ABSTRACT:

OBJECTIVE: The aim of this study was to assess the severity of adverse effects of tobacco consumption using the saliva flow rate and pH as diagnostic parameters. In addition, the effects of the chewing tobacco and smoking tobacco have been compared.

METHODOLOGY: A total of 210 patients participated in this study and were divided in three groups; [tobacco chewers, group A; smokers, group B and non-tobacco consumers, group C]. A questionnaire was developed to collect demographic and habitual information of subjects. The salivary flow rate (SFR) was recorded by asking patient to spit in a graduated container at each minute for 5 minutes. Mean SFR was calculated. Salivary pH was assessed with salivary pH strip.

RESULTS: Results showed that there is no effect of tobacco consumption on resting mouth salivary flow rate. But tobacco has significant effect on salivary pH. Lesser pH levels were noted in group A and group B in comparison to Group C. Present study indicates that resting mouth SFR does not get affected by tobacco consumption. Low pH levels were shown in tobacco consumers, especially smokers, which can lead to decreased salivary defence mechanism against various mucosal and dental diseases.

CONCLUSION: It can be concluded that the mean resting mouth SFR does not get affected by consumption of tobacco, however the pH levels certainly decreases with tobacco consumption.

KEYWORDS: Dry mouth, Oral health, Saliva pH, Xerostomia.


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INTRODUCTION

Saliva is a clear mucoserous fluid, secreted by major and minor salivary glands of oral cavity. Appropriate ecological balance of oral health is maintained by salivary functions such as lubrication, protection, buffering action and pH balance, tooth integrity maintenance, taste sensation digestion and antibacterial activity through antimicrobial peptides. The source of saliva, location and anatomy of salivary glands has an impact on salivary flow rate in relation to localised and systemic disease. It is widely used in diagnosis of various oral and systemic conditions as it is easily accessible, reliable and non-invasive diagnostic medium. Salivary contents are supposed to be altered by drugs (anti cholinergic, anti-hypertensive, antihistamines, diuretics and psychoactive substances) and conditions such as post-surgery, metabolic, nutritional, psychological and neurological diseases. Hence, alterations

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in any property of saliva, whether pH or flow rate could be associated with oral and dental diseases, pharyngeal, esophageal, neoplastic changes, autoimmune diseases, inflammatory changes and systemic diseases. \(^1\) The use of tobacco is well-known to affect the oral health. \(^2\) The active ingredient of tobacco is nicotine which stimulates cholinergic receptors in brain and other organs which results in neural activation leading to altered salivary secretion. \(^4\) Widely consumed chewable form of tobacco is the areca nut; approximately 600 million people around the globe use it. It is the 4th most commonly used psychoactive agent. Adverse effects of areca nut includes attrition, staining, caries, periodontal diseases, lichenoid reactions, burning sensation in oral mucosa, oral sub-mucous fibrosis, oral leukoplakia and oral squamous cell carcinoma. \(^5\) Saliva is the first fluid that gets exposed to tobacco whether smoked or smokeless form. \(^6\) The aim of current study was to analyze and compare the long term effect smoked and smokeless tobacco on SFR and pH of saliva. The aim of this study was to assess the severity of adverse effects of tobacco consumption using the saliva flow rate and pH as diagnostic parameters. In addition, the effects of the chewing tobacco and smoking tobacco were also compared.

**METHODOLOGY**

The research protocol was reviewed and approved by the research ethics committee at the College of Dentistry, Baqai Medical University, Karachi, Pakistan. A total of 210 patients attending the outpatient Department of Oral Medicine and Periodontology of Baqai Dental College were recruited for this study. Each patient was explained about the study protocol and an informed consent was obtained to participate in the research. Patients were divided in three groups (70 subjects in each group; Group A; included tobacco chewers, Group B included smokers and Group C included non-consumers of tobacco) and all required data were collected using the questionnaire within three months. The questionnaire was used to collect demographic information, and subjects reported of smoking and chewing habits.

**Inclusion Criteria**

1) Subjects in the age range of 20 to 50 years.
2) Patients who consumed tobacco either in smokeless form or in smoke form.
3) Apparent healthy patients; no systematic disease.

**Exclusion Criteria**

1) Subjects who had history of trauma to head and neck.
2) Subjects who wore dentures.
3) Subjects who had undergone radiotherapy.
4) Subjects who had salivary gland diseases.

**Saliva Collection**

After obtaining the informed consent, saliva of each subject was collected under resting condition using the simple drooling method for 5 minutes. The salivary flow rate expressed in ml/min. Salivary pH was determined using specific pH strips. Saliva was collected between 10 am to 1 pm. Each subject was requested not to eat, drink, perform any oral hygiene, chew or smoke before and during the entire procedure. Saliva was collected in graduated container every 1 min for 5 minutes. During saliva collection subject was instructed not to speak or swallow. After collection, SFR was measured and expressed in ml/min for 5 minutes.

**pH Measurement**

Salivary pH was measured immediately after measuring SFR. PH was assessed in accordance with the colour change on the indicator paper strips (SIMPLEX\(^\text{TM}\)), which gets either lighter or darker in colour when it comes in contact with saliva. Subsequent increase in lightness of shade suggests increase in acidity and increase in darkness suggests increase in basicity.

**Statistical Analysis**

Data was analyzed using IBM SPSS (v 23.0, Statistical Package for Social Service; IBM, USA) computer software. The frequency and percentage was computed for qualitative variables. One-way ANOVA test was applied to compare mean or median of the outcome variable.

**RESULTS**

The current study compared the effects of tobacco on salivary flow rate and its pH. The data were analysed using the frequency and percentage of participants. In group A, 27.1% was the highest frequency noted among the subjects which had 0.20 ml/min mean resting mouth SFR. Where as in the group B, 25.7% was the highest percentage that had 0.30 ml/min mean SFR (Table 1). In group C, 25.7% was the highest frequency which had mean SFR of 0.20 ml/min, while second highest frequency of subjects i.e. 24.3% had 0.5 ml/min SFR. The subjects presented in our study were in the age group from 30-40 years. The mean age (±SD) in the
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Analysis of Resting Mouth Salivary Flow Rate

Table 1. Comparison of various groups for the effects of chewing and smoking tobacco on the salivary flow rate (SFR; as calculated ml/min).

<table>
<thead>
<tr>
<th>Group A (Chewing)</th>
<th>Group B (Smoking)</th>
<th>Group C (Control)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SFR</td>
<td>Numbers (%)</td>
<td>SFR</td>
</tr>
<tr>
<td>0.02</td>
<td>4(5.7)</td>
<td>0.01</td>
</tr>
<tr>
<td>0.03</td>
<td>4(5.7)</td>
<td>0.02</td>
</tr>
<tr>
<td>0.10</td>
<td>13(18.6)</td>
<td>0.10</td>
</tr>
<tr>
<td>0.20</td>
<td>19(27.1)</td>
<td>0.20</td>
</tr>
<tr>
<td>0.30</td>
<td>9(12.9)</td>
<td>0.25</td>
</tr>
<tr>
<td>0.32</td>
<td>8(11.4)</td>
<td>0.30</td>
</tr>
<tr>
<td>0.40</td>
<td>8(11.4)</td>
<td>0.32</td>
</tr>
<tr>
<td>0.50</td>
<td>5(7.1)</td>
<td>0.40</td>
</tr>
<tr>
<td>Total</td>
<td>70(100)</td>
<td></td>
</tr>
</tbody>
</table>

In group A, 27.1% was the highest frequency noted among the subjects which had 0.20 ml/min mean resting mouth SFR. In group A, 75.7% subjects had pH of 6.

Subjects in the group B smoked 14.8±8.30 cigarettes per day (minimum=2, maximum=40 cigarettes). 25.7% was the highest percentage in group B who had 0.30 ml/min mean SFR. In group B, 68.6% subjects had pH of 6 while 8.6% showed pH level of 5 (Table 2).

Subjects who smoked and chewed tobacco per day had the habit of intake for longer periods having the greater risk for developing xerostomia. In group C which was the control group 25.7% was the highest frequency which had mean SFR of 0.20 ml/min, while second highest frequency of subjects i.e. 24.3% had 0.5 ml/min SFR. In group C, 91.4% subjects had pH level of 7, while 8.6% had pH levels of 8 (Table 2).

Table 2. Comparison of various groups for the effects of chewing and smoking tobacco on the pH of saliva.

<table>
<thead>
<tr>
<th>pH</th>
<th>Group A (Chewing)</th>
<th>Group B (Smoking)</th>
<th>Group C (Control)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Numbers (%)</td>
<td>Numbers (%)</td>
<td>Numbers (%)</td>
</tr>
<tr>
<td>5</td>
<td>2(2.3)</td>
<td>6(6.8)</td>
<td>NA</td>
</tr>
<tr>
<td>6</td>
<td>53(60.2)</td>
<td>48(54.5)</td>
<td>NA</td>
</tr>
<tr>
<td>7</td>
<td>15(17.0)</td>
<td>16(18.2)</td>
<td>64(72.7)</td>
</tr>
<tr>
<td>8</td>
<td>NA</td>
<td>NA</td>
<td>6(6.8)</td>
</tr>
<tr>
<td>Total</td>
<td>70(100)</td>
<td>70(100)</td>
<td>70(100)</td>
</tr>
</tbody>
</table>
**DISCUSSION**

Salivary flow is under control of higher salivary centres present within medulla oblongata of CNS and depends on afferent stimulations. Sympathetic as well as Parasympathetic nervous system determines the quality of saliva. Parasympathetic system involves vasodilation of blood vessels within salivary glands and thus increased mobility of liquid within saliva, thus producing serous saliva. In contrast Sympathetic system has an influential role in producing thick concentrated saliva. In absence of any external stimuli, salivary flow rate (SFR) is termed as resting mouth SFR which in normal healthy individuals is found to be 0.3-0.5 ml/minutes. In contrast stimulated salivary flow rate is found to be as high as 10 ml/minutes. Although it has been noted that salivary flow rate even in same individual does not remain constant and can vary when noted at different times which can be due to age, gender, circadian rhythms and other factors. Carbonic acid/bicarbonate system, phosphates system, protein system plays a key role in maintenance of Salivary pH which in numerous studies have been found to be 5.5-7.9 in resting mouth.

Use of tobacco has always been associated with poor oral hygiene, halitosis, local red and white lesions etc. A symptom which remains common with these conditions is Xerostomia. Xerostomia, the subjective sensation of dry mouth, is a frequent complaint and the most common symptom of salivary gland hypo-function (SGH) which reflects an objective, measurable decrease in salivary flow (hypo-salivation). Symptoms of dry mouth may range from mild oral discomfort to significant oral disease that can compromise patients health, dietary intake and quality of life. Signs and symptoms of hypo-salivation includes increased incidence of tooth decay, demineralization, attrition, erosion, plaque accumulation, mucositis, fungal candidiasis and can occur in response to oral, pharyngeal esophageal, neoplastic, metabolic nutritional, inflammatory, genetic, auto-immune and nervous system disorders and require early diagnosis and intervention.

The main ingredient of tobacco is nicotine which itself is Parasympathomimetic and acts on cholinergic receptors and induce Parasympathetic response and thus it has been seen that initially with use of tobacco SFR increase, in short term. Whereas in long term, some studies suggest that SRF remains unaffected. However, there are also studies which suggest that salivary flow reduces with long term consumption of tobacco in any form. Kanwar et al. compared long term effect of tobacco among tobacco chewers, smokers and non-tobacco consumers. They found significant difference with most decreased SFR for smokers, while chewers also had decreased SFR in comparison to non-consumers. Although they did not find any significant difference for pH among these three groups but salivary pH for tobacco consumers was found to be lower in comparison to non-consumers. Rad et al. although did not include tobacco chewers, but with pool of 100 patients in both groups i.e. tobacco smokers and non-smokers they found significant difference with lower SFR values in smokers group. They also found increased occurrence of calculus, gingivitis, periodontitis, mobility, halitosis and cervical caries in smokers then non-smokers.

Rooban et al. conducted their study regarding SFR and pH analysis of patient consuming different types of tobacco in comparison to non-consumers. They found the mean SFR for chewers to be 3.35 ± 1.7 and for non-chewers 3.55 ± 1.39. The difference was not statistically significant (p=0.5). The pH of chewers was 6.57 ± 0.52 and for non-chewers it was 6.77 ± 0.41. The difference for pH was statistically significant. Khan et al. proposed that long term habit of smoking leads to development of tolerance to salivary effects in some individuals, which may be the reason why some studies suggest that long term effects of tobacco consumption remains unclear, they also compared pH values between smokers and non-smokers and found lower pH in smokers. In contrast Reddy et al. found non-significant difference in salivary pH between chewers and non-chewers. There is a profound relationship seen between SFR and pH. With increase in SFR pH increases and vice versa. It is believed that increase in SFR increases bicarbonates in saliva which increases pH. There are multiple factors and complex oral environment that may affect the outcome. Further long term studies are required to analyse their interactions.

**CONCLUSIONS**

Based on calculated frequencies, it can be concluded that, the mean resting mouth SFR does not get affected by consumption of tobacco, but pH levels certainly decreases with tobacco consumption, more by smoked tobacco. The altered levels of salivary pH for tobacco consumers suggest that tobacco usage can impair the salivary defence mechanism and may eventually result in multiple mucosal and dental diseases.

**CONFLICT OF INTEREST**

The authors declare no conflict of interest.
ACKNOWLEDGEMENTS

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AUTHORS’ CONTRIBUTION

FR: gives the main research proposal and intervention to this research.

RSK: contributed in the collection and interpretation of data.

ZK: developed methodology and wrote part of the manuscript.

MSM: wrote discussion and conclusion.

SN: helped in data collection and writing of the manuscript.

MSZ: critically reviewed for intellectual contents, revised the manuscript and correspondence.

REFERENCES


