International Journal of Medical Science in Clinical Research and Review
Online ISSN: 2581-8945
Available Online at http://www.ijmscrr.in Volume 7|Issue 04 (July-August) |2024 Page: 780-784

Original Research Paper

Long-Term Effect of Smoking on the Salivary pH

Corresponding Author:
Hussein Haleem Jasim
Department of Oral Diagnosis, College of Dentistry, University of Wasit, Iraq

Article Received: 01-June-2024, Revised: 21-June-2024, Accepted: 11-July-2024

ABSTRACT:
Saliva serves a variety of purposes in the body, including defense against infection, digestion, lubrication, immune system support, buffering, remineralization in healthy oral mucosa, diagnostic use, and proteome analysis. The pH and flow rate of saliva are critical for maintaining oral tissue health. When the pH level falls below the standard range and becomes acidic, it could reflect an abnormality related to oral health issues like cavities and enamel erosion. In addition to influencing salivary flow rate, smoking can also alter salivary pH. **The aim of study**: To determine the relationship between the smoking and changing the pH level of the saliva. **Materials and method**: The study included 120 patients (60 smokers and 60 non-smokers) aged between 20-45 years. Saliva samples were collected in the morning after fasting all night then the whole saliva was collected in sterile glass 10 ml beaker. The pH values of collected saliva were measured using digital pH meter. **Results**: The statistical analysis showed a significant difference between smoking and the changing of salivary pH value by reduction of saliva pH. The *p*-value is 0.04 (Significant at $p < 0.05$). **Conclusion**: Long-term smoking has a significant impact by lowering of the salivary pH value that could make the oral mucosa more susceptible to a range of dental and oral diseases.

Keywords: Smoking, Saliva, pH

INTRODUCTION:

Saliva is the fluid that the salivary glands produce and release into the mouth. [1] The majority of the aqueous fluid in the oral cavity is composed of saliva.[2] Water makes up nighty-nine percent of the total composition of saliva, making it the main component of saliva. Inorganic and organic components are also included within saliva.[3] Each type of gland has different components, and different physiological and pathological changes can also affect the composition of saliva.[4] Particularly in preserving dental health and gastrointestinal digestive processes, each salivary component has a distinct purpose.[5]

The salivary glands produce between 500 - 2000 mL of saliva every day.[6] Saliva plays a crucial role in protecting the tissues of the oral cavity from infections and dental caries,[7] as well as in the relief of mastication, speaking, swallowing and lubricating the oral mucosa. It also provides an aqueous medium for taste perception.[8]

The two main salivary glands are the submandibular and sublingual glands, which are found in the floor of the mouth, and the paired parotid glands, which are situated across from the maxillary first molars. Saliva is secreted by small glands in the tongue, palate, cheeks, pharynx, and lower lip.[9]

Numerous electrolytes, such as sodium, magnesium, potassium, bicarbonate, calcium and phosphates, are found in saliva. Saliva also contains proteins, enzymes, immunoglobulins, nitrogenous and mucins, products like ammonia and urea. The following general areas are where these components interact in a related function: Saliva's pH and buffering ability are regulated by bicarbonates, phosphates, and urea; oral microorganisms are cleansed, aggregated, and/or attached by macromolecule proteins and mucins; dental plaque metabolism is aided by these substances; demineralization and remineralization are modulated by calcium, phosphate, and proteins in concert; and antibacterial action is provided by immunoglobulins, proteins, and enzymes.[10,11]

The functions of saliva include oral mucosal protection, teeth remineralization, taste sensation, digestion, pH balance, and phonation. It is made up of different electrolytes, peptides, glycoproteins, and lipids that have antioxidant, antimicrobial, buffering properties and tissue repair,[12] As a result, altered whole-mouth plays an important role in the development of oral and dental diseases.[13]

Oral health is greatly influenced by saliva flow, saliva buffer capacity, and saliva microorganism content.[14] Saliva's buffer systems are responsible for maintaining a

proper acid-base balance.[6] Buffer solutions are resistant to changes in the oral pH because they maintain a nearly constant pH even when little amounts of base or acid are added or when saliva is diluted. Saliva at rest typically has a pH of 6.2–7.6. [2] Saliva contains three different types of buffer systems: protein buffer, phosphate buffer, and carbonic acid/bicarbonate buffer (which plays the most significant role).[15,16]

The pH of saliva, oral clearance, salivary flow rate, concentrations of phosphate, calcium, and fluoride ions, and salivary levels of oral microorganisms are salivary parameters that influence the stability of enamel in the oral environment.[17] Microorganisms that can metabolize fermentable carbohydrates and produce a range of acidic byproducts are part of the oral cavity's microbial flora. Until the carbohydrate substrate is metabolized, bacteria in the dental plaque will continue to produce acids. Stephan et al. found that the pH of saliva and plaque drops below the crucial pH value of 5.5 three to five minutes after these microorganisms are exposed to fermentable carbohydrates.[18] The underlying tooth enamel becomes demineralized as a result of this decrease in the pH of saliva and plaque. As the acid is either neutralized or eliminated from the oral cavity, the pH eventually returns to its resting level.[19] Foods that cause a pH drop to less than 5.5, or critical pH, are thought to be harmful to teeth. The physical characteristics of the food consumed and the saliva's ability to act as a buffer are the two main variables that influence the decrease in salivary pH that occurs after consuming any type of food. While the amount of fermentable carbohydrates in a food influences the time it takes for the pH in the mouth to return to normal, it has no direct effect on the pH drop. Consequently, the oral clearance time and retentiveness of food have a significant impact on the demineralization of tooth structure. [20,21]

In fact, saliva and crevicular fluid paradoxically contribute to the development of periodontal pathology and are crucial in preventing periodontal disease. As a result, a lot of research has been done on these two factors. The use of salivary pH as a diagnostic marker for periodontal disease is strongly documented in the literature.[22]

Smoking is one of the most common bad habits in developing countries; it generally has a negative health impact because smoke inhalation is hazardous to every organ in the body and weakens overall health. According to Jena et al., [23] smoking is the leading cause of cancers in the lung, urinary bladder, renal pelvis, oral cavity, pharynx, larynx, esophagus, lip, and pancreas. The reason for causing cancer is that chemical substances in cigarettes damage the DNA in the body, including key genes that protect the body from cancer.[24] Smoking is the world's second leading cause of early preventable death.[25]

Tobacco's negative effects on oral health have been well documented in clinical and epidemiological studies. [26,27] Saliva is the first biological fluid to be exposed to tobacco (smoked or not), which contains a variety of toxic components that cause structural and functional changes in saliva. [28]

Since tobacco smoke permeates nearly the entire oral cavity, while a person smokes, they are continuously in contact with the taste receptors, which serve as the main receptor site for salivary secretion. It has been found that smoking activates the salivary glands, and smokers themselves attest to this fact. Furthermore, because habitual smokers do not salivate as much as novice smokers do in response to smoking, it has been noted that a certain amount of tolerance develops to the salivatory effects of smoking. Saliva is the first bodily fluid to come into contact with cigarette smoke, which contains a variety of toxic substances that cause structural and functional changes in saliva.[29]

MATERIALS AND METHODS:

The statistical analysis was done by the SPSS statistical package version 22.0. The chi-square calculator test was used for analyzing association between the level of salivary pH and smoking. The Statistical significance was set at 0.05.

Study sample:

The study included one-hundred twenty patients (60 smokers and 60 non-smokers) within the age group ranged between 20-45 years. The smoker individuals included in the study were smoked 10 –15 cigarettes daily for more than three years ago. Both smokers and non-smokers patients were examined on the basis of salivary pH value whether normal or abnormal range. Individuals wearing dentures, those with systemic or salivary gland disorders, patients with a radiation therapy, alcohol drinkers, patients taken any type of medicines and users of any kind of smokeless tobacco were among the exclusion criteria The normal level of salivary pH which considered in the study was ranged between [6.2 - 7.6]; relatively neutral, while the abnormal level of salivary pH which considered in the study was ranged between [4 – 6]; acidic. Table 1.

Saliva collection:

Saliva samples were collected in the morning after fasting all night without eating or drinking anything except water. The patients' mouths were rinsed with 100 milliliters of distilled water, and then the whole saliva was collected for two minutes in sterile glass 10 ml beaker. As soon as the whole saliva was collected, its pH level was measured to avoid degradation of the collected saliva. Measurements were taken at room temperature

(25°C), in a controlled condition, and in the same location.

Saliva Analysis*:*

The salivary pH values were measured using digital pH meter (Figure .1). A pH-sensitive electrode of pH meter was dipped into the collected saliva in glass beaker to measure the pH value of saliva. The pH reading was recorded after a few seconds of stabilization of the digital reading. The electrode was then cleaned with a distilled water steam and put in a standard pH 7 solution to be ready for the subsequent measurement.

Figure 1. Digital pH meter used in the measurements of salivary pH

RESULTS:

The statistical analysis found 43.3% of non-smoker patients were measured with acidic salivary pH level and 56.6% of them were measured with relatively neutral salivary pH level. In addition, the results found 61.6% of smoker patients were measured with acidic salivary pH level and 38.3% of them were measured with relatively neutral salivary pH level.

The statistical analysis showed a significant difference between smoking and the lowering of salivary pH value; The chi-square statistic was 4.04. The *p*-value is 0.04 (Significant at $p < 0.05$). **Table. 1**.

Table 1. The levels of salivary pH in smokers and non-smokers patients

	Acidic **salivary pH [pH 4 – 6] N (%)**	**Relatively neutral salivary pH [pH 6.2 - 7.6] N (%)**	*Marginal Row Totals*
Non smokers	26 (43.3%)	34 (56.6%)	60
Smokers	37 (61.6%)	23 (38.3%)	60
Marginal Column Totals	63	57	120

The chi-square statistic is 4.04. The *p*-value is 0.04. The results are significant at $p < .05$.

DISCUSSION:

Smoking is considered a widespread behavior among the population that has harmful effects on public health in the long term. In addition, smoking has a direct impact on oral health, such as increasing the risk of the oral cancer, gingivitis, periodontitis and teeth discoloration.

The current study examined the relationship between the smoking and pH level of the saliva, The study found that smoking has a significant effect on changing the pH level of saliva because it increases the acidity of saliva by reducing the pH of saliva.

Previous research also had been demonstrated that smoking tobacco has a negative impact on a saliva health parameter and it reached results similar to the current study which conducted to reduction of salivary pH levels in smokers compared to non-smokers. Singh et al, found that the salivary pH levels in the smokers group decreased from 7.10 to 6.30 in the non-smokers.[30] Another study found that individuals who smoke water pipes have lower salivary pH levels than people who don't smoke.[31] Similar results were found in other studies, which led researchers to conclude that tobacco smokers had lower salivary pH levels than non-smokers. [32,33]

According to Fazail et al., there was a significant impact in case of smoking tobacco or using smokeless tobacco by reduction of salivary flow rate and saliva pH.[34]
Rahmadi et al. discovered that among male students, smoking significantly lowers salivary amylase activity and increases the acidity of saliva.[35]
The amount of smoking was found to be strongly correlated with salivary flow rate and pH level by Saputri et al. Nevertheless, they discovered that salivary flow rate and salivary pH had no relationship with the nicotine concentrations listed on cigarettes.[36]
Challap et al. found that salivary pH level in tobacco smokers were lower than those of the non-smoker group. [37]

Long-term tobacco use, especially smokeless tobacco, can significantly alter salivary flow rate (decreases) and pH level (acidic), according to a study by Kanwar et al. [38]

In addition, there were several conditions that may affect the findings of the current study or previous studies; for example, consumption of food and beverages, particularly those high in sugar may have an impact on the salivary pH. Carbohydrates are broken down by oral bacteria when we eat or drink and the pH of saliva is lowered by the different acids that these bacteria release.

Ethical Policy: The research was carried out in compliance with the Helsinki Declaration of 1964 or similar guidelines.

Financial support and sponsorship: Nil.

Conflicts of Interest: There are no conflicts of interest.

REFERENCES:

1. Proctor, G.B. The physiology of salivary secretion. Periodontol. 2000 2016, 70, 11–25.

2. Dawood, I.M.; El-Samarrai, S.K. Saliva and Oral Health. Int. J. Adv. Res. Biol. Sci. 2018, 5, 1–45.

3. Spielman, A.I.; D'Abundo, S.; Field, R.B.; Schmale, H. Protein Analysis of Human von Ebner Saliva and a Method for its Collection from the Foliate Papillae. J. Dent. Res. 2016, 72, 1331–1335.

4. De Almeida, P.D.V.; Grégio, A.M.T.; Machado, M.Â.N.; De Lima, A.A.S.; Azevedo, L.R. Saliva composition and functions: A comprehensive review. J. Contemp. Dent. Pract. 2008, 9, 72–80.

5. Saher, F.; Khurshid, Z.; Zafar, M.S.; Mohammed, F.; Khurram, S.A. Salivary Glands. In An Illustrated Guide to Oral Histology; Wiley Online: Hoboken, NJ, USA, 2021; pp. 147–166.

6. Kubala, E.; Strzelecka, P.; Grzegocka, M.; Lietz-Kijak, D.; Gronwald, H.; Skomro, P.; Kijak, E. A review of selected studies that determine the physical and chemical properties of saliva in the field of dental treatment. BioMed Res. Int. 2018, 2018, 6572381.

7. Vila, T.; Rizk, A.M.; Sultan, A.S.; Jabra-Rizk, M.A. The power of saliva: Antimicrobial and beyond. PLoS Pathog. 2019, 15, e1008058.

8. Ok, S.-M.; Ho, D.; Lynd, T.; Ahn, Y.-W.; Ju, H.-M.; Jeong, S.-H.; Cheon, K. Candida Infection Associated with Salivary Gland—A Narrative Review. J. Clin. Med. 2021, 10, 97.

9. Roth G, Calmes R, editors. Salivary glands and saliva. In: Oral biology. St Louis: CV Mosby; 1981. p.196-236.

10.Humphrey SP, Williamson RT. A review of saliva: Normal composition, flow, and function. The Journal of Prosthetic Dentistry. 2001;85(2):162-169

11.Dowd FJ. Saliva and dental caries. Dental Clinics of North America. 1999;43:579-597

12. Zappacosta B, Persichilli S, De Sole P, Mordente A, Giardina B. Effect of smoking one cigarette on antioxidant metabolites in the saliva of healthy smokers. Arch Oral Biol 1999;44:485-8.

13. Mandel ID. The diagnostic uses of saliva. J Oral Pathol Med 1990;19:119-25.

14. Dawes, C.; Wong, D.T.W. Role of Saliva and Salivary Diagnostics in the Advancement of Oral Health. J. Dent. Res. 2019, 98, 133–141.

15. Meghana Reddy J., Gayathri R., Vishnu Priya V. Variation in salivary pH and buffering capacity of saliva in normal and diabetes mellitus patients—A pilot study. Drug Invent. Today. 2018;10:895.

16. Makawi, Y.; El-Masry, E.; El-Din, H.M. Salivary carbonic anhydrase, pH and phosphate buffer concentrations as potential biomarkers of caries risk in children. J. Unexplored Med. Data 2017, 2, 9–15.

17. Edgar M, Dawes C, O'Mullane D: Saliva and Oral Health. 3rd ed. London: British Dental Association; 2004.

18. Stephan RM. Changes in hydrogen-ion concentration on tooth surfaces and in carious lesions. JADA 1940;27(5):718-23.

19. Touger-Decker R, Loveren C. Sugars and dental caries. Am J Clin Nutr 2003;78: 881- 92.

20. Dawes C, Macpherson LM. Effects of nine different chewing gums and lozenges on salivary flow rate and pH. Caries Res 1992;26(3):176-82.

21. Mor BM, McDougall WA. Effects of milk on pH of plaque and salivary sediment and the oral clearance of milk. Caries Res 1977;11:223-30.

22. Baliga S, Muglikar S, Kale R. Salivary pH: A diagnostic biomarker. J Indian Soc Periodontol 2013;17:461-5.

23. Jena, P. K., Kishore, J. & Sarkar, B. K. 2013. Global Adult Tobacco Survey (GATS): a case for change in definition, analysis and interpretation of "cigarettes" and "cigarettes per day" in completed and future surveys. Asian Pac J Cancer Prev, 14, 3299-304

24. Kane, E. V., Roman, E., Cartwright, R., Parker, J. & Morgan, G. 1999. Tobacco and the risk of acute leukaemia in adults. Br J Cancer, 81, 1228-33.

25. Dunga, J. A., Adamu, Y., Kida, I. M., Alasiya, D., Jibrin, Y., Sabo, U., Ukoli, C., Chuhwak, C. H. & Musa, J. J. 2015. Tobacco Abuse and Its Health Effect. Niger J Med, 24, 354-62.

26. Millar WJ, Locker D. Smoking and oral health status. J Can Dent Assoc 2007;73:155.

27. Sham AS, Cheung LK, Jin LJ, Corbet EF. The effects of tobacco use on oral health. Hong Kong Med J 2003;9:271 7.

28. Fox PC, Ship JA. Salivary gland diseases. In: Greenberg MS, Glick S, editors. Burket's Oral Medicine: Diagnosis and Treatment. 11th ed. Hamilton: BC Decker; 2008. p. 191-223.

29. Khan GJ, Javed M, Ishaq M. Effect of smoking on salivary flow rate IJMS. 2010;8:221-5

30. Singh, M., Navin Anand Ingle, Navpreet Kaur, Pramod Yadav & Ingle, E. 2015. Effect of long term smoking on salivary flow rate and salivary pH. Journal of Indian Association Of Public Health Dentistry, 13 (1), p 11-13.

31. Khemiss, M., Ben Khelifa, M. & Ben Saad, H. 2017. Preliminary findings on the correlation of saliva pH, buffering capacity, flow rate and consistency in relation to waterpipe tobacco smoking. Libyan J Med, 12, 1289651.

32. Parmar, P., G. Radha, Rekha, R. & Pallavi, A. S. K. 2017. Assessing Salivary Flow Rate, Salivary pH and Oral Candidiasis among Tobacco Chewers, Smokers and Healthy Controls. A Cross Sectional Study. AJMAH, 7, 1-8.

33. Grover, N., Sharma, J., Sengupta, S., Singh, S., Singh, N. & Kaur, H. 2016. Long-term effect of tobacco on unstimulated salivary pH. J Oral Maxillofac Pathol, 20, 16-9.

34. Fazail Ahmad, Aarati Panchbhai, Impact of Tobacco on Salivary Flow Rate and Salivary pH, J Res Med Dent Sci, 2022, 10 (10): 235-238.

35. Rahmadi Sitompul1, Ulfa Mashitah1 , Siti Asriati1, Riansyah Sigit Kurniawan1 and Yurnaliza2* Effect Of Smoking Behaviour and The BMI On Ph Levels Of Saliva and Salivary Amylase Activity Among Male Students. International Journal of Ecophysiology Vol. 04, No. 02, 2022 |1 – 8.

36. Saputri, D., Nasution, A. I., Surbakti, M. R. W., & Gani, B. A. (2017). The correlation between pH and flow rate of salivary smokers related to nicotine levels labelled on cigarettes. *Dental Journal*, *50*(2), 61–65

37. Iqbal Dohan Challap, Fadhel M Lafta, Abdul-Ameer N Ghaloub Al-Rekabi3, Fatima Ahmed and Rehab Qasim. Investigation the impact of smoking on salivary pH and the reasons behind smoking. 2019 J. Phys.: Conf. Ser. 1294 062069

38. Kanwar A, Sah K, Grover N, Chandra S, Singh RR. Long-term effect of tobacco on resting whole mouth salivary flow rate and pH: An institutional based comparative study. Eur J Gen Dent 2013;2:296-9