in this study, 19 were males and 86 were females, with percentages of 18% and 82%, respectively, as shown in Table 1. Based on this result, it can be concluded that females visited Pancur Batu Health Center than male elderly.

Table 1. Distribution and frequency of participants based on gender.

Gender	Frequency (n=105)	Percentage (%)
Male	19	18
Female	86	82

Patients with a saliva flow rate (SFR) of less than 1 ml/min were considered to have hyposalivation, while those with 1 ml/min or greater had normal salivation. Among all participants, 92 have hyposalivation and 13 have normal salivation, with percentages of 83% and 27%, respectively, as shown in Table 2.

Table 2. Distribution and frequency of participants based on salivary flow rate (SFR).

Salivary Flow Rate	Frequency (n=105)	Percentage (%)
Hyposalivation (<1 ml/min)	92	83
Normal (≥1 ml/min)	13	27

The saliva pH measurement was expressed as acidic, neutral, or alkaline if the pH value is less than or equal to 6.9, 7, or greater than 7, respectively. For salivary pH measurement, 100 samples (95%) showed low salivary pH (acidic), while only 5 (5%) had neutral salivary pH and no alkaline pH detected, as shown in Table 3.

Table 3. Distribution and frequency of participants based on salivary pH

Salivary pH	Frequency (n=105)	Percentage (%)
Acidic	100	95
Neutral	5	5
Alkaline	0	0

A cutoff point was established for Candida colony counts with 100 or greater CFU/ml being considered a high CFU count. The relationship between SFR and Candida colony counts is shown in Table 4 and between salivary pH and Candida colony counts in Table 5.

Table 4. Relationship between salivary flow rate with Candida colony counts.

SFR	Candida Colony Counts (n=105)						p
	<100 CFU/ml		≥100 CFU/ml		Total		
	n	%	N	%	n	%	
Hyposalivation	79	75	13	12	92	83	0.03*
Normal	8	8	5	5	13	27	

* Statistically significant

Table 5. Relationship between salivary pH with Candida colony counts.

Salivary pH	Candida Colony Counts (n=105)						p
	<100 CFU/ml		≥100 CFU/ml		Total		
	n	%	N	%	n	%	
Acidic	82	78	18	17	100	95	0.59
Neutral	5	5	0	0	5	5	
Alkaline	0	0	0	0	0	0	

Relationships between salivary flow rate and pH with Candida colony count were determined using Chi-square analyses. The result showed a significant relationship between SFR and Candida colony overgrowth, as indicated by a p-value of 0.03. On the other hand, there was no relationship between salivary pH and Candida colony counts, as indicated by a p-value of 0.59.

4. Discussion

The demographic data of the elderly based on gender at Pancur Batu Health Center showed a higher number of females as compared to males. This result is consistent with the study conducted by Ritayani in 2020 on factors related to elderly visits to a health center in Selalong, Sekadau Hilir sub-district in 2020, which showed females as the majority of participants. Furthermore, the level of awareness among elderly women regarding health is higher compared to men, and according to the study, elderly women consult doctors more often regarding health issues compared to men [12]. Another study by Kurnia in 2019 showed that elderly women have three characteristics related to their health. Elderly women tend to be more aware, take responsibility, and have the motivation to maintain their health. These factors contribute to the higher frequency of health center visits of women compared to men [13].

The salivary flow rate may decrease over time due to physiological changes in the elderly. Most of the participants at Pancur Batu Public Health Center exhibited hyposalivation. According to previous studies, a decreased salivary flow rate may could increase the risk of various pathological conditions in the oral cavity of the elderly, such as the case of candidiasis [14-16]. Furthermore, anatomical changes in the oral cavity of the elderly, along with the reduced saliva flow rate in geriatric individuals showed that the aging process can lead to atrophy of acinar cells, resulting in changes and deterioration of salivary gland function. Loss of parenchymal tissue in the glands is replaced by adipose tissue and connective tissue, leading to a decrease in saliva production [17]. Several studies have shown that systemic diseases contributed significantly to a declined salivary flow rate in the elderly [18-19]. Reduced saliva production also causes a decrease in the saliva flow rate, making the elderly more susceptible to oral infections [17].

This study showed that the salivary pH of elderly patients at Pancur Batu Health Center tends to be acidic. This acidic property is caused by a decrease in saliva secretion, an increased number of microorganisms in the oral cavity, and changes in the buffering capacity of saliva in the elderly. Furthermore, the decreased pH in saliva significantly affects the stability of saliva in protecting the oral mucosa, facilitating bacteria attachment to the cavity. Bacterial attachment to the oral mucosa facilitates inflammation and leads to various

oral diseases [20-21]. A study also showed that low salivary pH accelerates enamel demineralization and increases the number of microorganisms in the oral cavity [22].

In this study, a significant relationship was found between saliva flow rate and the number of *Candida* colonies. In addition, decreased salivary gland function inhibits saliva secretion, resulting in increased growth and development of *Candida* colonies. The decrease in saliva flow rate and the absence of anti-fungal components, such as lactoferrin and lysozyme can contribute to the increasing number of *Candida* colonies in the oral cavity. Previous studies have shown that impaired salivary gland function leads to a low saliva flow rate, resulting in an increased number of *Candida* colonies [8, 19]. The impaired salivary gland function in the elderly also leads to increased infections in the oral cavity, hyposalivation, and accelerated growth of *Candida* colonies [19, 23]. These statements showed the impact of low saliva flow rate on the growth and development of *Candida* colonies due to impaired salivary gland function.

The result of this study showed no significant relationship between salivary pH and the number of *Candida* colonies, as indicated by a p-value of 0.59. The acidic pH accelerates bacterial growth in the oral cavity but does not have a significant impact on the growth of *Candida* colonies in the oral cavity of elderly patients [24]. In conclusion, most of the elderly patients in Pancur Batu Public Health Center had low salivary flow rates and pH. Low salivary flow rate was shown to be significantly correlated with excessive growth of *Candida* colonies. This correlation increased the chances of developing oral *Candida* infections by the elderly. Based on these results, preventive measures should be taken to maintain good oral hygiene and overall health in the elderly.

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6. Conflicts of Interest

The authors declare that there are no conflicts of interest to disclose concerning this study.

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