World Bulletin of Public Health (WBPH)
Available Online at: https://www.scholarexpress.net
Volume-20, March 2023
ISSN: 2749-3644

BACTERIOLOGICAL DETECTION OF VIRIDANS GROUP STREPTOCOCCI ASSOCIATED WITH DENTAL CARIES IN THI-QAR PROVINCE

Basim Jasim Mohammed[1], Seçil Akilli Şimşek[2] and Amany Shakeir Jaber[3]
[2] Department of microbiology /College of science / University of Cankiri Karatekin
[3] Department of Pathological Analysis / College of science / University of Thi-Qar
[1]basim.y9236@yahoo.com , [3]amanybiosciense@yahoo.com

Article history:

Received: January 20th 2023
Accepted: February 11th 2023
Published: March 26th 2023

Abstract:

This is a study conducted in Al-Nasiriya City-Dhi Qar province/ Iraq for the period from August 2020 to Jun 2021. A total of 250 dental caries swabs were collected from patients with dental caries (DC). . The age range was 7-59 years, 159 (63.6%) were males and 91 (36.4%) were females. The results found that the SVG isolation rate from dental caries was 128 (51.2%). The age group 40-49 years had significantly higher isolation rate (P= 0.005). Females had insignificantly higher rate of isolation (P= 0.915) compared to males. Urbanees had insignificantly higher isolation rate compared to rularees (P= 0.112). Smoking patients had insignificantly higher isolation rate (P=0.781). Generally, patients with comorbidities and particularly those with DM had significantly higher isolation rate of SVG (P= 0.0001). Neither site, frequency nor duration of DC had significant effect on the isolation rate of SVG. On the other hand, the presence of periodontitis had significantly increase the isolation rate (P= 0.0001). While the presence of pain, swelling and the dental care had no effect on the isolation rate. Consumption of snacks was found to be as insignificantly increase the isolation rate. The 6.0 pH of saliva was found to be associated with insignificantly increase in SVG isolation rate (p = 0.767). The results also found that 86.0% of the isolates produce proteases and 87.0% were alpha hemolytic. Additionally, 38.0% and 56.2% of the isolates were strong and moderate biofilm former

Keywords: Dental Caries, *Streptococcus Viridans*, Periodontal Disease, Tooth Decay.

1. INTRODUCTION:

Dental caries (DC), also referred to as tooth decay or cavities, is the disintegration of teeth causes via bacteria-produced acids. Cavities may range in hue from yellow to black. Pain and trouble eating are possible symptoms. Complications may include inflammation of the surrounding tissue, tooth loss, infection, or the development of an abscess (Laudenbach and Simon 2014). Dental caries is prevalent in the majority of developing low-income nations, with more than 90% of cases remaining untreated. Dental caries affects an estimated 5 billion individuals globally.

Early childhood caries (ECC), according to the American Academy of Dentistry, is defined as "the presence of one or more decaying (non-cavitated or cavitated lesions), missing (as a consequence of caries), or filled surface of the teeth in any primary tooth" in children under the age of seven. However, while 50% of children have one or more decayed primary teeth via the time they reach toddlerhood, the significance of these teeth should not be underestimated, as healthy primary teeth in childhood play a critical role in the eruption of healthy permanent teeth as well as the maintenance of one's aesthetic appearance as one grows older (Wagle *et al;* 2018). Dental decay in children is causes via a variety of factors including malnutrition, genetic predisposition, Poor health performance, particular dietary habits, the presence of teeth decay-cautilizing organisms such as streptococci, fluoride deficiency, vitamin D insufficiency, excessive sugar intake, and extended bottle-feeding are all risk factors.Caries is classified based to its location, origin, progression rate, and the amount of hard tissue that has been affected. Caries may manifest itself in a variety of ways, each of which may indicate the underlying cause (Ismail et al; 2015). In order for cavities to form, bacteria must create acid that corrodes the tooth's hard structures (enamel, dentin and cementum). Bacteria produce acid when they decompose food particles or sugars that have accumulated on the tooth's enamel. Diseases that

World Bulletin of Public Health (WBPH)
Available Online at: https://www.scholarexpress.net
Volume-20, March 2023
ISSN: 2749-3644

induce reduced saliva production, such as diabetes mellitus and Sjögren syndrome, as well as certain medications, are among the risk factors. Suppression of saliva production is causes via medicines such as antihistamines and antidepressants. Additionally, dental caries and poverty have been linked together as well as poor oral hygiene and receding gums that expose the tooth roots (Schwendicke et al; 2015, De Oliveira *et al;* 2017). The mutans streptococci, most notably Streptococcus mutans and Streptococcus sobrinus, as well as lactobacilli, are the bacteria that are most often associated with tooth cavity formation.
The *Streptococcus Viridans Group* (SVG) are a large group of Gram-positive commensal streptococcal bacteria that are α-hemolytic., and they are responsible for the green coloring of blood agar plates. These organisms do not have Lancefield antigens and, as a result, aren't very pathogenic (Ryan and Ray 2004). The optochin test may be utilized to differentiate SVG from Streptococcus pneumoniae; in addition, They do not have the polysaccharide-based capsule that is characteristic of S. pneumoniae, nor do they have the Lancefield antigens that are found in the genus's pyogenic members but are absent from S. pneumoniae (Patterson 1996). The formation of a biofilm, also known as dental plaque, on the surface of the teeth and oral mucosa, which is defined as microbial communities embedded in a self-produced matrix of extracellular polymeric substances and a dynamic metabolically structured matrix on the teeth and oral mucosa, is an outstanding feature of oral microflora, aside from the ability of these bacteria to synthesize proteolytic enzymes. It's estimated that Iraq has a high incidence of DC, which may be linked to patient features, family history, environmental variables that promote disease, and a lack of personal and public hygiene (Al-Mendalawi and Karam 2014).

2. MATERIAL AND METHODS

This is a cross-sectional research that was carried out in Al-Nasiria city, which is located in the heart of Dhi Qar Province in Iraq, between August 2020 and June 2021. Patient swabs with dental caries were 250 in total, collected from patients with dental caries (DC). In Al-Nasirya city, two dental facilities were utilized for this purpose: the Specialized Center of Dentistry and the Sumar Specialized Dentistry Center (both of which are located in Al-Nasirya city). While the patient was laying down on the dentistry chair and his/her mouth was opened, a sterile cotton swab was pull out from its tube and immediately used for swabbing the DC cavity and/or around it (paragingival area). Then the swab was recapped again as fast as possible and kept in a cool box priming for transport to the bacteriology laboratory.
The patients ranged in age from 7 to 59 years, with 159 (63.6 %) of them being males and 91 (36.4 %) of them being girls. All of the patients came from the city of Al-Nasiria and its surrounding areas. In preparation for this research, a special questionnaire form was created that included information on clinical, socio-demographic, and personal characteristics. Every patient's right to personal privacy was protected by obtaining their explicit permission.
Statistical analysis was done using Statistical Package of Social Science (SPSS) version 27.The difference was considered significant if P value is less than 0.05. All swabs were streaked on blood and MacConkey agar plates and incubated microaerobically for 24 hours. SVG bacteria were isolated and identified using morphological, biochemical tests and Vitek 2 system.

2.1 Bacterial Isolation and Identification

According to recommended diagnostic procedures (MaACFddin, 2000). Isolation and identification of SVG bacteria from caries swabs included in this study was achieved by macroscopic and microscopic examination: A single colony was obtained from each primary suspect culture and was dependent on its identification. Morphological appearance including punctate colonies with or without greenish discoloration, depending on the hemolysis ability of RBCs. The cultured colonies were then examined using Gram staining to observe Gram positive cocci, usually arranged in chains. After specific cultural and biochemical tests were performed to arrive at the final identification.

2.2 Detection of Virulence Factors by Cultural Methods

2.2.1 Hemolysin Production

It was possible to identify hemolysin production by streaking the pure colony of one of the isolates on the surface of blood agar medium. At 37 0C for 24 hours, the cultured plates were examined for the presence of a hemolysis ((β or α) or) zone surrounding the colonies or for the absence of hemolysis ((γ)) around the colonies. (Christen 1987).

2.1.2 Extracellular Protease

This was accomplished by inoculating one milliliter of overnight broth culture into each agar well of SVG isolates. The plates were incubated for 24-48 hours at 37 degrees Celsius. It was necessary to determine the diameter of the inhibition zone around the well. Extracellular protease was found in samples with diameters ranging from 22 to 25 millimeters. (Christen 1987).

3. RESULTS

The results presented in this chapter were based on statistical analysis of data accumulated throughout this

World Bulletin of Public Health (WBPH)
Available Online at: https://www.scholarexpress.net
Volume-20, March 2023
ISSN: 2749-3644

study which was extended from and include 250 patients with dental caries (DC) from different ages.

3.1 Results of culture

The results of bacteriological culture were illustrated in (Table 1). According to the types of isolates, the majority of cultures 191 (76.4%) yields single type of growth, 23(9.2%) yields two types of growth and 8(3.2%) yields three types of growth, while 28(11.2%) yields no growth. According to the type of isolates, the majority of culture 128 (51.2%) yields growth of *Streptococcus viridans* group (SVG), while 58 (23.2%) yields lactobacillus group and lastly, 75(30%) yields *Candida albicans* growth.

Table (1) : Distribution of the results of culture

CULTURE RESULTS		No.	%
Type of growth	No growth	28	11.2
	Single growth	191	76.4
	Two growth	23	9.2
	Three growth	8	3.2
Streptococcus viridans group (SVG)	Positive	128	51.2
	Negative	122	48.8
Lactobacillus group	Positive	58	23.2
	Negative	192	76.8
Candida albicans	Positive	75	30.0
	Negative	175	70.0

3.2 Association of SVG with patient variables

3.2.1 Age groups

Results presented in (Table 2) showed that the age group 40-49 years old of DC patients had significantly higher SVG positivity rate (65.4%), (P= 0.005), followed by the age group of 50 years or more (61.5%). Whereas, the least SVG positivity rate was among those with 10-19 years old (34.5%) Furthermore, the Mean age ± SD of DC patients with positive SVG was significantly different from that of DC patients who were negative for SVG (35.7±14.3 *Vs* 28.5±15.0), (P= 0.0001).

Table (2) : Association of SVG positivity rate with age groups of DC patients

AGE (Ys)	*STREPTOCOCCUS VIRIDANS* GROUP				P value
	POSITIVE		NEGATIVE		
	No	%	No	%	
<10years	5	38.5	8	61.5	0.0051*
10---19	19	34.5	36	65.5	
20---29	16	39.0	25	61.0	
30---39	30	60.0	20	40.0	
40---49	34	65.4	18	34.6	
≥ 50 years	24	61.5	15	38.5	

World Bulletin of Public Health (WBPH)
Available Online at: https://www.scholarexpress.net
Volume-20, March 2023
ISSN: 2749-3644

Mean ± SD	35.7±14.3	28.5±15.0	0.0001#

* Significant difference between percentages using Pearson Chi-square test (χ^2-test) at 0.05 level.
# Significant difference between two independent means using Students-t-test at 0.05 level.

3.2.2 Gender

(Table 3) revealed that the SVG positivity rate of female patients was insignificantly higher than that of male patients (51.6% *Vs* 50.9%), (P= 0.915).

Table (3) : Association of SVG positivity rate with gender of DC patients

GENDER	*STREPTOCOCCUS VIRIDANS GROUP*				P value
	POSITIVE		NEGATIVE		
	No	%	No	%	
Male	81	50.9	78	49.1	0.915
Female	47	51.6	44	48.4	

3.2.3 Residence

The results also found that DC patients reside in urban areas had insignificantly higher SVG positivity rate compared to those reside in rural areas (57.0% *Vs* 46.9%), (P= 0.112). all data were presented in (Table 4).

Table Error! No text of specified style in document.**) :** Association of SVG positivity rate with residence of DC patients

RESIDENCE	*STREPTOCOCCUS VIRIDANS GROUP*				P value
	POSITIVE		NEGATIVE		
	No	%	No	%	
Urban	61	57.0	46	43.0	0.112
Rural	67	46.9	76	53.1	

3.2.4 Smoking

Results presented in (Table 5) revealed that smoker DC patients had insignificantly higher SVG positivity rate compared to non-smoker DC patients (52.1% Vs 50.4%), (P= 0.781).

Table (5) : Association of SVG positivity rate with smoking of DC patients

SMOKING	*STREPTOCOCCUS VIRIDANS* GROUP				P value
	POSITIVE		NEGATIVE		
	No	%	No	%	
Yes	61	52.1	56	47.9	0.781
No	67	50.4	66	49.6	

3.2.5 Comorbidities

(Table 6) showed that generally the DC patients with comorbidities had significantly higher SVG positivity rate compared to those with comorbidities, but negative for SVG (65.0% *Vs* 35.0%), (P= 0.0001). Furthermore, DC patients with hypertension had insignificantly higher SVG positivity rate as compared to those hypertensive patients but with negative SVG (57.9% *Vs* 42.1%), (P= 0.250). Regarding the DM, the results found that DC patients with DM had significantly higher SVG positivity rate compared to those DM patients but with negative SVG (88.3% *Vs* 11.7%), (P= 0.0001). Additionally, the results also found that DC patients with asthma had insignificantly higher SVG positivity rate compared to asthmatic patients, but negative for SVG (55.4% Vs 44.6%), (P= 0.433).

Table (6) : Association of SVG positivity with comorbidities of DC patients

VARIABLES	*STREPTOCOCCUS VIRIDANS* GROUP	P value

World Bulletin of Public Health (WBPH)
Available Online at: https://www.scholarexpress.net
Volume-20, March 2023
ISSN: 2749-3644

		POSITIVE		NEGATIVE		
		No	%	No	%	
Comorbidities	Yes	89	65.0	48	35.0	0.0001
	No	39	34.5	74	65.5	
Hypertension	Yes	33	57.9	24	42.1	0.250
	No	95	49.2	98	50.8	
Diabetes Mellitus	Yes	53	88.3	7	11.7	0.0001
	No	75	39.5	115	60.5	
Asthma	Yes	36	55.4	29	44.6	0.433
	No	92	49.7	93	50.3	

3.2.6 Site and frequency of DC

Concerning the site of decayed tooth, the results in (Table 7) found that SVG positivity rate was higher (56.0%) among those patients who had decayed tooth in the lower jaw compared to other categories, However, the difference was failed to reach the levels of statistical significant (P= 0.062). In connection with the frequency (No. of decayed tooth), the results found that those patients with multiple decayed teeth had higher positivity rate of SVG compared to those with single decayed tooth, However, the difference was failed to reach the levels of statistical significance (P= 0.188).

Table (7) : Association of SVG positivity rate with sit and frequency of DC

VARIABLES		*STREPTOCOCCUS VIRIDANS* GROUP				P value
		Positive		Negative		
		No	%	No	%	
Site of DC	Upper jaw	27	39.1	42	60.9	0.062
	Lower jaw	89	56.0	70	44.0	
	Both	12	54.5	10	45.5	
Frequency (No of teeth)	Single	66	47.5	73	52.5	0.188
	Multiple	62	55.9	49	44.1	

3.2.7 Presence of periodontitis

(Table 8) found that DC patients with periodontitis around the decayed tooth has significantly higher SGV positivity rate (71.0%) compared to those patients with periodontitis but negative for SVG s (29.0%), (P= 0.0001).

Table (8) : Association of SVG positivity rate with periodontitis of DC patients

Presence of Periodontitis	*STREPTOCOCCUS VIRIDANS* GROUP				P value
	POSITIVE		NEGATIVE		
	No	%	No	%	
Yes	44	71.0	18	29.0	0.0001
No	84	44.7	104	55.3	

3.2.8 pH of the saliva

Results in (Table 9) revealed that DC patients those saliva pH was 6.0 (slightly acidic) had insignificantly higher SVG positivity rate (55.3%) compared to other categories (P= 0.767). Furthermore, the Mean saliva pH ± SD of patients with positive SGV was insignificantly lower than that of patients with negative SVG (P= 0.872).

World Bulletin of Public Health (WBPH)
Available Online at: https://www.scholarexpress.net
Volume-20, March 2023
ISSN: 2749-3644

Table (9) : Association of SVG positivity rate with pH of saliva in DC patients

PH OF THE SALIVA	*STREPTOCOCCUS VIRIDANS* GROUP				P value
	POSITIVE		NEGATIVE		
	No	%	No	%	
4.0	18	51.4	17	48.6	0.767
5.0	40	50.6	39	49.4	
6.0	52	55.3	42	44.7	
7.0	13	43.3	17	56.7	
8.0	5	41.7	7	58.3	
Mean ± SD	6.09 ± 0.99		6.11 ± 1.07		0.872

3.2.9 Enzymes production

(Table 10) showed the rate of enzyme production by SVG isolated from DC. It appears that 86.0% of these isolates were proteases producers against 14.0% which were non-proteases producers. Regarding the hemolysin production, the results found that 87.6% were alpha hemolytic, 3.3% were beta hemolytic and 9.1% were non-hemolytic.

Table (10) : Enzyme production rate of the SVG isolated from DC.

ENZYME PRODUCTION		*STREPTOCOCCUS VIRIDANS* GROUP	
		No	%
Proteases production	Yes	104	86.0
	No	17	14.0
Hemolysin production	Alpha hemolytic	106	87.6
	Beta hemolytic	4	3.3
	Non-hemolytic	11	9.1

4. DISCUSSION

In the present study, a total of 222 (88.8%) swabs collected from dental caries had positive growth culthure. Keeping in this regard, the results also found that single bacterial growth was appeared in the majority (76.4%) of the swabs collected. This undoubtedly indicate the precession and efficiency in collecting and culturing dental swabs with minimal contamination.

Another fact in this respect is that the majority of culture outcome (51.2%) yields growth of Streptococcus viridans group (SVG), while (23.2%) yields lactobacillus group and lastly, (30%) yields Candida albicans growth. These results are consistent with several studies affirming that SVG are responsible for the bulk of dental caries (Aas et al; 2008, Tanner et al; 2015).

So, more than one half of patients in this study had SVG infection, this high rate of SVG infection was in agreement with studies conducted in our surrounding countries Mediterranean and North African countries (Elamin et al; 2021) as well as worldwide countries, like India (Jindal et al; 2020). In Iraq, actually this result was not unusual since all risk factors of dental caries were available whether related to patient's characteristics, family background, and oral hygiene and feeding and eating habits. Beside the neglected personal health and general health services in Iraq over the past 20 years.

Probably another factor enables the SVG to be number one in dental caries, is that these bacteria are part of the normal residential mouth flora (Ryan and Ray 2004). These bacteria beside its unique ability to synthesize dextrans from glucose, which allows them to adhere to dental plaque, making benefits from the disruption of oral microbiota or lowering the individual's immune response to establish themselves on the affected teeth causing infection which ultimately progress to caries (Sitkiewicz, 2018). The oral cavity harbors one of the most complex microbiomes in the body (Dewhirst et al; 2010).

Bacteria belonging to the genus Streptococcus are the first inhabitants of the oral cavity which can be acquired

World Bulletin of Public Health (WBPH)
Available Online at: https://www.scholarexpress.net
Volume-20, March 2023
ISSN: 2749-3644

right after birth and thus play an important role in the assembly of the oral microbiota (Wade, 2013). So, it is not unusual that the current study found that the SVG is comprising the majority of bacterial causes of dental caries as these bacteria possess all the characteristics and activities enable it to colonize and biofilm formation, carbohydrate fermentation and change the mouth pH, demineralization of bony structure of teeth and cavity formation (Shelburne *et al;* 2008, Nobbs *et al;* 2009).

4.1 Age groups

In this regard, the present result found that the age group 40-49 years old had significantly higher SVG detection rate (65.4%). Furthermore, children less than 10 years old had 38.5% detection rate. It is worthy to mention that this study includes wide range of ages. It is well known that patients at this age start complaining certain degree of immune compromization most probably due to the high rate of chronic diseases (Chen et al; 2013). Beside the fact that bone resorption was started at this age probably due to diet deficiency of certain minerals as well as the oral microbiota characteristics may become more virulent at this age.

It is worthy to mention that most of the similar studies carried out in surrounding area were focused on children and young adults, for instance in Egypt, the mean age among children was 1-3.5 years (Abu Hamila, 2013), in Iran 7-12 years (Bashirian et al; 2018), in Jordan, 4-5 years (Sayegh et al; 2002), in KSA 2-6 years (Wyne et al; 2001), in Kuwait 12-14 years (Al-Mutawa et al; 2006), in Syria, 4-5 years (Qadri et al; 2012), in Turkey, 3-6 years (Namal et al; 2005), in Qatar, 6-15 (Bener et al; 2013) and in UAE 11-17 years (Khadri et al; 2018) Factors relating to children's features, family history, oral health and newborn feeding and eating behaviors were identified as major predictors of dental caries (Elamin et al; 2021).

4.2 Gender and Residence

In connection with the gender, the results found that females have very slightly higher SVG detection rate against male (51.6 % Vs 50.9). Similarly, people who reside in urban areas have slightly higher SVG detection rate compared to those reside in rural areas (57.0 % Vs 46.9 %). These mild insignificant differences can be assigned to individual variation. Actually, this result is not unusual, since it consistent with the fact that urbanization increases certain community habits such as consumption of snacks, high sugar food stuffs and juices plus smoking among adolescents and young adults (Kumar et al; 2020). While in our country, the rural areas are still conservative communities even in their feeding habits.

4.3 Smoking

In our study, smoker was appeared as having insignificant higher D.C. compared to non-smokers (52.1% Vs 50.4%). The WHO estimates that tobacco is responsible for more than 7 million deaths and hundreds of billions of dollars loss, worldwide each year (WHO, 2017). More than 60 toxic chemicals in tobacco such as nicotine can invade the body's multiple systems leading to cardiovascular diseases, cancers and other systemic diseases (Everson *et al;* 2021, Raja *et al;* 2016). Additionally, tobacco is a harmful product responsible for adverse oral conditions and some oral diseases (Petersen, 2003). Many factors such as food, environment and microorganisms are associated with caries. In spite of that, there was no clear-cut evidence to confirm the hypothesis that tobacco, as a risk factor, is involved in the dental caries process. Therefore, this interpretation was consistent with the result of the current study (Ashkanane et al; 2019, Wagenknecht, 2018).

Although the smoking was insignificantly increasing the rate of SVG isolation rate in this study. However, it has been documented that smoking is one of the leading causes that enhance DC (Tanner et al; 2015, Sharma *et al;* 2018).

4.4 Comorbidities

In the current study, the presence of comorbidities among persons is generally and significantly increase the rate of DC (P = 0.0001). The hypertension and asthma were insignificantly associated (P= 0.250 and P= 0.433) respectively, but on the other hand the presence of DM was significantly associated with the increase in DC (P= 0.0001).

A number of epidemiological studies have been extensively established, showing that DM type 1 increases the risk of cardiovascular illnesses, renal disease and cognitive decline (Tonoli et al; 2014). Furthermore, an increasing number of research suggest a connection between type 1 diabetes and oral problems, including periodontal and dental caries (Khader et al; 2006, Miko et al; 2010). However, the precise incidence of DC in individuals with Type 1 DM remains unclear (Akpata et al; 2012, Rafatjou et al; 2016).

Generally, the presence of comorbidities was found to be significantly associated with increased rate of SVG isolation. Furthermore, specifically patients with DM also had a significantly higher rate of isolation compared to other comorbidities. These fascinating results are in agreement with most studies affirming that comorbidities particularly immunocompromised diseases or their medication were associated with DC (Tanner et al; 2015, Wu and Liu, 2019). This result is also concordant with studies affirming that patients with DM had more prevalence and severity of DC (Rafatjou et al; 2016).

4.5 Site and frequency of DC

World Bulletin of Public Health (WBPH)
Available Online at: https://www.scholarexpress.net
Volume-20, March 2023
ISSN: 2749-3644

Concerning the site of decayed tooth, the current results found that SVG positivity rate was insignificantly higher among those patients who had decayed tooth in the lower jaw compared to other categories (P= 0.062). Whereas, the frequency in the current results found that those patients with multiple decayed teeth had insignificantly higher positivity rate of SVG compared to those with single decayed tooth (P= 0.188). the current results are consistent with other studies assuring that higher frequency of DC was found due to pregnancy (Cho et al; 2020). This is most probably related to an increased craving for sweet and fast foods (Orloff et al; 2016), changes in oral factors, such as increased acidity in the mouth/saliva and reduction in saliva production, and fear of dental treatment (Russell and Mayberry, 2008, Ressler-Maerlender et al; 2005), pregnant women become more susceptible to (Martinez-Beneyto *et al;* 2011).

4.6 Presence of periodontitis

In the current study a significantly higher isolation rate was recorded in patients with periodontitis. This results is consistent with other studies obtained similar results (Milgrom et al; 2000, Dhotrea et al; 2018). Periodontal disease (gum disease), is a set of inflammatory conditions affecting the tissues surrounding the teeth. In its early stage, called gingivitis, the gums become swollen, red, and may bleed (Savage et al; 2009). The more severe kind of gums termed periodontitis may tear off the tooth, lose the bone and lose the teeth. Bad breath may also happen (Nibali *et al;* 2007). Among the contributing factors of gingivitis is Poor or ineffective oral hygiene, which leads to the accumulation of a mycotic and bacterial matrix at the gum line, called dental plaque. Other contributors are poor nutrition and underlying medical conditions such as DM (Lalla et al; 2007, Urzua et al; 2008).

4.7 Reaction of saliva

DC patients whose saliva pH was 6.0 (slightly acidic) had insignificantly higher SVG positivity rate (P= 0.767). Furthermore, the Mean saliva pH ± SD of patients with positive SGV was insignificantly lower than that of patients with negative SVG (P= 0.872). So, our result is consistent with (McKinnon and Davis 2004), found that however, there is no comprehensive evidence showing that salivary proteins could serve as potential indicators for the early diagnosis of the risk factors causing dental caries.

The current results found that the highest SVG isolation rate (55.3%) was among patient who's their pH of the saliva was 6.0. Although it is insignificant compared to other pH categories, but it clearly denotes that acidic pH of saliva promote the growth of SVG bacteria in the mouth. On the other hand, tooth minerals, especially hydroxyapatite was become soluble when exposed to acidic environments. Enamel begins to demineralize at a pH of 5.5. (Dawes, 2003). Dentin and cementum are more susceptible to caries than enamel because they have lower mineral content.

4.8 Enzymes production

The SVG isolated from DC had the ability for liberation of proteases as well as hemolysin production. The ability of these SVG isolates for biofilm formation was also detected. These virulence factors appear to play a central role in the pathogenesis of DC (Ryan and Ray 2004, Ardizzoni *et al;* 2018).

5. CONCLUSIONS

Dental caries is widely prevalent in our community over wide range of ages, most probably due to unhealthy eating habits and neglected dental health. More than eighty percent of dental caries swabs were positive for bacteriological culture.Streptococcus viridans group forming the highest rate of positivity among dental caries swab culture. The majority of these isolates are alpha hemolytic and posses high ability of proteases liberation as well as biofilm formation.The mostly affected ages are 40-49 years, while no significant effect of gender, residence, smoking, site and frequency of dental caries, presence of pain and swelling and duration. Concomitant Hypertension and Diabetes Mellitus and presence of periodontitis are significantly associated with SVG positivity. Shifting of salina pH toward acidity is positively associated with high SVG culture positivity.

REFERENCES

1. Aas, J.A., Griffen, A.L., Dardis, S.R., Lee, A.M., Olsen, I., Dewhirst, F.E., *et al;* (2008). Bacteria of dental caries in primary and permanent teeth in children and young adults. J. Clin. Microbiol. 46:1407-1417.
2. Al-Mendalawi, M.D. and Karam, N.T. (2014). Risk factors associated with deciduous tooth decay in Iraqi preschool children. Avicenna J. Med. 4(1): 5–8.
3. Abu Hamila, N. (2013). Early childhood caries and certain risk factors in a sample of children 1–3.5 years in Tanta. Dentistry. 4:1–3.
4. Bashirian S, Shirahmadi S, Seyedzadeh-Sabounchi S, Soltanian AR, Karimi-Shahanjarini A., *et al;* (2018). Association of caries experience and dental plaque with sociodemographic characteristics in elementary school-aged children: a cross-sectional study. BMC Oral Health. 18:7.
5. Bener, A., Al Darwish MS, Tewfik I, Hoffmann GF. (2013). The impact of dietary and lifestyle factors on the risk of dental caries among

World Bulletin of Public Health (WBPH)
Available Online at: https://www.scholarexpress.net
Volume-20, March 2023
ISSN: 2749-3644

young children in Qatar. J. Egypt. Public. Health. Assoc. 88:67–73.
6. Christen, G.L. (1987). A Rapid Method for Measuring Protease Activity in Milk Using Radiolabeled Casei. Journal of Dairy Science. 70 (9): 1807–14.
7. Chen, X., Clark, J.J., Preisser, J.S., Naorungroj, S., and Shuman, S. (2013). Dental Caries in Older Adults in the Last Year of Life. J Am Geriatr Soc. 61(8): 1345-50.
8. Dewhirst, F.E., Chen, T., Izard, J., Paster, B.J., Tanner, A.C., Yu, W.H., *et al;* (2010). The human oral microbiome. J. Bacteriol. 192(19):5002-17.
9. Elamin, A., Garemo, M. and Mulde, A. (2021). Determinants of dental caries in children in the Middle East and North Africa region: a systematic review based on literature published from 2000 to 2019. BMC Oral Health, 21:237-67.
10. Ismail, A.I., Pitts, N.B. and Tellez, M. (2015). The International Caries Classification and Management System (ICCMS™) an example of a Caries Management Pathway. BMC Oral Health 15(Suppl 1):S9
11. Jindal, L., Dua, P., Mangla, R., Gupta, K., Vyas, D.and Gupta, P. (2020). Dental caries in relation to socioeconomic factors of 6 and 12-year-old schoolchildren of Paonta Sahib, Himachal Pradesh, India: An epidemiological study. International Journal of Clinical Pediatric Dentistry (2020): 10.5005/jp-journals-10005-1805.
12. Khadri, F.A., Gopinath VK, Hector MP, Davenport ES. (2018). Evaluating the risk factors that link obesity and dental caries in 11–17-year-old school going children in the United Arab Emirates. Eur. J. Dent. 12:217–24.
13. MaACFddin, J.F. (2000). Biochemical tests for identification of medical bacteria. 3rd ed. Lippincott Williams and Wilkins, pp. 123- 131, USA.
14. Namal, N., Vehit HE, Can G. (2005). Risk factors for dental caries in Turkish preschool children. J. Indian. Soc .Pedod. Prev. Dent. 23:115–8.
15. Oliveira, L.B., Sheiham, A., Bonecker, M. (2008).Exploring the association of dental caries with social factors and nutritional status in Brazilian preschool children. Eur. J. Oral. Sci. 116(1):37-43.
16. Patterson, M.J. (1996). "Streptococcus". In Baron S, *et al;* (eds.). Baron's Medical Microbiology (4th ed.). University of Texas Medical Branch.
17. Ryan, K.J. and Ray, C.G. eds. (2004). Sherris Medical Microbiology (4th ed.). McGraw Hill. pp. 293-4.
18. Schwendicke, F., Dörfer, C.E., Schlattmann, P., Page, L.F., Thomson, W.M. and Paris, S. (2015). Socioeconomic Inequality and Caries: A Systematic Review and Meta-Analysis. Journal of Dental Research. 94 (1): 10–18.
19. Tanner, T., Pakkila, J., Karjalainen, K., *et al;* (2015). Smoking, alcohol use, socioeconomic background and oral health among young Finnish adults. Community Dentistry and Oral Epidemiology. 43(5):406-14.
20. Wade, W.G. (2013). The oral microbiome in health and disease. Pharmacol. Res. 69:137-43.
21. Sitkiewicz, I. (2018). How to become a killer, or is it all accidental? Virulence strategies in oral streptococci. Mol. Oral Microbiol. 33: 1–12.
22. Wagle, M., D'Antonio, F., Reierth, E., Basnet, P., Trovik, T.A., Orsini, G., *et al;* (2018). Dental caries and preterm birth: a systematic review and metaanalysis. BMJ Open. 8(3):e018556.
23. Laudenbach, J. M. and Simon, Z. 2014. Common dental and periodontal diseases: evaluation and management. Medical Clinics, 98: 1239-1260.
24. De Oliveira, K.M.H., Nemezio, M.A., Romualdo, P.C., da Silva, R.A.B., de Paula, E., Silva, F.W., *et al;* (2017). Dental Flossing and Proximal Caries in the Primary Dentition: A Systematic Review. Oral Health & Preventive Dentistry. 15 (5): 427-34.
25. Tanner, T., Päkkilä, J., Karjalainen, K., Kämppi, A., Järvelin, M. R., Patinen, P. and Anttonen, V. 2015. Smoking, alcohol use, socioeconomic background and oral health among young Finnish adults. Community dentistry and oral epidemiology, 43: 406-414.
26. Shelburne, S. A., Davenport, M. T., Keith, D. B. and Musser, J. M. 2008. The role of complex carbohydrate catabolism in the pathogenesis of invasive streptococci. Trends in microbiology, 16: 318-325.
27. Nobbs, A. H., Lamont, R. J. and Jenkinson, H. F. 2009. Streptococcus adherence and colonization. Microbiology and Molecular Biology Reviews, 73: 407-450.
28. Wyne, A., Darwish, S., Adenubi, J., Battata, S. and Khan, N. 2001. The prevalence and pattern of nursing caries in Saudi preschool

World Bulletin of Public Health (WBPH)
Available Online at: https://www.scholarexpress.net
Volume-20, March 2023
ISSN: 2749-3644

children. International journal of paediatric dentistry, 11: 361-364.
29. Qadri, G., Nourallah, A. and Splieth, C. H. 2012. Early childhood caries and feeding practices in kindergarten children. Quintessence International, 43: 503-510.
30. Everson, T. M., Niedzwiecki, M. M., Toth, D., Tellez-Plaza, M., Liu, H., Barr, D. B. and Gribble, M. O. 2021. Metal biomarker mixtures and blood pressure in the United States: cross-sectional findings from the 1999-2006 National Health and Nutrition Examination Survey (NHANES). Environmental Health, 20: 1-11.
31. Wagenknecht, D. R., BalHaddad, A. A. and Gregory, R. L. 2018. Effects of nicotine on oral microorganisms, human tissues, and the interactions between them. Current Oral Health Reports, 5: 78-87.
32. Ashkanane, A., Gomez, G. F., Levon, J., Windsor, L. J., Eckert, G. J. and Gregory, R. L. 2019. Nicotine upregulates coaggregation of Candida albicans and Streptococcus mutans. Journal of Prosthodontics, 28: 790-796.
33. Sharma, S., Mishra, S. K. and Mittal, N. 2018. Influence of tobacco dependence on caries development in young male adults: A cross-sectional study. Journal of conservative dentistry: JCD, 21: 597-602.
34. Petersen, P. E. 2003. Tobacco and oral health-the role of the World Health Organization. Oral Health and Preventive Dentistry, 1: 309-316.
35. Everson, T. M., Niedzwiecki, M. M., Toth, D., Tellez-Plaza, M., Liu, H., Barr, D. B. and Gribble, M. O. 2021. Metal biomarker mixtures and blood pressure in the United States: cross-sectional findings from the 1999-2006 National Health and Nutrition Examination Survey (NHANES). Environmental Health, 20: 1-11.
36. Raja, M., Garg, A., Yadav, P., Jha, K. and Handa, S. 2016. Diagnostic methods for detection of cotinine level in tobacco users: a review. Journal of clinical and diagnostic research: JCDR, 10: ZE04.
37. Rafatjou, R., Razavi, Z., Tayebi, S., Khalili, M. and Farhadian, M. 2016. Dental health status and hygiene in children and adolescents with type 1 diabetes mellitus. Journal of research in health sciences, 16: 122-129.
38. Akpata, E. S., Alomari, Q., Mojiminiyi, O. A. and Al-Sanae, H. 2012. Caries experience among children with type 1 diabetes in Kuwait. Pediatric dentistry, 34: 468-472.
39. Wu, F. Y. and Liu, J. F. 2019. Asthma medication increases dental caries among children in Taiwan: An analysis using the National Health Insurance Research Database. Journal of dental sciences, 14: 413-418.
40. Khader, Y. S., Dauod, A. S., El-Qaderi, S. S., Alkafajei, A. and Batayha, W. Q. 2006. Periodontal status of diabetics compared with nondiabetics: a meta-analysis. Journal of diabetes and its complications, 20: 59-68.
41. Miko, S., Ambrus, S. J., Sahafian, S., Dinya, E., Tamas, G. and Albrecht, M. G. 2010. Dental caries and adolescents with type 1 diabetes. British dental journal, 208: E12.
42. Cho, G. J., Kim, S. Y., Lee, H. C., Kim, H. Y., Lee, K. M., Han, S. W. and Oh, M. J. 2020. Association between dental caries and adverse pregnancy outcomes. Scientific reports, 10: 1-6.
43. Orloff, N. C., Flammer, A., Hartnett, J., Liquorman, S., Samelson, R. and Hormes, J. M. 2016. Food cravings in pregnancy: Preliminary evidence for a role in excess gestational weight gain. Appetite, 105: 259-265.
44. Russell, S. L. and Mayberry, L. J. 2008. Pregnancy and oral health: a review and recommendations to reduce gaps in practice and research. MCN: The American Journal of Maternal/Child Nursing, 33: 32-37.
45. Ressler-Maerlender, J., Krishna, R. and Robison, V. 2005. Oral health during pregnancy: current research. Journal of women's health, 14: 880-882.
46. Martinez-Beneyto, Y., Vera-Delgado, M. V., Pérez, L. and Maurandi, A. 2011. Self-reported oral health and hygiene habits, dental decay, and periodontal condition among pregnant European women. International Journal of Gynecology & Obstetrics, 114: 18-22.
47. Milgrom, P., Riedy, C. A., Weinstein, P., Tanner, A. C. R., Manibusan, L. and Bruss, J. 2000. Dental caries and its relationship to bacterial infection, hypoplasia, diet, and oral hygiene in 6-to 36-month-old children. Community dentistry and oral epidemiology, 28: 295-306.
48. Dhotrea, S., Jahagirdar, V., Suryawanshi, N., Davane, M., Patil, R. and Nagoba, B. 2018. Assessment of periodontitis and its role in viridans streptococcal bacteremia and infective endocarditis. Indian heart journal, 70: 225-232.
49. Savage, A., Eaton, K. A., Moles, D. R. and Needleman, I. 2009. A systematic review of definitions of periodontitis and methods that

World Bulletin of Public Health (WBPH)
Available Online at: https://www.scholarexpress.net
Volume-20, March 2023
ISSN: 2749-3644

have been used to identify this disease. Journal of clinical periodontology, 36: 458-467.
50. Nibali, L., D'Aiuto, F., Griffiths, G., Patel, K., Suvan, J. and Tonetti, M. S. 2007. Severe periodontitis is associated with systemic inflammation and a dysmetabolic status: a case–control study. Journal of clinical periodontology, 34: 931-937.
51. Lalla, E., Cheng, B., Lal, S., Kaplan, S., Softness, B., Greenberg, E. and Lamster, I. B. 2007. Diabetes mellitus promotes periodontal destruction in children. Journal of clinical periodontology, 34: 294-298.
52. Urzua, B., Hermosilla, G., Gamonal, J., Morales-Bozo, I., Canals, M., Barahona, S. and Cifuentes, V. 2008. Yeast diversity in the oral microbiota of subjects with periodontitis: Candida albicans and Candida dubliniensis colonize the periodontal pockets. Sabouraudia, 46: 783-793..
53. Dawes, C. (2003). What is the critical pH and why does a tooth dissolve in acid?. J. Canad. Dent. Ass. 69 (11): 722-4.
54. McKinnon, P. S. and Davis, S. L. 2004. Pharmacokinetic and pharmacodynamic issues in the treatment of bacterial infectious diseases. European Journal of Clinical Microbiology and Infectious Diseases, 23: 271-288.
55. Ardizzoni, A., Pericolini, E., Paulone, S., Orsi, C. F., Castagnoli, A., Oliva, I. and Blasi, E. 2018. In vitro effects of commercial mouthwashes on several virulence traits of Candida albicans, viridans streptococci and Enterococcus faecalis colonizing the oral cavity. PLoS One, 13: e0207262.