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The effect of aging on the balance and quality of salivary ph in the oral cavity

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Abstract

Background and aim: The balance between salivary buffer capacity and salivary components plays a vital role in maintaining oral health. Aging, as a natural physiological process, affects various organs including the salivary glands, leading to changes in both the quantity and quality of saliva. These alterations influence salivary pH, which tends to decrease with age, potentially disrupting the oral ecosystem.

Purpose: This review is to evaluate the effect of aging on the balance and quality of salivary pH.

Methods: This study employed a literature review approach, involving a comprehensive search of both international and national scientific articles through academic databases. The method enabled the synthesis of existing data and the detailed discussion of findings, providing a clear examination of the effects of aging on the balance and quality of salivary pH in the oral cavity.

Result: Indicate that elderly individuals generally exhibit lower salivary pH and flow rates compared to younger adults. Reduced salivary secretion due to aging is often associated with complications such as xerostomia, plaque accumulation, dental caries, and periodontitis. Moreover, systemic factors like hypertension and medication use can further decrease salivary pH, worsening oral health conditions. In conclusion, aging significantly affects the balance and quality of salivary pH, which may lead to decreased salivary function and an increased risk of oral diseases.

Keywords: Aging; Salivary pH; Buffer capacity; Oral health; Xerostomia

1. Introduction

Saliva is a fluid secreted by the major and minor salivary glands. This complex fluid plays a crucial role in maintaining the oral ecosystem, serving functions such as protection, mucosal maintenance, antimicrobial activity, pH stabilization in the oral cavity, assistance in digestion, and numerous other roles. Under normal conditions, the oral cavity is consistently moistened by saliva. Consequently, dentists now use saliva as an indicator of oral ecosystem balance. One of the primary roles of saliva is its function in maintaining the stability of oral pH, as salivary pH is a critical factor influencing oral health. For saliva to function optimally, its composition and properties must remain balanced, particularly its pH, which is closely related to various masticatory activities occurring in the oral cavity. Under normal conditions (resting saliva), the pH ranges between 6.2 and 7.6.

In the elderly, the aging process affects multiple aspects of life, including social, economic, and most notably, health. As age increases, organ function declines—a process known as organ degeneration—due to natural factors or disease. One organ affected by functional degeneration is the salivary gland, which undergoes atrophy, resulting in reduced saliva production and altered composition.

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Furthermore, according to Yunus (2020), as individuals age, there is a decline in taste sensation on the tongue caused by a reduction in the number of taste buds. By the age of 45, taste buds begin to decrease, resulting in diminished taste perception in older age. This reduction in taste sensitivity is also attributed to delayed turnover of receptor cells and

1.1. Research purpose

The objective of this review is to assess and discuss how aging influences the balance and quality of salivary pH within the oral cavity. This study particularly focuses on examining the physiological changes in salivary glands that occur with age and their impact on salivary secretion, buffering ability, and pH regulation. Furthermore, it explores the consequences of these changes on oral health issues such as xerostomia, dental caries, and periodontal disorders. By integrating data from both national and international research, this review aims to provide a thorough understanding of the link between aging and salivary function, thereby supporting better prevention and management approaches for oral health in older adults.

2. Research methods

2.1. Research Strategy

A literature search was conducted using preselected databases, specifically Google Scholar, PubMed, and Scopus. The search focused on articles and journals related to the topic "Age-Related Changes in Oral Health, Salivary Parameters, Halitosis, and Systemic Diseases and Medication Usage." Only articles containing the specified keywords were included in the search process, while publications outside the given keywords or unrelated to the topic were excluded.

2.2. Inclusion and Exclusion Criteria

In this study, the inclusion criteria consisted of literature available in full-text and open access, written in English, applying an original research design. The exclusion criteria included literature written in languages other than English, literature that was not available in full text, not open access, as well as review articles or case reports that did not directly investigate age-related changes in oral health and salivary parameters.

2.3. Synthetic Data

The selected literature was analyzed through comprehensive full-text reading and data extraction, focusing on key elements such as research title, author(s), research objectives, methodology, results, and conclusions. The collected data were systematically reviewed to formulate a synthesis that addresses the research questions and objectives concerning the relationship between aging, salivary changes, oral health, halitosis, and systemic conditions. The selection process involved keyword-based searches followed by title and abstract screening, and finally full-text evaluation to ensure relevance according to the predefined inclusion and exclusion criteria.

3. Research result

Based on the results of the literature review, seven studies were found and seven relevant studies published were identified that investigated the relationship between aging and changes in salivary pH balance and quality. These studies were selected based on their methodological relevance, focus on salivary parameters, and inclusion of aging populations. Each article was analyzed in terms of its research design, sample characteristics, measurement methods, and findings, as summarized in Table 1.

Table 1 Result of Article Review

Sample	Method	Results	References
The sample consisted of 138 men who attended a designated gathering location at the clinic, conducted by the University College of Dentistry.	Salivary flow, pH, quality of life, and caries status were recorded for each sample. Quality of life was assessed using the Arabic version of the Oral Health Impact Profile-14 (OHIP-14), while caries status was measured using the Decayed, Missing,	The mean age of the sample was 67.5 years, and 64% of the participants were classified as experiencing hyposalivation. Older respondents were found to have lower salivary flow and pH compared to younger respondents. An inverse	The Impact of Hyposalivation on Quality of Life (QoL) and Oral Health in the Aging Population of Al Madinah Al Munawarrah. Ahmad et al. 2017.

	and Filled Teeth (DMFT) index.	association was observed between caries status and the average salivary flow rate. Additionally, a significant positive correlation was found between caries status and the quality of life scores within the sample.	
One hundred women, aged 40–60 years, were divided into two groups: premenopausal and menopausal	This study was conducted using an observational (cross-sectional) method, comparing two groups: premenopausal and postmenopausal women. Unstimulated saliva was collected in a graduated container. Data were analyzed using percentages, mean, standard deviation, t-test, and Pearson correlation to examine the relationships between variables.	In the menopausal group, salivary pH was significantly lower and potassium concentration was higher; a negative correlation was observed between dry mouth symptoms and salivary flow.	Estimation of Unstimulated Salivary Flow Rate, pH, Calcium, and Potassium in Pre- and Postmenopausal Women in Relation to Oral Symptoms. Baipadavu, Jayalakshmi, et al. 2025.
The study included 103 subjects, comprising 70 women and 33 men, with a mean age of 65.61 years.	This study consisted of interviews, clinical examinations, measurement of salivary secretion (sialometry), and assessment of taste sensitivity using chemical gustometry. Taste sensitivity was measured using four different substances: sweet (sucrose), salty (NaCl), sour (citric acid), and bitter (quinine sulfate), each at four different concentrations. A score of four was assigned if the participant recognized the lowest concentration of a substance, and a score of zero was given if none of the concentrations were detected. The total taste sensitivity score was scaled from 0 to 16. Salivary secretion data and taste sensitivity data were analyzed using Spearman's correlation test to determine the relationship between the two variables.	The mean scores for taste sensitivity were 2.81 for sweet, 3.32 for salty, 3.69 for sour, and 2.98 for bitter. The mean total taste sensitivity score was 12.80 out of 16. Unstimulated whole saliva measurements showed an average flow rate of 0.170 ml/min, with the majority of subjects exhibiting normal salivary flow. Spearman's correlation analysis yielded $r = -0.078$ with $p > 0.05$, indicating no significant correlation. The study concluded that there is no relationship between salivary secretion and taste sensitivity in the elderly.	The relationship between salivary secretion and taste sensitivity level in the elderly. Naritasari, Agustina & Supriatno 2018.
This study involved 40 elderly participants aged over 60 years, of whom 20 individuals (control group) were normotensive and not	Both stimulated and unstimulated saliva samples were collected from all participants, and pH was measured using salivary pH strips. Salivary flow rate was	The results showed no association between hypertension and either stimulated or unstimulated salivary flow rate. However, a significant association was	Influence of Hypertension on pH of Saliva and Flow Rate in Elder Adults

taking any medication, and 20 individuals (study group) were hypertensive and using antihypertensive medication.	measured using calibrated test tubes and correlated with oral health status. The collected data were then subjected to statistical analysis using an unpaired t-test and chi-square test.	found between hypertension and salivary pH, indicating a decrease in salivary pH among hypertensive participants. Additionally, the study reported a significant relationship between periodontal pocket bleeding and hypertension in individuals using antihypertensive medication.	Correlating with Oral Health Status. Nimma et al. 2016
The study included 274 patients (66 men and 208 women) with a mean age of 59.39 ± 16.10 years, all of whom reported complaints of xerostomia or halitosis.	Data were collected retrospectively from patient medical records between August 2020 and May 2023.	There are no significant differences found in unstimulated salivary flow, stimulated salivary flow, salivary pH, or salivary buffering capacity between age groups (all $p > 0.05$). However, advanced age was significantly associated with the presence of sticky saliva, poor oral hygiene, tongue coating, and halitosis (all $p < 0.05$).	Age-Related Changes in Oral Health, Salivary Parameters, Halitosis, and Systemic Diseases and Medication Usage. 2017
20 orthodontic patients with non-syndromic cleft lip and palate.	Salivary pH and buffering capacity were measured, and oral hygiene was assessed using the OHI-S index.	Eighty-five point seventy- one percent of the samples had a normal salivary pH, and 90.48% exhibited very low buffering capacity. No significant association was found between salivary pH and oral hygiene ($p > 0.05$). However, salivary buffering capacity showed a significant positive correlation with the calculus index ($p = 0.01$).	Correlation between Salivary pH, Buffer Capacity, and Oral Hygiene in Orthodontic Patients with Non-syndromic Cleft Lip and Palate.2025

4. Discussion

The first article evaluated the impact of hyposalivation on quality of life and oral health in the elderly population of Al Madinah Al Munawarah. The sample consisted of 138 men who attended a designated gathering location at the clinic conducted by the University College of Dentistry. This study recorded salivary flow, pH, quality of life, and caries status using the Arabic version of the OHIP-14 and the Decayed, Missing, and Filled Teeth (DMFT) index. The results showed that older respondents had lower salivary flow and pH compared to younger respondents. Additionally, an inverse relationship was observed between caries status and salivary flow, while a significant positive correlation was found between caries status and quality of life scores [1].

The second study by Baipadavu, J., Chirakara, R. A., Anekar, J., Kumar, K. S., & John, I. E. (2025) investigated differences in salivary pH and ion concentrations in premenopausal and menopausal women. The sample included 100 women aged 40–60 years, divided into two groups. The study employed an observational (cross-sectional) design, collecting unstimulated saliva in graduated containers. Data analysis was conducted using percentages, mean, standard deviation, t-test, and Pearson correlation. The results indicated that in the menopausal group, salivary pH was significantly lower and potassium concentration was higher, with a negative correlation between dry mouth symptoms and salivary flow [3].

The third article, authored by Naritasari, Agustina & Supriatno (2018), examined the relationship between salivary secretion and taste sensitivity in elderly individuals in the Special Region of Yogyakarta, Indonesia. The sample

consisted of 103 subjects (70 women and 33 men) with a mean age of 65.61 years. The study involved interviews, clinical examinations, measurement of salivary secretion (sialometry), and taste sensitivity testing using chemical gustometry with four tastes (sweet, salty, sour, bitter) at four different concentrations. Total taste sensitivity scores were scaled from 0 to 16. Results showed a mean total taste sensitivity of 12.80 out of 16 and an average unstimulated salivary flow of 0.170 ml/min, with most subjects exhibiting normal flow. Spearman correlation analysis yielded $r = -0.078$ with $p > 0.05$, indicating no significant relationship between salivary secretion and taste sensitivity in the elderly [9].

Finally, Nimma et al. (2016) studied the relationship between hypertension, salivary pH, salivary flow rate, and oral health status in 40 elderly individuals aged over 60 years, including a normotensive control group and a hypertensive study group using antihypertensive medication. Both stimulated and unstimulated saliva samples were collected and pH was measured, followed by correlation of salivary flow with oral health status. Statistical analysis was performed using an unpaired t-test and chi-square test. The results showed no association between hypertension and either stimulated or unstimulated salivary flow. However, hypertension was significantly associated with decreased salivary pH, and a significant relationship was observed between periodontal pocket bleeding and both hypertension and antihypertensive medication use [10].

Another study investigated 274 patients (66 men and 208 women; mean age 59.39 ± 16.10 years) who reported complaints of xerostomia or halitosis. Data were collected retrospectively from patient medical records between August 2020 and May 2023. No significant differences were found in either stimulated or unstimulated salivary flow, salivary pH, or buffering capacity across different age groups. However, advanced age was significantly associated with sticky saliva, poor oral hygiene, tongue coating, and halitosis ($p < 0.05$).

Finally, a study involving 20 orthodontic patients with non-syndromic cleft lip and palate assessed salivary pH, buffering capacity, and oral hygiene using the OHI-S index. Results showed that 85.71% of the samples had normal salivary pH, while 90.48% exhibited very low buffering capacity. No significant association was found between salivary pH and oral hygiene ($p > 0.05$), but salivary buffering capacity demonstrated a significant positive correlation with the calculus index ($p = 0.01$).

5. Conclusion

Based on the results of the analyzed studies, it can be concluded that aging affects the balance and quality of salivary pH in the oral cavity. Several studies indicate that elderly individuals tend to have lower salivary flow and pH compared to younger groups, although not all studies show a significant relationship with taste sensitivity. The decline in salivary secretion due to aging can increase the risk of complications such as xerostomia, plaque accumulation, dental caries, periodontitis, and poor oral hygiene. Additionally, other factors, such as hypertension, can also reduce salivary pH and elevate the risk of periodontal disorders. Research on orthodontic patients shows that salivary buffering capacity has a significant correlation with the calculus index, although salivary pH is not always directly related to oral hygiene. Overall, these findings confirm that aging can influence the quality of saliva, both in terms of pH and its protective functions for oral health.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that there is no conflict of interest.

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