

Quantitative and Qualitative Analysis of Relative Saliva Viscosity among Carious and Non-Carious Young Adults

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ABSTRACT

Objective: To determine relative saliva viscosity (RSV) among carious and non-carious young adult Nigerians

Methods: Participants included in this study were young adults of both sexes aged 11-40 years recruited and categorized as non-carious individuals as those with Decayed, Missing and Filled Teeth (DMFT) of 0 and carious individual as those with DMFT of ≥ 1 . The collection of unstimulated saliva samples was done using disposable cups and aspirated into 10 mls syringe. RSV was determined by allowing saliva to flow through a 10 mls syringe and measuring the rate of flow from 2 mls to 0 mls. The timing was done by means of a stopwatch and recorded in seconds. The plunger of the disposable syringe is carefully removed to allow the saliva to flow through the adaptor without the needle. The start off for the flow is usually above 2 mls but timing start off timing is at 2 mls as a precautionary measure. This is a simple and accurate model for measuring the viscosity of liquid (Figure 1). Statistical tests used in this study were independent t-test and one-way ANOVA. Statistical significance was at $P < 0.05$.

Results: The participants in this study were between 17 and 40 years with a mean age of 27.81 ± 6.56 years. The overall mean relative saliva viscosity among the participants was 1.93 ± 0.26 . The mean relative saliva viscosity was 2.39 ± 0.65 among participants aged 31-40 years old. Female participants had mean relative saliva viscosity of 2.09 ± 0.40 . Participants with dental caries had mean relative saliva viscosity of 2.41 ± 0.44 .

Conclusion: Relative saliva viscosity measured with a 10 disposable syringe was found to be higher in participants with dental caries than those without. Strategies to prevent dental caries should include efforts to increase the viscosity of saliva. Salivary viscosity of 1.16-1.66 Poise (P) (which is the CGS unit of viscosity) signifies oral cavity without dental caries. The SI Unit of viscosity is pascal second (Pa s). Ten poise equal one pascal second making the centipoise (cP) and millipascal second (mPa s) identical. Further studies on salivary viscosity and severity of dental caries is recommended.

Keywords: Relative saliva viscosity, salivary, carious, non – carious, young adults.

Citation: Azodo CC, Osahon OD. Quantitative and qualitative analysis of relative saliva viscosity among carious and non-carious young adults. *Nig J Dent Res* 2020; 5(2):131-135.

INTRODUCTION

Dental caries considered as a chronic, multifactorial disease, which causes destruction and demineralization of hard tissues of teeth by acid production occurring from bacterial fermentation of food, is one of the most prevalent infectious diseases to afflict mankind.¹ It is a major cause of tooth loss and affects all people regardless of their sex, socio

economic strata, race and age.^{2,3} The established factors are associated with dental caries aetiology are bacteria, time, susceptible tooth surface, and fermentable carbohydrates. The dental caries process is dependent upon the following⁴: 1) the interaction of protective and deleterious factors in saliva and plaque, 2) the balance between the cariogenic and non-cariogenic microbial population

within saliva and in particular plaque, and 3) the physicochemical characteristics of enamel, dentin and cementum that make the dental hydroxyapatite more or less vulnerable to an acidogenic challenge.

Saliva has been stated to influence the incidence of dental caries in four ways⁵: (1) as a mechanical cleansing agent that results in less accumulation of plaque, (2) by reducing enamel solubility by means of calcium, phosphate and fluoride, (3) by buffering and neutralizing the acids produced by cariogenic organisms or introduced directly through diet and (4) by antibacterial activity.

The mechanical cleansing property of saliva depends on its rheological properties specifically viscosity which is a measure of resistance to fluid flow. Viscosity of saliva is closely linked with various factors such as the flow rate, pH, dry weight of solids, calcium, protein content, glycoproteins, and proline-rich protein composition.⁶ Studies^{5,7} have found association between saliva viscosity and the incidence of dental caries using viscometer to objectively assess saliva viscosity. However, the studies^{8,9} that measured salivary viscosity subjectively and its relationship documented controversial findings. The disposable syringe saliva viscosity measurement method which is cheap, easy and very applicable in developing country is not being used in the study of the relationship. Hence the objective of this study was to compare salivary viscosity among carious and non-carious young adults using the disposable syringe method.

MATERIALS AND METHODS

Study participants were young adults of both sex aged 17-40 years recruited from Outpatient Dental Clinic of University of Benin Teaching Hospital, Benin City, Edo State, Nigeria. Non carious individuals recorded as Decayed, Missing and Filled Teeth (DMFT) of 0 while caries was recorded as DMFT of ≥ 1 . Those with history of chronic medical illness that compromises salivary secretion, take any medications with xerogenic effect and wear any fixed or removable dental prostheses were excluded. The collection of unstimulated salivary samples was done using disposable cups and aspirated into 10 mls syringe for the period of the study between 9 and 10a.m to eliminate the effect of circadian rhythm on the obtained saliva.

Salivary viscosity measurement was done in the laboratory developed for the purpose of this research

in Outpatient Dental Clinic of University of Benin Teaching Hospital, Benin City, Nigeria. Salivary viscosity was determined by allowing saliva to flow through a 10 mls syringe and measuring the rate of flow from 2 mls to 0 mls. The timing was done by means of a stopwatch and recorded in seconds. The plunger of the disposable syringe is carefully removed to allow the saliva to flow through the needle end without the needle. The start off for the flow is usually above 4 mls but timing start off is at 2 mls as a precautionary measure. This simple syringe method is accurate for measuring the relative viscosity of liquid (Figure 1). The viscosity of the liquid is determined by a comparison with a standard which is water.

The relative saliva viscosity was calculated as flow time for saliva/flow time of water in line with the method of previous research on blood by Osahon & Ihaza (2019)¹⁰ in which the simple syringe method was used. In this study, a needle with wider bore was used. The wider bore needle was to allow for aspiration of the saliva. Data processing and analysis were carried out using IBM SPSS version 20.0. Statistical tests used in this study were independent t-test and one-way ANOVA. Statistical significance was at $P < 0.05$.

RESULTS

A total of 21 males and females aged between 17 and 40 years participated in this study with a mean age of 27.81 ± 6.56 years. There were equally (33.3%) divided in the age groups; 17-24 years, 25-30 years and 31-40 years. About two thirds (61.9%) of the participants were females and 52.4% of the participants had carious teeth (Table 1).

The overall mean relative saliva viscosity among the participants was 1.93 ± 0.26 . The mean relative saliva viscosity was 2.39 ± 0.65 among participants aged 31-40 years old. Female participants had mean relative saliva viscosity of 2.09 ± 0.40 . Participants with dental caries had mean relative saliva viscosity of 2.41 ± 0.44 (Table 2). The mean relative saliva viscosity in participants aged 25-30 years that have dental caries was 1.30 ± 0.11 and those without dental caries is 2.46 ± 0.53 . The mean relative saliva viscosity of male participants without dental caries was 1.28 ± 0.07 while that of female participants without dental caries was 1.49 ± 0.11 (Table 3).



Figure 1: The simple syringe method for measuring relative viscosity of liquid

Table 1: Demographic Characteristics of the participants

Characteristics	Frequency (n)	Percent (%)
Age (years)		
17-24	7	33.3
25-30	7	33.3
31+	7	33.3
Gender		
Male	8	38.1
Female	13	61.9
Tooth Status		
Normal	10	47.6
Carious	11	52.4
Total	21	100.0

Table 2: Mean relative saliva viscosity with Standard Error of Mean (SEM) among the participants

Characteristics	Mean $\pm$ SEM	P-value
Age (years)		0.333
17-24	1.44 $\pm$ 0.13	
25-30	1.97 $\pm$ 0.37	
31-40	2.39 $\pm$ 0.65	
Gender		0.446
Male	1.68 $\pm$ 0.18	
Female	2.09 $\pm$ 0.40	
Tooth status		0.047
Normal	1.41 $\pm$ 0.08	
Carious	2.41 $\pm$ 0.44	
Total	1.93 $\pm$ 0.26	

Table 3: Age and gender with Mean relative saliva viscosity and Standard Error of Mean of participants with and without dental caries

Characteristics	Normal Mean $\pm$ SEM	Carious Mean $\pm$ SEM
Age (years)		
17-24	1.41 $\pm$ 0.12	1.53 $\pm$ 0.41
25-30	1.30 $\pm$ 0.11	2.46 $\pm$ 0.53
31-40	1.58 $\pm$ 0.20	2.72 $\pm$ 0.89
Gender		
Male	1.28 $\pm$ 0.07	2.07 $\pm$ 0.19
Female	1.49 $\pm$ 0.11	2.61 $\pm$ 0.70

DISCUSSION

Whole saliva which is product of major and minor salivary gland secretions and crevicular fluid, is a unique biologic fluid in oral cavity that serves a critical role in the maintenance of oral health. It functions in moistening the mucosa, digestion, taste perception, antimicrobial activity, homeostasis, clearance of unwanted substances, buffering and calcium and phosphate delivery for remineralization. These functions serve a critical role in the maintenance of oral-systemic health and enjoyment of life. The flow of saliva, clearance of unwanted substances and lubrication of the oral cavity are influenced by salivary viscosity. Inverse relation exists between salivary viscosity, hydration level and salivary flow rate.⁷ In this study, the mean relative saliva viscosity was found to higher in participants with dental caries than participants without dental caries. Viscosity which denote opposition to flow, impairs the mechanical cleansing effect of saliva as more viscid saliva is less effective in clearing the mouth. The greater the viscosity of saliva, the lesser will be its cleansing action leading to a higher dental caries rate. Increased salivary viscosity occur in increased mean reduction in water content with an increased salivary thickness that makes saliva thick and ropy with decreased cleaning and clearance. Higher salivary viscosity in dental caries has been reported previously.^{5,7,11} An increase in salivary viscosity has been stated to be disadvantageous to oral health in terms of bacterial clearance from the oral cavity as salivary viscosity affects the co-aggregation of oral *Streptococci* with *Actinomyces*.¹² This reduced bacterial clearance from the oral cavity and increases the risk of infectious diseases which includes dental caries. Salivary secretion whose rheological capacity is compromised is less capable of flowing freely to oral sites where its protective functions such as clearance would be affected which

is essential for removal of food debris and bacteria thereby increasing the susceptibility to dental caries.¹³

The older participants had higher salivary viscosity than the younger participants. This age-dependent increase in salivary viscosity has been reported by Kazakov *et al.* (2009)¹⁴ using elongational thread viscometer. It may be due to the fact that MUC5B which is the mucins that contribute to viscosity of saliva from submandibular salivary gland may increase with ageing. Sticky or ropy and bubbly saliva which are signs of increased salivary viscosity occasionally contributes to dribbling and speech difficulty as saliva is more difficult to swallow. These complaints interestingly occur more with ageing. Interestingly, the salivary viscosity among participants without dental caries was lowest in the 25-30 years old and highest in 31-40 years old. Although reasons for this finding cannot be fully explained, further study of viscosity and composition of saliva is recommended.

Females had higher viscosity than males in those with and those without dental caries. This may explain why females experience more dental caries than their male counterparts and help to discountenance the idea that more caries in females is due to their more tendency to visit the dental clinic for care.

CONCLUSION

Relative saliva viscosity measured with ten disposable syringes was found to be higher in participants with dental caries than those without it. Strategies to prevent dental caries should include efforts to increase saliva viscosity. Salivary viscosity of 1.16-1.66 (P) signifies oral cavity without dental caries. Further studies on salivary viscosity and severity of dental caries is recommended.

Source of Support

Nil.

Conflict of Interest

None declared.

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