



# The Difference Between Salivary Viscosity and Salivary Flow Rate on Nicotine Electric Smokers and Non-Smokers

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## KEY WORDS

Saliva; Viscosity;  
Smokers; Electric  
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## ABSTRACT

**Background:** Electric cigarette which contained nicotine affected bad impact to oral cavity, since the nicotine contained on e-liquid electric cigarette could reduce function of salivary gland. This condition decreases the salivary flow rate and increase salivary viscosity. could impact to less activity of self-cleansing and antimicrobial of saliva. **Objectives:** To prove the difference of salivary viscosity and salivary flow rate on nicotine electric smokers and non-smokers. **Methods:** This research was an analytic descriptive research which exerted cross sectional research design. As many as 60 people were selected to be the research subjects who were then divided into 30 electric smokers and 30 non-smokers. The saliva on each subject was collected in a beaker cup stimulated for 8 minutes and continued to the viscosity measurement to be valued both visually and subjectively. The data was analyzed through Mann-Whitney test to identify the difference between viscosity and salivary flow rate on nicotine electric smokers and non-smokers. **Results:** The result of Mann-Whitney test showed a significant difference between salivary flow rate where  $p = 0,000$  ( $p < 0,05$ ) and salivary viscosity of nicotine electric smokers and non-smokers  $p = 0,039$  ( $p < 0,05$ ). **Conclusion:** This research indicated the difference of viscosity and salivary flow rate between electric smokers and non-smokers. The electric smokers have thicker viscosity and lower flow rate compared to the non-smokers.

## 1. INTRODUCTION

Smoking is casual factor of health problems in Indonesia. According to the data from World Health Organization (WHO) Report on the Global Tobacco Epidemic in 2017, it has been stated that the daily smoking behavior in Indonesia on man 62% and on woman 1,7%. [1] According to the data from Riset Kesehatan Dasar (RISKESDAS) in 2018, the smoking behavior in society of 15 years old and above 62,9% on man and 4,8% on woman. [2] The consumption of tobacco cigarette affects to the health, because it is the main cause of premature infant death, cancer, lung disease, and heart disease. Thus, it requires a contemporary strategy to support hampering and stopping the consumption of tobacco cigarette, which starts from the basic medical advice, until pharmacotherapy and counseling. However, the consumer number of tobacco cigarette is still many, then, it raises to the new approach, electric cigarette. [3] The electric cigarette or vaporizer is a new phenomenon which develops rapidly and grabs the interest of tobacco smokers. [4] This electric cigarette is attractive because it tends to be safer, less addictive substance, and contains flavoring as candy and fruits. [5] Therefore, this electric cigarette is considered as an effective way to reduce frequency of tobacco cigarette consumers. [6] The electric cigarette works through energy and battery use in order to heat up the liquid and turn it to vapor, which is inhaled by the consumers to the mouth and lungs. The solvent or liquid which has been heated, it contains propylene glycol (PG), vegetable glycerin (VG), nicotine, and flavoring. [7,8] The electric cigarette is said to be safer than the tobacco cigarette, but according to Food and Drug Administration (FDA), the electric cigarette is still in dilemma as the nicotine conductor, which has been approved to danger the human health. [4,9,10,11]

Based on the research in 2018 by Junior, et al, in the community of Manado, it has been found the result that the vapor from electric cigarette to the oral cavity leads to the damage on soft tissues, because the vapor from electric cigarette does not leave stain or plaque on the teeth surface. [12] Besides, the previous research by Stanwick in 2015 in Canada, the clinical test has been conducted on 40 electric smokers to the impact of their health status and according to this research finding, the electric smokers often suffer irritation of dried cough, xerostomia, and throat irritation. [3,8]

The electric cigarette can also cause to the decrease of salivary flow rate and increase of salivary viscosity. The nicotine is a substance which is absorbed by the mucosa of oral cavity, and then channeled through bloodstream, and distributed to the

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brain and all body organs. The spread nicotine on blood vessel can affect blood vascularization to the salivary gland, then turns the decrease of function on salivary gland, the parotid gland results to serous saliva and submandibular gland as well as sublingual gland which result mucous saliva to be hampered. This condition causes the high salivary viscosity.[13,14] The saliva plays a significant role to the raise of oral disease, hence, the saliva is used as the important factor to measure the oral health.[15] The lack of salivary flow can influence the life quality of individual, since it can cause to difficulty in speaking, eating, swallowing, and also xerostomia. Xerostomia is a kind of symptom which indicates dryness in the oral cavity which is affected by hypofunction of salivary gland.[16] Moreover, the factor of salivary viscosity can affect the health of oral cavity, because the higher salivary viscosity would decrease the salivary flow rate.[17]

Several research have been conducted to identify the effects which resulted from tobacco cigarette to the health status of oral cavity by examining from viscosity and salivary flow rate aspects. Some alternatives have been developed in the context of tobacco conductor, the electric cigarette raises to the new question from the aspect of health, especially the health of oral cavity. Based on this fact, research which examines the difference between salivary viscosity and salivary flow rate on nicotine electric smokers and non-smokers is essential.

## 2. METHODOLOGY

This research was categorized into an analytic descriptive research which exerted cross sectional research design. This research was conducted in Tembalang and Banyumanik Sub-district, Semarang. The total of research subjects were 60 respondents, which were then divided into 30 electric smokers and 30 non-smokers who were willing to give their saliva sample. The inclusion criteria from this research were man in age range 18-35 years old, electric smoker in minimum of 6 months and minimum consumption of 60 ml e-liquid with the nicotine level 3 mg per month, never smoked tobacco cigarette. The inclusion criteria for the control group were the individual who had never smoked. Whilst the exclusion criteria from this research were fasting during saliva sampling, unstable emotional condition (stress or depression), active tobacco smoker, have a record of systemic disease which obstructed the function of salivary gland (Diabetes mellitus, Hypertension), medicine consumption (antidepressant, anxiolytic, antihistamine, and anti-hypertension), and record of radiation therapy.

Before this research was started, the researchers explained to the research subjects about the research procedure and filling the informed consent. The subjects were suggested to gargle for several times in aquadest and be relaxed for 5 minutes, the subjects were asked to chew wax gum for 3 minutes and not to swallow the saliva, after those three minutes, the saliva that has been collected within oral cavity was spitted out into beaker glass, and then they were asked to chew the wax gum and saliva was spitted out for every 1 minutes during 5 minutes length of time, then, the total was along 8 minutes and continued to the calculation of saliva amount.

The saliva that has been collected was then used to calculate the salivary viscosity. The viscosity was measured its consistency through visual inspection. The criteria of good salivary viscosity were watery, clear, un-foamed, and when the cup was tilted, the saliva was immediately flowed. The criteria of moderate or normal viscosity were white saliva, foamed, and slowly flowed. Last, the criteria of bad salivary viscosity were white saliva, sticky, foamed, and flowed for a long time. The saliva was categorized into 3 types of research subject, which aimed to result un-subjectively, and after the categorization, the saliva result was recorded.

The data of research was analyzed through computer software SPSS 25<sup>th</sup> version. The Mann-Whitney test was employed to see the difference between salivary flow rate and salivary viscosity on the electric smokers and non-smokers. The ethical clearance of this research was acquired from Ethical Commission of Health Research of Medical Science Faculty of Diponegoro University Semarang in registration number 426/EC/KEPK/FK UNDIP/X/2019.

## 3. RESULTS

Based on the statistic result in this research, it showed the mean value of salivary flow rate on electric smokers group  $0,97 \pm 0,64$  ml/minute, while on non-smokers group  $1,80 \pm 0,68$  ml/minute. The mean value of salivary flow rate on electric smokers was lower than the mean value of salivary flow rate on non-smokers. It required to the abnormal data distribution on electric smokers and non-smokers by exerting Shapiro-Wilk ( $p > 0,05$ ). The result of Mann-Whitney test between electric smokers and non-smokers group was presented in table 1.

Group	N	Median (min-max) (ml/mnt)	P Value*
Electric Smokers	30	0,78(0,4 – 2,5)	0,000
Non-Smokers	30	1,73(0,9 – 3,4)	

Table 1. The Difference of Salivary Flow Rate on Electric Smokers and Non-Smokers  
Mann-Whitney Test (it was significant if p value < 0,05)

The result of Mann-Whitney test referred that that p value < 0.05, therefore, it was asserted a significant difference between electric smokers group and non- smokers group. The Mann-Whitney test was also used to identify the significant difference of salivary viscosity between electric smokers group and non-smokers group which was presented in table 2. Based on the result of Mann-Whitney test, it indicated p value = 0,039 which referred a significant difference of salivary viscosity on the electric smokers and non-smokers.

Group	N	Percentage	P Value*
<b>Electric Smokers</b>			0,039
Watery/Liquid	9	30 %	
Normal	6	20 %	
Thick	15	50 %	
<b>Non-Smokers</b>			
Watery/Liquid	5	16,7 %	
Normal	25	83,3 %	
Thick	0	0 %	
<b>Total</b>	60		

Table 2. The Difference of Salivary Viscosity on Electric Smokers and Non-Smokers  
Mann-Whitney Test (it was significant if p value < 0,05)

#### 4. DISCUSSION

Based on the research finding, it was referred that the salivary flow rate on electric smokers have lower mean value than the non-smokers. The similar research finding has been proposed by Mala Singh, et al. in 2015 in India within the total sample of 70 research subjects (35 smokers and 35 non-smokers), this research has shown that the average of salivary flow rate on smokers  $0,20 \pm 0,05$  ml/minute and  $0,36 \pm 0,06$  ml/minute on non-smokers, this result was also similar to the research done by Rad, et al. where the mean value of salivary flow rate was lower on the smokers group  $0,38 \pm 0,13$  ml/minute if it was compared to the non-smokers  $0,56 \pm 0,16$  ml/minute.[18,19] This result showed that if the nicotine substance was used or consumed for a long time, it could affect to the decrease of salivary flow rate. The vapor would transmit the nicotine to spread out to all parts of oral cavity, thus, the taste receptor, the main site of receptor for the saliva secretion would be always exposed and affected to the salivary gland activity.[18] The substances on e-liquid electric cigarette as propylene glycol and vegetable glycerin were the substances which functioned as humectant.[20] Chemically, all kinds of humectant have acidity as hydroxyl category which enabled that substance to tie water or hygroscopic. The general symptoms that have been complained by the electric smokers were dried mouth and throat, which was initially from the water absorbability that resulted from propylene glycol and vegetable glycerin in form of humectant.[21] The effects of nicotine were also able to affect obstruction of vascularization to salivary gland, then, the parotid gland would result liquid or watery saliva, and submandibular and sublingual gland would result mucous saliva, which were hampered at all. This condition caused to lower salivary flow rate.[14]

Based on the research finding regarding to the salivary viscosity, it found a significant difference between electric smokers group and non-smokers group. This research finding was in line with the research done by Nikolina Petrušić, et al. in 2015, this research has involved 60 research subjects who were divided into two groups: 30 smokers in subject group and 30 non-smokers in control group. This research also showed that the smokers group have greater subject number with thicker salivary consistency, if it was compared to the non-smokers with thinner and liquid salivary consistency.[14] This condition was because the nicotine could obstruct the blood vascularization to salivary gland. The obstruction on salivary gland especially on acinar and mioepitel cell would cause to the swelling on acinar cells, moreover, it also caused to the increased number of intraacinar secretory granules. Most of this granules were immature and only consisted of high concentration of glycoprotein which would be drastically decreased. The expose from chronic nicotine on salivary gland would affect to exhaustion on acinar

cells of salivary gland, then the production of saliva was decreased as well. This impact was a causal factor of high salivary viscosity.[14,22]

## 5. CONCLUSION

Based on the research finding, the researchers concluded a significant difference between salivary viscosity on electric smokers and non-smokers, which specifically the electric smokers have thicker salivary viscosity than the non-smokers, also a significant difference between salivary flow rate on electric smokers and non-smokers, where the electric smokers have lower salivary flow rate than the non-smokers.

### Conflict of Interest

The authors declare no conflicts of interest in this study.

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### Authors Contribution

Conceptualization: SAD, DR, IAK; Methodology: SAD, DR, IAK; Formal Analysis: SAD, DR, IAK; Funding Acquisition: SAD, DR, IAK; Data Curation: SAD, DR, IAK; Original Draft Writing: SAD; Supervision and Editing: DPD; Administration: SAD, DR, IAK, DPD.

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