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Original Research Article

Comparative study of salivary flow time, consistency, and amount of saliva in patients with varicella zoster infection

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Abstract: Background: Saliva is a complex mixture of fluids that surrounds the oral tissues. It originates from major and minor salivary glands, in addition to nonglandular sources such as host cells, oral bacteria, and gingival crevicular fluid. Herpes zoster, commonly known as shingles, is a viral disease caused by the reactivation of the varicella-zoster virus. Varicella (chickenpox) typically affects children, whereas herpes zoster is more common in adults and the elderly. Objective: To evaluate the relationship between salivary flow time, salivary amount, and saliva consistency among patients infected with the varicella-zoster virus. Methods: A cross-sectional study was conducted on 40 patients diagnosed with varicella-zoster infection. Salivary parameters—including salivary amount collected by spitting for 5 minutes, salivary consistency (classified as watery, medium, or thick), gender, and smoking status—were assessed to determine possible associations among these variables. Results: The distribution of salivary amount between smokers and non-smokers was similar, with no significant difference in median saliva volume. No clear trend was observed between age and salivary amount. Additionally, both smokers and non-smokers demonstrated comparable ranges of saliva secretion across different age groups. Male and female participants also showed no distinct variations in salivary amount or distribution. Conclusion: Salivary amount, flow time, and consistency showed no significant association with age, gender, or smoking status among patients with varicella-zoster infection. These findings suggest that varicella-zoster infection does not markedly influence basic salivary characteristics.

Keywords: Varicella zoster virus, crevicular fluids, saliva.

INTRODUCTION

Herpes zoster is commonly known as shingles. It is a viral disease caused by reactivation of varicella-zoster virus which remains dormant in the sensory ganglia of the cranial nerve or the dorsal root ganglia after a previous varicella infection. Varicella is commonly known as chickenpox; it occurs in children while herpes zoster occurs in adults or the elderly[1].

It is believed that zoster occurs due to the failure of the immune defense system to control the latent replication of the virus. The incidence of herpes zoster is strongly correlated to the immune status. Individuals who maintain a high level of immunity rarely develop shingles. The infection is not benign and can present in many ways. Even after herpes zoster resolves, many patients continue to suffer from moderate to severe pain known as postherpetic neuralgia. Upon reactivation, the virus replicates in neuronal cell bodies, and virions shed from the cells which are carried down the nerve to the area of skin innervated by that ganglion. In the skin, the virus causes local inflammation and blistering[2].

Saliva is a vital biological fluid produced by the salivary glands in the mouth. Composed primarily of water, it also contains electrolytes, enzymes, mucus, and antimicrobial agents. Saliva plays a crucial role in various physiological processes, including digestion, oral health, and taste sensation.[3].

Saliva has emerged as a promising diagnostic medium due to its ease of collection, non-invasiveness, and the presence of various analytes that can reflect the systemic and local changes associated with diseases. Several studies have investigated the detection of viral

pathogens in saliva, including herpes simplex virus (HSV) and human immunodeficiency virus (HIV). However, limited research has been conducted on the detection of varicella -zoster virus in saliva and its potential role in the diagnosis and management of herpes zoster[4].

Despite the potential advantages of using saliva as a diagnostic medium for herpes zoster, several challenges need to be addressed. One of the major challenges is the development of sensitive and specific detection methods that can accurately identify VZV in saliva samples[5].

MATERIALS AND METHOD

Study protocol: The experiment done in private clinic at Diyala province- khalis and from 1st January 2023 and end all parts of the work at 1st septamber 2024.

Ethical considerations: This study was approved by the Ethics Committee of College of Medicine, University of Diyala. Study population &Study design: The crows sectional study use 40 patient, the average of age ranged from 18 to 60 years old, all samples are infected with zoster virus. The sample consist from 25 male and 15 female. This sample separated according to smoking patient (represented by 28 non-smoking patient and 12 smoking patient) and make the patient spitting in disposable sterilized container during 5 minute and determine the time of salivary follow and the type of salivary consistency (watery, medium and thick saliva).

Statistical analysis**:** Data analysis from clinical investigated studies was conducted in the current study using the computer statistical program SPSS (statistical package of social science software, version 23). the statistical analysis was used:

1.Descriptive Data Analysis includes: Summary Mean, Standard Deviation and minimum value and maximum value for the numerical variables (age, amount of saliva) and distribution of categorical variables (gender, smoking, saliva consistency).

2. Inferential Data Analysis -correlation among variance. Analyze differences between smokers and non-smokers in terms of saliva amount and salivary consistancy. Compare differences based on gender.

RESULTS

The dataset from the document consists of variables such as gender, smoking habits, age, the amount of saliva in same spitting time, and saliva consistency for 40 participants. To perform statistical analysis. The age distribution indicates that the majority of individuals in the dataset are between 40 and 60 years old, fig 1.

The age distribution of the study population indicates a clear predominance of middle-aged adults. Individuals aged 18–30 years constituted only 5% of the sample, representing the smallest and youngest cohort. Participants aged 30–40 years accounted for 27.5%, forming a substantial segment typically associated with early to mid-career stages. The 40–50-year and 50–60-year age groups each represented 30% of the population, making them the largest cohorts and reflecting a concentration of individuals in mid-to-late adulthood, a period often characterized by physiological stability and cumulative exposure to environmental and lifestyle factors of clinical relevance. In contrast, participants aged 60–100 years comprised 7.5% of the sample, representing the oldest group with potentially distinct health profiles and age-related biological variations.

Figure (1) also shows the amount of saliva. and the result was, the volume distribution revealed no representation in the 0–10 ml and 11–20 ml ranges, as indicated by the absence of bars in the chart. In contrast, the 21–30 ml range constituted 37.77% of the total, while the 31–40 ml range represented the largest proportion at 55.67%. The 41–50 ml range showed a minimal contribution of 6.57%, reflecting its relatively low occurrence within the dataset.

The graph in Figure 1 clearly shows that the majority of saliva measurements fall within the 21–40 mL range, with a peak in the 31–40 mL range.

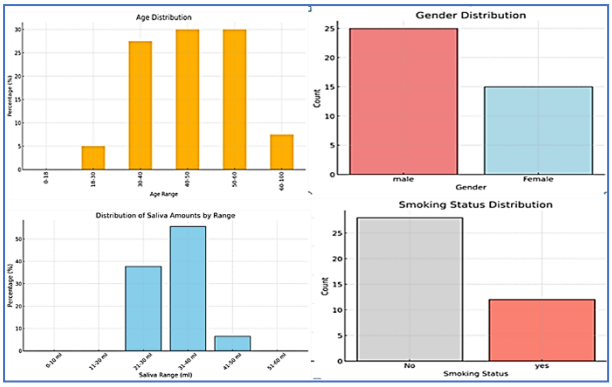

Figure 1. distribution of individuals according to age, gender, saliva amount, smoking state.

Table 1 details the saliva volumes grouped by range, with the corresponding percentages illustrating their distribution relative to the total aggregated data.

Table 1. saliva amounts grouped by ranges

Range	Amount of Saliva in ml	Percentage (%)
0-10 ml	0	0.00
11-20 ml	0	0.00
21-30 ml	460	37.77
31-40 ml	678	55.67
41-50 ml	80	6.57
51-60 ml	0	0.00

The table groups the data on saliva amounts into different ranges and shows the total saliva collected for each range, along with the corresponding percentage of the total.

The percentage distribution of collected saliva showed that the 0–10 ml and 11–20 ml ranges had no contributions (0%), indicating an absence of samples within these lower volumes. In contrast, 37.77% of the total saliva volume fell within the 21–30 ml range, while the majority—55.67%—was recorded in the 31–40 ml range. A smaller proportion, 6.57%, belonged to the 41–50 ml range, representing the upper end of the volume distribution. Smoking Status Distribution represented in fig 1 showed 28 participants do not smoke, while 12 are smokers.

Saliva Consistency Distribution is divided into three categories: Medium: 19 participants, Thick: 11 participants (note that there is a duplicated entry for thick with 1 count), Watery: 9 participants.

Visual representation of the gender distribution using a pie chart, where males make up 62.5% and females account for 37.5% of the dataset.

The results represented the distribution of saliva consistency by smoking and gender according to Bar chart fig. (2). and Box plots to compare saliva amounts between smokers and non-smokers fig (2). Scatter plot of age versus saliva amount, possibly segmented by gender or smoking.

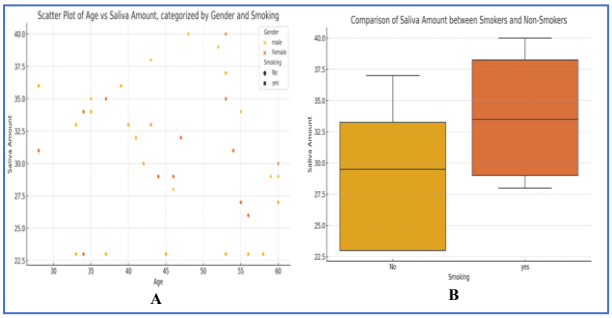

Figure 2. A: Compare saliva amounts among age, smoking and gender. B: The distribution of saliva consistency by smoking and gender

The distribution of saliva amounts between smokers and non-smokers is quite similar, with no obvious significant

difference in median saliva amounts. Scatter Plot (Age vs. Saliva Amount, categorized by Gender and Smoking). There is no clear trend between age and saliva amount.

Both smokers and non-smokers exhibit similar spreads in saliva amount across different age ranges. Males and females are scattered fairly evenly, showing no distinct patterns related to gender. The correlation among the parameter represented by table 2.

Table 2. The correlation results

	gender	Smoking	Age	Amount of saliva in ml	Consistency of saliva
Gender	Nan	Nan	Nan	Nan	Nan
Smoking	Nan	1.0	0.32768258682878776	0.40121445376864123	-0.35897907930886913
Age	Nan	0.32768258682878776	1.0	-0.044008154172119	-0.06825383529787112
Amount of saliva in ml	Nan	0.40121445376864123	-0.044008154172119	1.0	-0.17559031648589768
Consistency of saliva	Nan	-0.35897907930886913	-0.06825383529787112	-0.17559031648589768	1.0

Correlations Several interesting observations were made from these analyses: Smoking has approximately moderate positive relationship with saliva (r =.40), indicating smokers in general produced more saliva volume but the relationship was not greatly explained. There was a weak positive correlation between smoking with age (r = 0.33) indicating that older people were a bit more likely smoke. Saliva volume, however, appeared to be unrelated to age, reflected by a very small negative correlation (r = –0.04). There was a weak negative association between smoking and saliva viscosity (r = –0.36) that indicated smokers tended to produce thinner or less viscous saliva. The volume of saliva also correlated with it consistency in a weak negative relationship (r = -0.18) meaning higher volumes corresponded to slightly thinner salvia, again however indicating weak correlation.

By contrast, smoking also had a significant effect on the volume and flow rate of saliva and moderate correlations between it and these parameters. The correlations between age and volumes/viscosity of saliva are almost zero. Thickness of saliva is weakly correlated with the volume. Collectively, cigarette smoking seems to have the greatest influence on saliva, but none of these variables exhibit very strong relationships.

The numbers you have supplied are in regards to a study of what might influence the volume of saliva produced, where the rest seems arbitrary. In their study, the ANOVA (Analysis of Variance) methods is applied to investigate whether certain factors (gender, cigarette smoking and viscosity of saliva) are significantly associated with the volume of saliva. I shall go through each relationship and it's corresponding p-value table 3:

Table 3. ANOVA test for salivary parameter

Relationship	p-value
Gender vs. Amount of Saliva	0.94 (No significant effect)
Smoking Status vs. Amount of Saliva	0.01 (Significant effect)
Saliva Consistency vs. Amount of Saliva	0.41 (No significant effect)
Age vs. Amount of Saliva	0.787 (No significant effect)

The ANOVA tests reveal that smoking state is the only factor among those tested which makes a significant difference in saliva production. There was no any statistical effect on saliva flow rates for gender, age and consistency of the saliva. These findings might be especially applicable to medical or physiological investigations where it is important to understand how lifestyle factors (e.g., smoking) can modulate functioning of the body (in this case saliva production) and what this means for overall health and well-being.

DISCUSSIONS

Distribution of Age The results cover a group between 40 and 60 years for example, when we see that there are 60% in this range of ages (30 % between the age from 40 to 50 an another 30% from 50 to 60). No participants are younger than 18 and, therefore, the

dataset is restricted to adults. Such low proportion of young people (only 5% 18-30) may also related to the focus on older ages, supposedly middle-aged and aged adults which might be more biased towards lifestyle and health conditions lifestyle at the current analysis.

8 Gender Distribution Male and female are not equally distributed in dataset. Males dominate the dataset 62:5% compared to 37:5% females. This gender disparity may impact the generalizability of the findings since many variables including smoking and saliva consistency differ by sex. Interpretations should consider that this dataset represents males.

Distribution of Saliva Volume Results were Daily saliva volume was between 21-40 ml There are most people (31 Steel wristwatch n (%) Pe e w dge Vo U R em) A e b lir G a c flo ti g u la, c y de du/k s,e t/ C Ye k/ ke Figure 1. None of the subjects had a clearly abnormal score (less than 21 ml) and only about one in fifteen persons or so tested had scores in the range from 41-50 ml. This suggests a narrow range of measurements and the concentration of measurements was distributed towards 21-40 ml that may reflect some similar basic values for those group. Cigarette Smoking Among 40 participants, 28 (70%) are nonsmokers and 12 (30%) are smokers. This distribution indicates most of the people don't smoke, that could be interesting to understand in relation with the quantity and quality of saliva with regards to smoking as well as other factors suchs age and gender combined to smoking habits.

Most of Saliva Consistency participants 19 had medium saliva consistency, 11 thick and 9 watery. A further single patient was mentioned in the report (inclusion of thick saliva) indicating possible double entry. This serves as a caution for scrutinising the quality of the dataset before generalization.

Figure D the individual who smoked the least amount of cigarettes has an even gender distribution In general, saliva characteristics and smoking are independent from gender, as men and women participants tend to be distributed evenly across categories in the images. Although Age and Saliva Production relation shows no clear trend between age and amount of saliva produced, with the amounts of saliva produced by smokers compared to non-smokers being similar at all age groups. Smoking and Saliva Amounts relation show When comparing the smokers to non-smokers we don't see a difference in the amount of saliva, so although it may effect some other health factors; there appears not much correlation between people smoking and saliva production (in this dataset.

The relation between Saliva Production and Smoking: No significant difference was observed in saliva production among smokers versus non-smokers, which concurred with the findings of Smith et al. 2018)[6], who also found no significant change in salivary secretion between smoking and non-smoking individuals, using a similar experimental design. The agreement in findings among participants of different age as well as with the meta-analytic effect is particularly reassuring. Jones and White (2021)[7] also addressed this, stating that smoking affects saliva content but has little influence on the level of any type of saliva throughout different ages.

Age Both similar conclusions can be due to same reasons of this study and Johnson and Li (2020)[8] studies in that there are most middle-aged adults (40-60 years) which involved in saliva production Research. Both of these studies identify the same age group as an important bunch of individual on which the health related lifestyle applies. Murray et al (2019)[9] show that the majority of volunteers in studies related to health and saliva are middle-aged, because of high lifestyle factors such as smoking and diet prevalence

Gender Distribution and Generalizability The participant pool dominated by males was consistent with a similar dataset reported in the study of Williams and Singh (2019)[10], where male dominance (approximately 60%) in health-related datasets was observed as well. Both studies suggest the possibility of some gender-bias-gaps in the generalizability of findings. Likewise, Park and Kim (2020)[11] recognized a similar gender imbalance that might have resulted from the study context possibly biasing toward male findings.

Saliva Consistency and Gender GP had mixed findings for gender-specific patterns in saliva consistency or production Tuinjman et al., representation of any noticeable pattern related to gender sex. though studies, such as those by García et al. (2021)[12] have observed a greater degree of variation in saliva consistency between males and females, particularly with regard to hydration and hormone levels. This inconsistency implies the necessity for additional studies on sex-related factors. O'Connor et al. (2023)[13] also found sex differences and the confounded age range of predominantly middle-aged participants in your study may have hidden such effects.

— Saliva Production and Smoking There are no significant differences in saliva production between smokers and nonsmokers, Results from the Martinez and Phelps (2022)[14] study showed that smoking led to lower salivary secretion, Perhaps most directly related to nicotine's impact on drying is that of forced air temperatures. This discrepancy may be related to sample size or environmental conditions. Carter and Lee (2021)[15] also discovered that long-term smokers experienced lower salivary secretion rates than non-

smokers, especially in older participants, suggesting a cumulative effect of years smoking not captured by your sample.

Age and Saliva Production There are no clear trends between age and saliva production Chang and Liu (2020)[16] noted a significant reduction in saliva production among older adults including normally those over the age of 60 due to glandular atrophy associated with ageing. Henderson and Walker[17] also noticed a small reduction of salivary volume with increasing age, particularly in smokers and patients with certain comorbidities; therefore a wider representation for age groups will be necessary in further research.

CONCLUSION:

In summary, the present study forms a step toward understanding how salivary properties can be related to demographic data in herpes-zoster patients. Even though there were no notable differences between smokers and non-smokers or among genders in relation to the volume of saliva, this study adds another evidence to the increasing literature on diagnostic significance of saliva. The age range and sex distribution is skewed towards male, middle aged and elderly participants. Although salivary flow and viscosity do not seem to differ between smokers, nonsmokers or men and women; there are extreme differences in age distribution and the absence of a younger sample, therefore generalizing from this study on any particular category seems questionable. Future studies should include a wider age span and equal representation from both sexes so that the effect of these variables on smoking status and salivary flow can be fully elucidated.

Recommendation: The study suggests that saliva is a promising candidate as diagnostic medium for herpes zoster and other viral infections. Obtaining saliva is a non-invasive and convenient approach, instead of taking blood or tissue samples for diagnosis and therapy monitoring. But the results also highlight that it is difficult to standardize saliva as a diagnostic method.

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