DonnishJournals

Donnish Journal of Dentistry and Oral Hygiene
Vol. 8(4) pp. 019-024 June 2022.
http://www.donnishjournals.org/djdoh
ISSN: 2984-8806
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Original Research Paper

The Influence of Vape Smoking on the Saliva Flow Rate and Saliva PH Compared to Cigarette Smokers and Non-Smokers: A Cross-Sectional Study

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Accepted 30th May, 2022.

Introduction: In recent years, a new type of smoking has emerged known as (electronic smoking), and under this new type, there are types such as (electronic hookah or electronic cigarette). This new type of smoking has attracted the attention of many as a solution or a temporary alternative to reduce the use of tobacco cigarettes. Materials and methods: A cross-sectional study population consisted of the conventional sample from REU students, staff, and patients. The research was divided into three groups: non-smokers as a controlled group, e-cigarettes users, and traditional cigarette smokers. The target sample comprised of male and female adults ≤ 18 years and free of systemic diseases. Results: The normal pH range is extending from 5.3 to 7.8, all participants showed a PH within the normal limit. The mean and standard of deviation for the study groups are; nonsmokers (6.45±0.32), Cigarette smokers (6.07±0.41), and vape (6.27±0.48). ANOVA test showed that the difference is statistically insignificant. Conclusion: From the present study, it can be concluded that the SFR in both smoker groups was lower than that in non-smokers which the conventional cigarette smokers group has the lowest rate. Salivary pH was not significantly different in all groups..

Keywords: Electronic cigarettes, Vape, Saliva flow rate, and Saliva PH.

INTRODUCTION

In recent years, a new type of smoking has emerged known as (electronic smoking), and under this new type, there are types such as (electronic hookah or electronic cigarette). This new type of smoking has attracted the attention of many as a solution or a temporary alternative to reduce the use of tobacco cigarettes (Siegel, M et al.,2011). This electronic cigarette is made of tubes filled with liquid chemicals that have and generally comprised of high nicotine content, flavor ingredients in propylene glycol, and vegetable glycine; it mimics the same amount of nicotine, almost the same as in a traditional cigarette, and permanent use of electronic hookah is addictive (Eaton, D.L., 2018).

In the past, the harmful effects of nicotine in conventional cigarettes have been identified, leading to heart disease, stroke, lung diseases, diabetes, and chronic obstructive pulmonary disease (COPD), which includes emphysema and chronic bronchitis. Smoking also increases the risk for tuberculosis, certain eye diseases, and the immune system's problems, including rheumatoid arthritis, poor oral and dental health accelerated gingivitis, and periodontal disease may also affect the salivary flow rate (SFR) and pH of the Saliva (Glantz and Bareham, 2018).

Saliva is known as a complex clear liquid that helps balance and promote oral and dental health. Saliva is excreted in the mouth by three major salivary glands, which are the parotid gland, sublingual gland, and submandibular gland. Also, from the minor glands. Saliva also plays an important role in the oral cavity and its protection from microorganisms from viruses, bacteria, and fungi, remineralization of teeth, digestion, and pH balance. Saliva pH and saliva rate are important factors in the growth and reproduction of bacteria in the mouth. Saliva plays an important role in the oral cavity and is protected from microorganisms from viruses, bacteria, fungi, remineralization of teeth, digestion, and pH balance (M, S, F, and N, 2021).

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The composition of unstimulated Saliva differs from the stimulated one, which resembles plasma in composition. Although there is great individual variability, a normal salivary flow rate for unstimulated Saliva is above 0.1 mL/min. In contrast, under-stimulation, the flow rate may increase up to about 4 mL/min. Unstimulated whole Saliva (UWS) is the mixture of secretions that enters the mouth in the absence of exogenous stimuli and depends on the oral cavity's daily basal salivary flow rate (Kobus et al., 2017). The sampling of unstimulated Saliva is often preferred because it minimizes standardized analyses' dilution (Bellagambi et al., 2020).

The normal pH range is between 6 and 7 for unstimulated Saliva, extending from 5.3 to 7.8 when the flow rate changes. In stimulated Saliva, the pH increases since the concentration of bicarbonate ions in the Saliva are higher, i.e., from 2.4 ± 1.5 mM to 15 ± 7 mM.

AIMS OF THE STUDY

The research aims to assess and measure the effect of smoking (conventional or vape) on the salivary flow rate (SFR) and salivary pH among three different groups: e-cigarette smokers, non-smokers, and traditional (regular) smokers.

Hypothesis

Conventional cigarette and vape smoking will reduce the salivary rate and reduce the saliva PH compared to non-smoking people.

Null Hypothesis

Conventional cigarette and vape smoking will not reduce the salivary rate and reduce the saliva PH compared to non-smoking people.

MATERIALS AND METHODS

Population Sample

A cross-sectional study population consisted of the conventional sample from REU students, staff, and patients. The research was divided into three groups: non-smokers as a controlled group, e-cigarettes users, and traditional cigarette smokers. The target sample comprised of male and female adults ≤ 18 years and free of systemic diseases.

Questioner

A questionnaire that consists of basic information about the participant including age, sex, addiction level, and type of nicotine, was used before taking saliva sampling. Fagerstrom Test for nicotine dependence (FTND): The test was designed to provide an ordinal measure of nicotine dependence related to cigarette smoking (Fagerstorm, 2011) (Appendix 1). It contains six items that evaluate the quantity of cigarette consumption, the compulsion to use, and dependence. The World Health Organization also develops modified FTND to measure the addiction level with e-cigarette smoking (Appendix 2).

Salivary Flow Rate and Saliva Sample Collection

Unstimulated whole saliva sampling collection methods (passive collection into a sterile container), the head is tilted forward, collecting saliva at the front of the mouth, and then spat into a sterile container (Khan, Jameel, Razak, and Bakri, 2018). Then the pH will be tested by using pH test strips.

Saliva Collection Method

Unstimulated whole saliva samples were collected in the morning and afternoon sessions, in a ventilated and well-illuminated room, 2 hours after eating, drinking, or brushing the teethcollection of the samples with their eyes open, without stimulating salivation, remaining comfortably seated, with their arms resting on their knees, and ask the patients to refrain from talking and drop their heads lowered and facing slightly forwards, between their arms and let the saliva run naturally to the front of the mouth. (Baliga, Muglikar and Kale, 2013).the patients were asked not to cough up mucus as saliva is collected. Before collection, the participants were asked to rinse their mouth with water (bottled) out well (without drinking water). 5 min after this oral rinse, the subject was asked to swallow or spit out the first saliva accumulation. Then they were instructed to allow new saliva to accumulate in the mouth, and to expectorate it into a sterile collection tube (figure1) about once a minute for up to 5 min.

Figure 1

Salivary Flow Rate Measurement

Graduated syringes - After the total saliva collected was aspirated from the collection receptacle with a disposable 5 mL sterile syringe(figure2)avoiding contact with the saliva foam. Only the liquid component of the saliva was measured. (Alves, Brandão, Andion and Menezes, 2010).

Figure 2

- Flow rate= $\frac{\text{volume (milli litres) of saliva}}{\text{minute}}$

The weight was divided by the time of duration of the collection (5 min) and the flow rate was calculated in g/min, which is equivalent to mL/min since over 99% of the saliva is composed of water. The whole unstimulated saliva flow rate is approximately 0.3-0.4 ml/min. The flow rate for normal, unstimulated saliva is 0.25 to 0.4 ml/minute. A resting flow rate between 0.1 and 0.25 ml/min is considered low and less than 0.1 is considered very low.

Known Values for Flow Rates for Whole Saliva *		
Salivary Flow Rates (ml/min)		
	Normal	Low
Unstimulated (resting) Whole Saliva	0.3 - 0.4 ml/min	≤ 0.1 ml/min
Stimulated Whole Saliva	1 - 2 ml/min	≤ 0.7 ml/min

* Whole saliva is the total output from the major salivary glands; no general agreement about what constitutes a 'normal' salivary flow rate

Saliva pH Measured

The pH of the saliva was immediately measured to prevent any deterioration of the sample. Saliva has a pH normal range of 6.2-7.6 with 6.7 being the average pH

1. Test the pH by dipping the strip into a saliva collection tube. Non-bubble saliva works best.
2. Make sure both pads on the test strip are sufficiently covered in liquid, remove and then wait 15 seconds (or the time indicated on the pack instructions).
3. Match the color reading against the indicator chart *(figure 3*).

Figure 3

Statistical Analysis

Data were analyzed using excel computer software. The student's unpaired *t*-test was applied to assess between-group differences. $P \leq 0.05$ was considered statistically significant.

RESULTS

A total of thirty-six subjects participated in the research (16 males, 19 females). Ages ranged between 18 -34 years old. None of the female participants were pregnant or using contraceptive pills. Three patients who had esophagus reflux were included in the study because of a limited number of participants. The distribution of samples among the study group is (12 patients' nonsmokers, 9 Cigarette smokers, 13 vape smokers, and one smokes both Cigarette and vape)

The salivary flow rate in different study groups

According to Kobus et al., 2017, the normal unstimulated salivary flow should be above 0.1 mL/min. All participants showed a salivary flow rate within the normal limit. The mean and standard of deviation for the study groups are; nonsmokers (2.5±1.7), Cigarette smokers (0.2±0.1), and vape (2.1±1.6). Subjects that are smoking Cigarettes have a lower saliva flow rate followed by vape and lastly nonsmokers. ANOVA test shows a p-value ≤0.05 which indicate that Cigarette smoker is has a statistically significant difference between the other groups.

PH value in different study groups

The normal pH range is extending from 5.3 to 7.8, all participants showed a PH within the normal limit. The mean and standard of deviation for the study groups are; nonsmokers (6.45±0.32), Cigarette smokers (6.07±0.41), and vape (6.27±0.48). ANOVA test showed that the difference is statistically insignificant.

Limitation, and Future Recommendation

The initial data shows that vape smoking will not affect the salivary flow or saliva ph. However, the sample size was not enough for the final conclusion. In addition to that, the majority of the participant was from low addiction level. Expansion of the study will allow including more participants and comparing the effect of the level of addiction to the saliva rate and saliva flow.

DISCUSSION

Salivary secretion is a complex process, and its flow and composition vary greatly under different conditions. Resting the whole saliva is the mixture of secretions, which enter the mouth in the absence of exogenous stimuli (Gopinath and John, 2015). The study of unstimulated salivary secretion is an accurate method to analyze salivary gland status while stimulated saliva is useful for the study of the functional reserve. (Fenoll-Palomares et al., 2004).There is clinical and epidemiological evidence regarding the adverse effect of smoking on oral health. Nicotine use has been associated with gingival, oral mucosa, and dental alterations.

The purpose of this study was to measure and assess the long-term effect of smoking on the salivary flow rate (SFR) and salivary pH among 3 different groups: e-cigarette smokers, and conventional cigarette smokers. The study results showed that the mean unstimulated salivary flow rate in both smoker groups was lower than that in non-smokers while the conventional cigarette smokers group has the lowest rate than e-cigarette smokers.

In this study, the mean SFR was 0.20 ± 0.1 ml/min in conventional cigarette smokers, 2.1 ± 1.6 ml/min in vape and 2.5 ± 1.7 ml/min in nonsmokers, which was following the study conducted by (M, S, F and N, 2021) in which the mean SFR was lower in smokers that is, 0.38 ml/min ± 0.13 as compared to nonsmokers that are, 0.56 ml/ min ± 0.16 ml/min, with a significant statistical difference (p=0.0001).

Table 1: Participant distribution among different groups

#	Age	Gender	Level of addiction	PH	Saliva Flow
	Non-Smoker				
1	25 to 34	Female	NA	6.7	3.7
2	18 to 24	Female	NA	6.7	4
3	25 to 34	Male	NA	6.7	4
4	55 to 64	Male	NA	6.6	3.8
5	45 to 54	Female	NA	6.6	3.8
6	18 to 24	Female	NA	6.6	4
7	18 to 24	Female	NA	6.7	4
8	25 to 34	Female	NA	6.2	0.18
9	18 to 24	Female	NA	5.8	0.3
10	35 to 44	Male	NA	6.4	0.4
11	18 to 24	Female	NA	6.6	0.3
12	18 to 24	Male	NA	5.8	1.8
Mean				6.45	2.523333
Standard Deviation				0.322749	1.677694
	Cigarette Smoker				
1	45 to 54	Male	L	5.5	0.1
2	45 to 54	Male	L	5.5	0.36
3	35 to 44	Female	L	5.5	0.5
4	25 to 34	Male	M	6.2	0.18
5	35 to 44	Female	M	6.4	0.19
6	45 to 54	Male	M	6.4	0.15
7	45 to 54	Male	H	6.4	0.14
8	25 to 34	Male	H	6.4	0.13
9	25 to 34	Male	H	6.4	0.14
Mean				6.077778	0.21
Standard Deviation				0.413058	0.124633
	Vape Smoker				
1	18 to 24	Female	L	6.6	3.5
2	35 to 44	Male	L	6.6	3.6
3	55 to 64	Female	L	6.5	3.7
4	25 to 34	Female	L	6.6	3.8
5	25 to 34	Male	L	6.6	3.7
6	25 to 34	Female	L	6.5	3
7	25 to 34	Female	L	6.2	0.36
8	25 to 34	Female	L	6.2	0.12
9	18 to 24	Female	L	6.6	0.3
10	18 to 24	Female	L	5.6	3.3
11	35 to 44	Male	M	5	0.26
12	25 to 34	Female	M	6.2	0.13
13	25 to 34	Male	H	6.4	1.5
Mean				6.276923	2.097692

Standard Deviation				0.478111	1.640235
	Both Cigarette/ Vape Smoker				
1	25 to 34	Male	H	5.5	2

Similarly, in the study conducted by (Singh et al., 2015) the mean SFR was 0.20 ± 0.05 ml/min in smokers and 0.36 ± 0.06 ml/min in nonsmokers.

Salivary pH was not significantly different in all groups. The range of pH was between 5.5-6.7 with a mostly normal range. The present study revealed that the mean salivary pH was 6.07 ± 0.41 in cigarettes smokers, 6.27 ± 0.84 in e-cigarettes, and 6.45 ± 0.32 in nonsmokers which are following the study conducted by Fenoll-Palomares et al. in which the mean salivary pH was lower in smokers than is, 6.7 ± 0.27 as compared to nonsmokers that are 6.8 ± 0.29. Nostatistical difference was seen. Similarly, Rooban et al .also observed a lower salivary pH in smokers that is, 6.48 ± 0.36 in comparison to 6.59 ± 0.56 in nonsmokers. The difference was statistically significant (P = 0.03).

As a result of hot smoke that was produced by conventional cigarettes may disperse to all parts of the oral cavity and suppress the saliva reflex, leading to a change in salivary flow rate. Furthermore, e-cigarettes don't produce smoke. Instead, e-cigarettes use an aerosol or vapor. The aerosol produced by e-cigarettes is often mistaken for harmless water vapor. Hence the myth that vaping isn't harmful to the teeth and body. But this vapor contains not only nicotine, which is harmful to the oral health and body on its ownbut also contains fewer toxic chemicals than the deadly mix of 7,000 chemicals in smoke from regular cigarettes. However, e-cigarette aerosol is not harmless. It can contain harmful and potentially harmful substances, including nicotine, heavy metals like lead, volatile organic compounds, and cancer-causing agents. Many of these chemicals are linked to cancer, respiratory disease, and heart disease (About Electronic Cigarettes (E-cigarettes), 2021). nicotine that is presented in both cigarette and vape may also cause morphological and functional abnormalities of the salivary glands that reduce the salivary flow rate.

CONCLUSION

From the present study, it can be concluded that the SFR in both smoker groups was lower than that in non-smokers which the conventional cigarette smokers group has the lowest rate. Salivary pH was not significantly different in all groups.

The result from this study suggested that smoking either conventional or electrical cigarettes are affecting oral health, e-cigarettes are less harmful than regular cigarettes and smoke but that doesn't mean e-cigarettes are a safe alternative smoking method. vaping still poses health risks similar to smoking tobacco. This includes risks to your body, teeth, and mouth. no better than stop smoking

LIMITATION AND FUTURE RECOMMENDATIONS

The initial data shows that vape smoking will not affect the salivary flow or saliva ph. However, the sample size was not enough for a conclusion. In addition to that, the majority of the participant was from low addiction level. Expansion of the study will allow including more participants and comparing the effect of the level of addiction to the saliva rate and saliva flow.

CONFLICT OF INTEREST

There is no conflict of interest among the authors.

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