Salivary Viscosity in Relation to Oral Health Status among a Group of 20-22 Years Old Dental Students

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ABSTRACT

Background: Elevated salivary viscosity increases the risk for dental caries and periodontal diseases. The aim of this study was to disclose the relationship between salivary viscosity and dental caries as well as gingival disease severity among a group of 20-22 years old dental students.

Materials and methods: Forty five dental students of both gender aged 20-22 years at College of Dentistry, University of Baghdad took part in this study. Stimulated salivary samples were collected then taken to the laboratory for measuring salivary viscosity at the Poisoning Consultation/Surgical Specialty Hospital. Dental caries was recorded by lesion severity according to Decayed, Missing and Filled (D_{1-4} MFS) Index (Mühlemman, 1976). Plaque index PlI (Silness and Löe, 1964) was used for measuring dental plaque thickness while gingival index GI (Löe and Silness, 1963) was used for diagnosis of the gingival disease. SPSS version 18 was used for statistical analysis.

Results: Salivary viscosity showed weak non significant correlation with caries experience (P>0.05). However, according to dental caries severity students with severe dental caries recorded higher salivary viscosity than those with moderate caries severity with significant difference in case of DS fraction (m.d.= -0.01, P< 0.05). However, according to DMFS statistical difference was close to the confidence limit (P=0.07). No significant correlation could be found between salivary viscosity and gingival inflammation (P> 0.05). Also regarding severity of gingivitis no significant difference in salivary viscosity was recorded between those with mild and those with moderate gingivitis (P> 0.05).

Conclusions: It is recommended that measuring salivary viscosity to be a part of routine dental diagnosis when treating patient with higher dental caries risk. However, further studies are needed to disclose the effect of increased salivary viscosity on gingival health with larger sample size.

Keywords*: Salivary viscosity, dental caries, gingivitis.*

Introduction:

Saliva is a unique biologic fluid produced by different salivary glands [1-3]. It is composed of approximately 99% water and 1% protein and salts. Normal daily production of saliva is 0.5-1.5 liters [4]. Saliva serves several functions that are critical for oral health. In addition to moistening the mucosa, antimicrobial activity, homeostasis, clearance, buffering and delivery of calcium and phosphate for remineralization, saliva provides lubrication of oral tissues [5,6]. The lubricating properties are provided mainly by high molecular weight glycoproteins that increase salivary viscosity beyond that of water [7].

Fresh mixed human saliva is viscoelastic fluid with distinct surface activity [8,9]. Glycoproteins particularly mucin are responsible for the viscoelastic character of saliva giving a lubricating film that enables free movement of oral tissues [10]. Submandibular/sublingual salivary viscosity was higher than that of parotid saliva [11]. Since submandibular/sublingual saliva contains much higher concentration of mucin and glycoproteins than parotid saliva. Such differences also found between saliva secreted under resting conditions (that contain relatively higher concentration of submandibular/sublingual saliva) and that secreted under stimulation [12,13]. Clinically, clear and watery saliva indicates normal viscosity which is essential for food digestion and motor functions of chewing, swallowing and speaking. While sticky or ropy and bubbly saliva are signs of increased salivary viscosity especially if stimulated salivary flow rate is low. Increased salivary viscosity occasionally contributes to dribbling and speech difficulty as saliva is more difficult to swallow [14,15].

Measuring salivary viscosity is of paramount importance since an elevated salivary viscosity was found to be associated with an increased occurrence of oral diseases particularly dental caries and periodontal diseases [11,16,17]. However, limited studies could be found. It was recorded that salivary viscosity was significantly higher among individuals with increased caries severity compared with caries free ones [18-20]. Concerning periodontal diseases, studies reported that subjects with viscous saliva are at higher risk for periodontal disease [16,21]. Therefore, the aim of this study was to explore the relationship between salivary viscosity and dental caries as well as gingival disease severity among a group of 20-22 years old dental students.

Materials and Methods:

Study participants were forty five dental students of both gender aged 20-22 years at College of Dentistry, University of Baghdad. They should be with no medical history that compromises salivary secretion, shouldn't take any medications with xerogenic effect and shouldn't wear any fixed or removable dental prostheses. The collection of stimulated salivary samples was performed according to the instructions cited by Tenovuo and Lagerlöf [22]**.** Salivary samples were then taken to the laboratory for measuring salivary viscosity at the Poisoning Consultation/Surgical Specialty Hospital. Caries experience was recorded according to Decayed, Missing and Filled (D_{1-4} MFS) Index described by Mühlemman [23]. The sample was divided into three groups (mild, moderate and severe) according to decayed, missing and filled teeth surfaces (DMFS) regarding decayed fraction of

DMFS (DS). Plaque index (PlI) [24] was used for measuring dental plaque thickness while gingival index (GI) of Löe and Silness was used for diagnosis of the gingival disease [25]. The whole teeth were examined.

Salivary viscosity was determined by allowing saliva to flow through a tube of circular cross section and measuring the rate of flow. This is done by using the Ostwald viscometer (Aldrich Company) (Figure 1) which is a simple device and accurate for measuring the viscosity of liquid [26]. Usually the viscosity of the liquid is determined by a comparison with a standard such as water:

$$\eta_1 / \eta_2 = \rho_1 t_1 / \rho_2 t_2$$

η_1=viscosity of distilled water (equal to 0.008937 dyne/cm^3).

η_2=viscosity of saliva sample.

ρ_1 = density of distilled water gm/cm^3.

t_1= time to pass the distilled water in second.

ρ_2 = density of saliva sample

t_2= time to pass saliva sample in second [26, 27].

Figure (1): Ostwald viscometer (Aldrich Company).

Data processing and analysis were carried out using Statistical Package for Social Science (SPSS version 18). Statistical tests used in this study are: Pearson's correlation coefficient (r), Analysis of Variance (ANOVA), Least Significant Difference (L.S.D) and student's t-test. The confidence limit was accepted at 95% (P <0.05).

Results:

The distribution of the total sample by gender is seen in Table 1. The sample was divided into three groups according to caries severity: (DS): Group 1: mild (2-7), Group 2: moderate (8-13), and Group 3: severe (14-20); (DMFS): Group 1: mild (1-9), Group 2: moderate (10-19), and Group 3: severe (20-29).

Table (1): Distribution of the Total Sample According to Gender.

Gender	No.	%
Male	15	33.33
Female	30	66.67
Total	45	100

Table (2) demonstrates the mean values of caries experience of total sample. DS was recorded a higher mean value of DMFS components while the lowest value was noticed by MS. According to grades of lesion severity, D1 was found to be the higher mean value while D3 was recorded the lowest.

Table (2): Dental Caries Experience (Mean±SD) of the Total Sample.

Parameter	No.	Minimum	Maximum	Mean	±SD
D1	45	0.00	15.00	5.18	4.27
D2	45	0.00	19.00	4.69	5.32
D3	45	0.00	2.00	0.53	0.79
D4	45	0.00	10.00	1.11	2.58
DS	45	0.00	19.00	11.51	4.57
MS	45	0.00	5.00	0.11	0.74
FS	45	0.00	26.00	4.51	5.50
DMFS	45	1.00	28.00	16.13	5.46

Table (3) illustrates the mean values of plaque index, gingival index and salivary viscosity (dyne/cm^3) of total sample. The minimum score of plaque and gingival indices was recorded to be a mild type while the maximum score was recorded of moderate type.

Table (3): Oral Variables (Mean±SD) of the Total Sample.

Parameter	No.	Minimum	Maximum	Mean	±SD
PlI	45	0.13	1.50	0.72	0.36
GI	45	0.05	1.35	0.59	0.36
Salivary viscosity (dyne/cm^3)	45	0.01	0.09	0.06	0.02

Table (4) illustrates the correlations between caries experience and salivary viscosity. Negative weak non significant correlations were found with D1, D3, D4 and MS. While a positive weak non significant correlations were recorded between D2, DS, FS and DMFS with salivary viscosity.

Table (4): The Relation of Dental Caries Experience to Salivary Viscosity.

Parameter	Salivary viscosity (dyne/cm^3)	
	r	P-value
D1	-0.08	0.63
D2	0.23	0.14
D3	-0.29	0.05
D4	-0.07	0.64
DS	0.09	0.524
MS	-0.19	0.21
FS	0.09	0.56
DMFS	0.15	0.33

Table (5) demonstrates the mean values of salivary viscosity according to caries severity (DMFS). A higher means values were noticed among groups with mild and severe caries. ANOVA test was found to be not significant among three groups (P> 0.05). LSD test showed no statistical significant difference between three groups concerning salivary viscosity as seen in Table (6).

Table (5): Salivary Viscosity (Mean±SD) According to Dental Caries Severity (DMFS).

Dental caries severity (DMFS).	No.	Mean	±SD	ANOVA test df=2	
				F-value	P-value
Mild (1-9)	3	0.07	0.02	2.02	0.14
Moderate (10-19)	28	0.06	0.02		
Severe (20-29)	14	0.07	0.02		

Table 6: Least Significant Difference (L.S.D) of Salivary Viscosity According to Dental Caries Severity (DMFS).

Dental caries severity (DMFS)		Mean difference (m.d.)	Standard Error	Significancy
Mild (1-9)	**Moderate (10-19)**	0.01	0.01	0.24
Mild (1-9)	**Severe (20-29)**	0.002	0.01	0.84
Moderate (10-19)	**Severe (20-29)**	-0.01	0.006	0.07

Table (7) explains the mean values of salivary viscosity and statistical analysis according to caries severity (DS). A higher mean value was noticed among students with mild and severe caries, while a lower mean value of salivary viscosity was noticed in students with moderate caries. ANOVA test revealed a non significant difference among three groups (P> 0.05).

Table (7): Salivary Viscosity (Mean±SD) and Statistical Analysis According to Dental Caries Severity (DS).

Dental caries severity (DS).	No.	Mean	±SD	ANOVA test df=2	
				F-value	P-value
Mild (2-7)	6	0.07	0.02	2.84	0.07
Moderate (8-13)	21	0.05	0.02		
Severe (14-20)	17	0.07	0.01		

Table (8) represents the Least Significant Difference of salivary viscosity according to dental caries severity (DS). LSD test showed that the only significant difference was found between students with moderate and severe caries (M.D.= -0.01, P< 0.05). While no significant differences were noticed regarding other groups (P> 0.05).

Table 8: Least Significant Difference (L.S.D) of Salivary Viscosity According to Dental Caries Severity (DS).

Dental caries severity (DS)		Mean difference (m.d.)	Standard Error	Significancy
Mild (2-7)	**Moderate (8-13)**	0.02	0.009	0.09
Mild (2-7)	**Severe (14-20)**	0.002	0.009	0.84
Moderate (8-13)	**Severe (14-20)**	-0.01	0.006	0.04*****

***Significant**

Table (9) demonstrates the correlation between plaque and gingival indices with salivary viscosity. Negative weak non significant correlations were recorded between them. In addition positive weak significant correlation was recorded between PlI and GI (r=0.30, P-value=0.04).

Table (9): The Relation of Salivary Viscosity with Plaque and Gingival Indices.

Parameter	Salivary viscosity (dyne/cm^3)	
	r	**P-value**
PlI	-0.09	0.57
GI	-0.01	0.93

Table (10) represents the mean values of salivary viscosity according to severity of gingivitis. It was recorded a mild and moderate type of gingivitis while the severe type was not noticed in the total sample. A lower mean value of salivary viscosity was recorded for those with moderate type of gingivitis compared with those with mild gingivitis, difference was statistically not significant (P> 0.05).

Table (10): Salivary Viscosity (Mean±SD) According to Severity of Gingivitis.

Gingivitis severity	No.	%	Mean	±SD	Significancy		
					t-test	df	P-value
Mild (0.1-1)	38	84.4	0.06	0.02	0.99	43	0.33
Moderate (1.1-2)	7	15.6	0.05	0.02			
Severe (2.1-3)	0	0.0	/	/	/	/	/

Discussion:

Viscosity is a rheological property of complex salivary fluid; it means a quality or state of being viscous and related to its glycoprotein content [28,29,30]. Viscoelastic properties are essential for lubrication and humidification thus providing mucosal integrity [8]. However, an increased salivary viscosity increases the risk of dental caries and periodontal diseases [11,16,17,31]. This was also noticed in the current study, it was found that students with severe dental caries recorded higher salivary viscosity than those with moderate caries severity with significant difference in case of DS fraction, however, according to DMFS statistical difference between those with severe and moderate caries severity was considered not significant but the P-value was close to the confidence limit (P=0.07). These results were also reported by other studies [18-20]. The possible explanation is that when salivary viscosity increased that mean reduction in water content with an increased salivary thickness because the rate of production is low [19]. 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 [11,32].

Regarding gingival inflammation, results of present study revealed a positive significant correlation between plaque index and gingival inflammation since poor oral hygiene represented by dental plaque accumulation plays an important role in the etiology and progression of periodontal diseases [33, 34]. This was also found by other studies [35-39]. However no significant correlation could be found between salivary viscosity and gingival inflammation. Also regarding severity of gingivitis no significant difference was recorded between those with mild and those with moderate gingivitis (subjects with severe gingivitis were not found in the sample probably because they were dental students and take care of their oral cleanliness and gingival health). This finding was inconsistent with other studies [16,21]. From these results we can suggest that the effect of increased salivary viscosity is more obvious regarding dental caries, but unpronounced effect was recorded regarding gingival inflammation. Therefore, further studies with larger sample size in addition to measuring probing pocket depth and clinical attachment level are warranted to get more clear and obvious results concerning the effect of salivary viscosity on periodontal health.

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