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ORIGINAL ARTICLE

Effect of Tobacco on Unstimulated Salivary pH and Flow Rate

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ABSTRACT

Objective: To assess the effect of smoking (tobacco) and chewing (betel quid) on the alteration of salivary pH and flow rate. **Material and Methods:** The sample consisted of 45 participants divided into three groups: G1: Chewers (n=15); G2: Smokers (n=15), and G3 (Control): Healthy individuals (n=15). Unstimulated saliva was collected by the passive drooling method. Salivary pH was measured using a pH meter, and flow rate using a micropipette. One-way ANOVA compared groups; a p-value less than 0.05 was considered statistically significant. **Results:** Statistical significance was observed in the mean salivary flow rate between Chewers (8.0403) *vs.* Controls (11.5) ($p<0.001$) as well as Smokers (7.9333) *vs.* Controls (11.5) ($p<0.001$). Statistical significance was observed in the mean salivary pH between Chewers (6.6133) *vs.* Smokers (6.4067) ($p=0.007$), Chewers (6.6133) *vs.* Controls (7.31) ($p<0.001$) as well as Smokers (6.4067) *vs.* Controls (7.31) ($p<0.001$). **Conclusion:** Salivary pH was more acidic in individuals with smoking than those with chewing habits. Flow rate was less in individuals using tobacco (smoking and smokeless) compared to controls. Long-term consumption of tobacco is one of the risk factors for alterations in salivary pH and flow rate.

Keywords: Behavior and Behavior Mechanisms; Tobacco Smoking; Mastication; Saliva.

Introduction

Saliva is an aqueous, hypotonic body fluid essential for maintaining oral health. Saliva is required for protecting the oral mucosa, teeth remineralization, digestion, taste sensation, pH balance, and phonation [1]. Certain drugs (anticholinergics, diuretics, anti-histamines, antihypertensives, antidepressants, anxiolytics, sedatives, and opiates) and conditions (post-surgery, metabolic, nutritional, neurological abnormalities, and hydration status) are reported to alter salivary parameters [2]. Nicotine in tobacco induces neural activation by acting on specific cholinergic receptors in the brain and other organs, thereby altering salivary parameters [3].

Previous reports have documented that individual variations exist in the salivary flow rate, and 0.3 – 0.5 ml/ min is the average flow rate of unstimulated saliva [4]. The salivary flow rate helps decrease the acids' intensity and thereby reduces teeth' dissolution. Singh et al. [5] stated that approximately 0.5 L of saliva is secreted per day. The pH in the saliva plays an essential role in the life, growth, and multiplication of oral bacteria. The number of acidophilic bacteria is increased when the pH in the saliva is very low, whereas the number of acid-sensitive bacteria is decreased [5]. It is necessary to have a balanced pH since it plays a role in maintaining balance in the demineralization of teeth by acids and initial caries remineralization. This buffering action is done by carbonate and phosphate ions. Altered whole-mouth salivary flow rate (SFR) is important in the pathogenesis of oral and dental diseases. The aim of this study is to assess the effect of tobacco (smoking) and betel quid (chewing) on unstimulated salivary pH and flow rate.

Material and Methods

Ethical Clearance

The institutional ethics committee reviewed and approved the study protocol (RDCH 02/04 /2018), and informed consent was obtained from the study participants before recruiting for the study.

Participants

The study participants (n=45) were divided into three groups:

- Case group 1: Chewers (n=15), Inclusion criteria: Both the genders in the age range of 20 - 60 years, with the habit of betel quid chewing for ≥1 year. Exclusion criteria: Individuals with the habit of smoking, alcohol consumption, pregnant and postmenopausal women with a history of radiotherapy, and those wearing complete dentures.
- Case group 2: Smokers (n=15). Inclusion criteria: Both genders in the age range of 20 - 60 years, with the habit of smoking tobacco for ≥1 year. Exclusion criteria: Individuals with the habit of betel quid chewing, alcohol consumption, pregnant and postmenopausal women with a history of radiotherapy, and those wearing a complete denture.
- Control Group 3: Healthy controls. (n=15). Inclusion criteria: Both genders are in the age range between 20 - 60 years, without habits of smoking tobacco, chewing betel quid, and consuming alcohol. Exclusion criteria: Pregnant and postmenopausal women, individuals with a history of radiotherapy, and those wearing complete dentures.

Saliva Collection and Salivary Measurements

The study participants were asked to be seated on the dental chair. The study participants were asked to be seated on the dental chair. The participants were instructed to refrain from drinking, eating, performing

oral hygiene activities, chewing, or smoking 60 min before the collection of unstimulated saliva. Unstimulated saliva was collected by the passive drooling method. The study participants were instructed to spit saliva in a disposable container at 2–3 times/1 minute intervals for 5 minutes. During saliva collection, they were instructed not to speak or swallow. Salivary pH was measured immediately after collection using a pH meter and flow rate using a micropipette.

Statistical Analysis

All the data was entered in SPSS, version 21 (IBM Corp., Armonk, NY, USA). One-way ANOVA made the comparison between the groups; a p-value less than 0.05 was considered to be statistically significant.

Results

Age distribution among the participants in the 3 study groups is depicted in Figure 1. Regarding the distribution of participants according to gender, 31.1% (n=14) were females and 68.9% (n=31) were males. Regarding the distribution by group, chewers (G1) were equally distributed among males (53.3%) and females (46.7%), nevertheless all the smokers (G2) (100%) were found to be males.

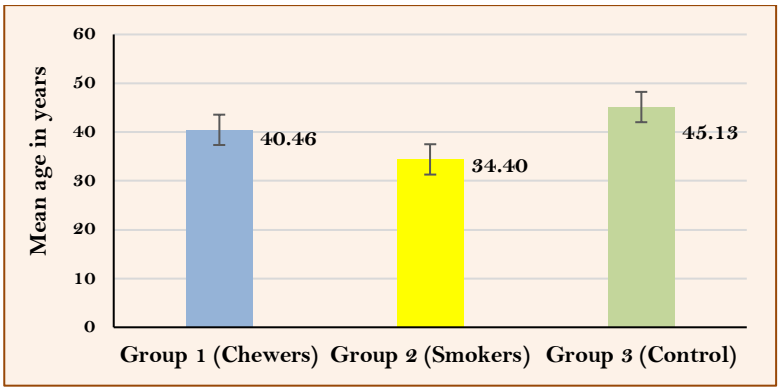

Figure1. Age distribution in study groups.

Table 1 shows each group's mean salivary flow rate of the study participants. A significant difference was observed in the mean salivary flow rate between the groups (p<0.001). A statistical significance was observed in the mean salivary flow rate between Chewers *vs.* Controls (p<0.001) as well as Smokers *vs.* Control (p<0.001). Nevertheless, there was no statistical significance between Chewers *vs.* Smokers (p=0.441) (Table 2).

Table 1. Distribution of groups according to salivary flow rate.

Groups	Mean	SD	p-value
G1 (Chewers)	8.0403	0.91548	<0.001
G2 (Smokers)	7.9333	0.70373	
G3 (Control)	11.5000	1.08012	

Table 2. Comparison of salivary flow rates.

Dependent Variable	Groups Compared	Mean Difference	p-value	95% Confidence Interval	
				Lower Bound	Upper Bound
Flow Rate	Chewers *vs.* Smokers	-0.40000	0.441	-1.1915	0.3915
	Chewers *vs.* Controls	-3.96667	<0.001	-4.8516	-3.0817
	Smokers *vs.* Controls	-3.56667	<0.001	-4.4516	-2.6817

The mean salivary pH in each group is shown in Table 3. The mean salivary pH was significantly different between groups (p<0.001). Statistical significance was observed in the mean salivary pH between Chewers *vs.* Controls (p<0.001) as well as Smokers *vs.* Control (p<0.001). Also, there was a statistically significant difference in the mean salivary pH between Chewers *vs.* Smokers (p=0.007) (Table 4).

Table 3. Distribution of groups according to salivary pH.

Groups	Mean	SD	p-value
G1 (Chewers)	6.6133	0.20656	<0.001
G2 (Smokers)	6.4067	0.17915	
G3 (Control)	7.3100	0.09944	

Table 4. Comparison of salivary pH.

Dependent Variable	Groups Compared	Mean Difference	p-value	95% Confidence Interval	
				Lower Bound	Upper Bound
Salivary pH	Chewers *vs.* Smokers	0.20667	0.007	0.0505	0.3629
	Chewers *vs.* Controls	-0.69667	< 0.001	-0.8713	-0.5220
	Smokers *vs.* Controls	-0.90333	< 0.001	-1.0780	-0.7287

Discussion

Saliva is the first body fluid that is exposed to tobacco (smoking and smokeless form) [3]. Tobacco and tobacco products contain numerous toxic compositions that contribute to structural and functional alterations in human saliva. This study shows that the pH was more acidic in subjects who smoked than those who chewed. Nevertheless, Rooban et al. [6] observed a decrease in the mean salivary pH (acidic) among RAN (Raw form of Areca nut) chewers compared to the processed areca nut chewers and nonchewers. Also, Rad et al. [1] verified a lower salivary pH in smokers than nonsmokers. Nevertheless, Reddy et al. [7] observed no difference in salivary pH between the chewers and nonchewers. According to Kanwar et al. [3], long-term consumption of tobacco in any form, especially smokeless form, is one of the risk factors for reducing salivary pH, and this is mainly due to the reaction of lime with saliva, which alters the bicarbonate levels resulting in a reduction in pH.

The results of our study indicate that the salivary flow rate was lower in Group 1 (Betel quid-chewers) and Group 2 (Tobacco smokers) than in Group C (Control). However, there was no statistically significant difference in the salivary flow rate between the smokers and chewers. The reduction in salivary flow rate in tobacco consumers is because of the resultant action of nicotine on nervous components for taste [3]. Another study reported that salivary flow rates (SFRs) are 0.3 ml/min when unstimulated and rise to 1.5-2.0 ml/min when stimulated, but the flow rate is negligible during the night [5]. The buffering capacity of saliva is an essential factor, which plays a role in the maintenance of salivary pH, and in dental remineralization [8]. An increase in SFR increases the bicarbonate secretion, increasing salivary pH [9].

Salivary pH initially increases with smoking, nevertheless, long-term continuation of tobacco is known to reduce salivary pH. Parvinen et al. [10] reported that salivary pH was lower in smokers than in nonsmokers of both sexes. A few studies conducted to assess the relationship between passive smoking (a passive smoker) and dental caries have documented that smokers are at risk of dental caries caused by cariogenic bacteria, *Streptococcus mutans* and *Lactobacillus* compared to the controls [10,11]. In another study, it was reported that passive smoking can reduce the density of secretive IgA and increase amylase activity and the level of sialic acid in saliva [12].

Several studies have documented the resting salivary pH range of 5.5–7.9. The pH of saliva is maintained by the carbonic acid/bicarbonate system, phosphate system, and protein system. The combined use of lime and areca nut allows adequate interaction between areca nut and the salivary bicarbonate, which alters the buffering capacity due to the loss of bicarbonate, resulting in decreased pH [13].

Rehan et al. [14] conducted a study among a sample size of two hundred and ten population categorized into smokers, chewers, and non-tobacco consumers, and they concluded that the pH of saliva decreased in tobacco consumers. Still, there was no alteration in the resting salivary flow rate. Chakrabarty et al. [15] conducted a study among ninety populations. They categorized them into three groups: chewers, smokers, and controls, and they concluded that both salivary pH and flow rate decreased among tobacco users more than in the control group. Jain et al. [16] evaluated 60 people, including areca nuts, tobacco chewers, and controls aged eighteen to seventy-five years and concluded that reduction in SFR and pH of saliva is an outcome of continuous usage of tobacco products [16]. Similar results were obtained by Shubha et al. [17] among tobacco users, including smokers, chewers, and those with both habits in the age group twenty to fifty years.

The salivary flow was significantly higher in males than females, and the change in salivary flow rate is proportional to the age factor [18]. The decreased salivary flow rate in females could be attributed to hormonal influences. Also, decreased Salivary flow rates have been reported in postmenopausal women [19]. However, loss of estrogens would not be sufficient to account for reduced flow in females as age is considered an important factor in the parotid saliva flow rate [10].

Conclusion

The salivary pH was more acidic in participants with smoking habit than those with chewing habits. Flow rate was less in participants using tobacco (smoking and smokeless) compared to controls. Further studies should be conducted with a larger sample size to correlate salivary pH and salivary flow rates in oral diseases.

Authors' Contributions

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BS	https://orcid.org/0000-0001-8584-2642	Formal Analysis and Writing - Review and Editing.

All authors declare that they contributed to a critical review of intellectual content and approval of the final version to be published.

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Conflict of Interest

The authors declare no conflicts of interest.

Data Availability

The data used to support the findings of this study can be made available upon request to the corresponding author.

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