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Streptococcus mutans Dental Caries among Patients Attending Debre Berhan Referral Hospital, Ethiopia

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Abstract

Background: Dental caries is an irreversible microbial disease of the calcified tissues of the teeth. *Streptococcus mutans* is a bacterial resident of the oral cavity and is considered to be the principal etiological agent of dental caries in humans. Therefore, the aim of this study was to determine the prevalence and risk factors associated with *Streptococcus mutans* dental caries.

Methods: A cross sectional study was conducted among patients who attended Debre Berhan referral hospital dental clinic. Patient's demographic and clinical information was collected by using pre-tested questionnaire. Dental plaques from all patients was picked up by forceps and suspended in to phosphate-buffered saline for further *Streptococcus mutans* identification.

Result: From a total of 115 study participants 56 (48.7%) and 59 (51.3%) were males and females respectively. The overall prevalence of *Streptococcus mutans* was 79 (68.7%) among patients with dental caries. participants 25 (21.7%) had gem bleeding and 47 (40.9%) of the participants had previous tooth decay.

Conclusion: In this study, again *Streptococcus mutans* is the common public health problem among dental caries patients. Drinking soft drinks, oral debris and gingival index were the associated risk factor for dental caries of *Streptococcus mutans*.

Keywords: *Streptococcus mutans;* Dental caries; Ethiopia

Introduction

Dental plaque is an adherent deposit of bacteria and their products, which forms as a white greenish or even yellow film on all tooth surfaces. Dental plaque accumulates naturally at stagnant or retentive sites formed after one to two days with no oral hygiene [1]. Dental caries is the single most prevalent and costly infectious disease worldwide, affecting more than 90% of the population in the US. The development of dental cavities requires the colonization of the tooth surface by acid producing bacteria, such as *Streptococcus mutans*, in conjunction with the frequent ingestion of a cariogenic high sucrose diet, the substrate for acid and glucan production by organisms. The elevated amounts of acid and glucans modulate the establishment of cariogenic organisms within tightly adherent biofilms known as dental plaque [2]. *Streptococcus mutans* is one of the major etiological factors of dental caries. Tooth surfaces colonized with *S. mutans* are at a higher risk for developing caries [3]. Dental caries is an irreversible microbial disease of the calcified tissues of the teeth, which is characterized by demineralization of the inorganic portion and destruction of the organic substance of the tooth, which often leads to cavitation. Dental caries is a multifactorial disease, which is caused by host, agent, and environmental factors [4]. *Streptococcus mutans* are gram positive cocci bacteria. These facultative anaerobes are commonly found in the human oral cavity, and are a major contributor of tooth decay. *S. mutans* grow at temperatures between 18°C-40°C. *Streptococcus mutans* are a cariogenic microorganism that breaks down sugar for energy and produces an acidic environment, which dematerialize the superficial structure of the tooth. The result of the conversion disintegrates the coating of the tooth then later dissolves the Calcium molecule creating a hole [5,6]. *S. mutans* can be isolated from individuals either with or without a history of caries, but the development of dental caries dependent on the bacterial load strain variation of *S.mutans* including, acid-utility, biofilm-formation potential, and production of glucans [7,8].

Materials and Methods

Study area and period

The study was conducted at Debre Berhan referral hospital, which is located around 130 km away from Addis Ababa. The study was conducted from March, 2017 to August, 2018.

Study design

A cross sectional study was conducted.

Inclusion and exclusion criteria

All patients attending dental clinic of Debre Berhan referral hospital with clinical manifestation of dental caries and who are volunteer and able to give sample were included. Patients who are taking antibiotics in the last 30 day were excluded.

Sample size and sampling technique

The sampling technique was based on convenient sampling method. The sample size was all patients with clinical manifestation of dental caries who were visited Debre Berhan referral hospital dental clinic and fulfill inclusion criteria.

Data collection methods

Patient's socio demographic and clinical information was collected by using pre-tested questionnaire. All study participants was examined by dental doctor. Dental plaques from all patients were picked up through forceps (probe) and transferred into 2 ml of sterile tube containing phosphate-buffered saline and processed immediately after collection in Debre Berhan university microbiology laboratory [9].

Isolation and identification of *S. mutans*

The dental plaque suspension was vortexed for 30 s for content homogenization. Then a volume of 100 µl was spread onto Mitis-salivaris (MS-agr) by using sterile cotton swab and incubated in 5% CO_2 for 48 hours at 37°C. A colony count of more than 250 colonies (104 cells/ml) was considered as positive samples. Small colony was subculture on the surface of blood-agar plates for further identification. A gram positive cocci, alpha hemolytic on blood agar, catalase negative mannitol, and lactose fermenters was considered *S. mutans* [1,10].

Data entry and analysis

Data was edited, cleaned and checked for its completeness and was entered SPSS version 16 for analysis. Patients' Socio-demographic and clinical characteristics were described by using descriptive statistics. Bivariate and multivariate logistic regression analysis was done to identify the risk factors and p-value less than 0.05 was taken as statistically significant.

Ethical consideration

Ethical clearance was obtained from Debre Berhan University Ethical Review Board. Letter of permission was secured from Debre Berhan referral Hospital clinical director managements. Written informed consent and assent was obtained from the study participants. Any information concerning the patients was kept confidential and patients with positive result were communicated.

Quality control

To assure the quality of the data generated during the study, standard operating procedures were followed during media preparation and other laboratory procedures. Sterility check was performed to avoid the possibility of contamination. All reagents was checked for their expiry date and prepared according to the manufacturer's instruction.

Results

Among of 115 study participants, the overall prevalence of dental caries of *Streptococcus mutans* was 79 (68.7%).

Socio-demographic characteristics of the of the participants

Among 115 participants, 56 (48.7%) were males and 59 (51.3%) were females. The mean age of the participants was 32.67 years with standard deviation (SD=1.48). 64 (55.7%) and 51 (44.3%) of the participants were come from urban and rural area respectively. Regarding occupation 17 (14.8%) of them were housewife followed by farmer 13 (11.3%). In terms of educational status, majority of the residents, 34 (49.3%) has completed grade 12, as shown in Table 1.

Socio- demographic characteristics		Culture result for *Streptococcus mutans*		Total NO (%)
		Positive NO (%)	Negative NO (%)	
Sex	Male	43 (37.4)	13 (11.3)	56 (48.7)
	Female	36 (31.3)	23 (20.0)	59 (51.3)
Place of residence	Urban	41 (35.7)	23 (20.0)	64 (55.7)
	Rural	38 (33.0)	13 (11.3)	51 (44.3)
Occupation	Farmer	11 (9.6)	2 (1.7)	13 (11.3)
	Merchant	6 (5.2)	5 (4.3)	11 (9.6)
	Employed	10 (8.7)	7 (6.1)	17 (14.8
	Unemployed	3 (2.6%)	1 (0.9)	4 (3.5)
	Housewife	11 (9.6)	6 (5.2)	17 (14.8)
	Driver	1 (0.9)	0 (0)	1 (0.9)
	Other	37 (32.2)	15 (13.0)	52 (45.2)
Educational status	Illiterate	36 (31.3)	10 (8.7)	46 (40.0)
	Read &write only	2 (2.9)	3 (4.3)	5 (7.2)

	1-4 grade	5 (7.2)	5 (7.20)	10 (14.5)
	5-8 grade	7 (10.1)	1 (1.4)	8 (11.6)
	9-12 grade	7 (10.1)	5 (7.2)	12 (17.4)
	Above 12	22 (31.9)	12 (17.4)	34 (49.3)

Knowledge and practice on tooth cleaning habit of the respondents

From 115 participants 73 (63.5%) were cleaned their teeth and among these 73 (63.5%), 40 (54.8%) were used tooth stick and tooth brush respectively. From respondents who cleaned their teeth more than half of them were cleaned their teeth in sideway (horizontally) and also most of the participants were cleaned their tooth after meal and morning only. Very few were cleaned their teeth morning and before going to bed as shown in Table 2.

Knowledge and practice on oral health		**Culture result for *S. mutans***		
		Positive NO (%)	**Negative NO (%)**	**Total NO (%)**
Habit of cleaning teeth	Yes	47 (40.9)	26 (22.6)	73 (63.5)
	No	32 (27.8)	10 (8.7)	42 (36.5)
Materials used to clean teeth	Tooth Stick	28 (38.4)	12 (16.4)	40 (54.8)
	Charcoal	1 (1.4)	2 (2.7)	3 (4.1)
	Tooth brush & rinse with water	9 (12.3)	8 (11.0)	17 (23.3)
	Others	9 (12.3)	4 (5.5)	13 (17.8)
Frequency of cleaning teeth	Once a day	22 (30.1)	4 (5.5)	26 (35.6)
	After each meal	2 (2.7)	3 (4.1)	5 (6.8)
	Before and after each meal	2 (2.7)	3 (4.1)	5 (6.8)
	More than once a day	3 (4.1)	4 (5.5)	7 (9.6)
	Irregularly	18 (24.7)	12 (16.4)	30 (41.1)
Way of cleaning teeth	Top to bottom	6 (8.2)	5 (6.8)	11 (15.1)
	Side way	23 (31.5)	10 (13.7)	33 (45.2)
	Mixed	16 (21.9)	11 (15.1)	27 (37.0)
	Circular	2 (2.7)	0 (0.0)	2 (2.7)
Time of brushing teeth	Morning only	13 (17.8)	10 (13.7)	23 (31.5)
	After meal	16 (21.9)	8 (11.0)	24 (32.9)
	Before meal	3 (4.1)	0 (0.0)	3 (4.1)
	Before going to bed	2 (2.7)	0 (0.0)	2 (2.7)
	Irregular	11 (15.1)	8 (11.0)	19 (26.1)

Table 2: Knowledge and practice on tooth cleaning habit of patients attending dental clinic of Debre Berhan referral hospital from March 2017 to April 2018.

Associated risk factor for dental caries

Sixteen (13.9%) and 8 (7.0%) of the study participants had a habit of drinking alcohol and smoking cigarette respectively. Twenty eight (24.3%) of the participants had a habit of chewing chat. Seventy two (62.6%) of the participants had a habit of taking sweet in take or food. Twenty two (30.6%) of the participants were taking sweet intake irregularly. Eighty one (70.4%) of the participants had a habit of taking soft drink and significantly associated with *S. mutans* dental caries (p=0.01) as shown in Table 3.

Associated risk factor		Culture result *Streptococcus mutans*			p- value
		Positive No (%)	Negative No (%)	Total No (%)	
Habit of drinking alcohol	Yes	13 (11.3)	3 (2.6)	16 (13.9)	0.24
	No	66 (57.4)	33 (28.7)	99 (86.1)	
Frequency of drinking alcohol	Always	0 (0.0)	1 (6.2)	1 (6.2)	0.10
	Sometimes	6 (37.5)	1 (6.2)	7 (43.8)	
	Rarely	7 (43.8)	1 (6.2)	8 (50)	
Habit of smoking cigarette	Yes	8 (7)	1 (0.9)	9 (7.8)	0.17
	No	71 (61.7)	35 (30.4)	106 (92.2)	
Frequency of smoking cigarette	Regularly	5 (55.6)	0 (0.0)	5 (55.6)	0.32
	Occasionally	3 (33.3)	0 (0.0)	3 (33.3)	
	Rarely	0 (0.0)	1 (11.1)	1 (11.1)	
Habit chewing chat	Yes	23 (20)	5 (4.3)	28 (24.3)	0.08
	No	56 (48.7)	31 (27.0)	87 (75.7)	
Frequency of chewing chat	Regularly	8 (28.6)	1 (3.6)	9 (32.6)	0.40
	Occasionally	12 (42.9)	2 (7.1)	14 (50.0)	
	Rarely	3 (10.7)	2 (7.1)	5 (17.9)	
Habit of taking sweet intakes or food	Yes	46 (40)	26 (22.6)	72 (62.6)	0.15
	No	33 (28.7)	10 (8.7)	43 (37.4)	
Kind of sweet intake	Chocolate	0 (0.0)	3 (4.2)	3 (4.2)	0.20
	Candy	1 (1.4)	1 (1.4)	2 (2.8)	
	Sugar cane	6 (8.3)	3 (4.2)	9 (12.5)	
	Sugared coffee	21 (29.1)	8 (11.1)	29 (40.3)	
	Sugared tea	12 (16.7)	9 (12.5)	21 (29.2)	
	Others	6 (8.3)	2 (2.8)	8 (11.1)	
Frequency of taking sweet intake	Once a day	13 (18.1)	3 (4.2)	16 (22.2)	0.15
	After each meal	8 (11.1)	1 (1.4)	9 (12.5)	
	More than once a day	12 (16.7)	10 (13.9)	22 (30.6)	
	Irregularly	12 (16.7)	10 (13.9)	22 (30.6)	
	Every other day	1 (1.4)	1 (1.4)	2 (2.8)	
	Once time per week	0 (0.0)	1 (1.4)	1 (1.4)	
Habit of taking soft drinks	Yes	50 (43.5)	31 (27.0)	81 (70.4)	0.01
	No	29 (25.2)	5 (4.3)	34 (9.6)	
Frequency of taking soft drink	Regularly	3 (3.7)	4 (4.9)	7 (8.6)	0.26
	Occasionally	28 (34.6)	12 (14.8)	40 (49.4)	
	Rarely	19 (23.5)	15 (18.5)	34 (42.0)	

Presence xerostomia	Yes	4 (3.5)	0 (0.0)	4 (3.5)	0.17
	No	75 (65.2)	36 (31.3)	111 (100)	
Diabetes mellitus	Yes	15 (13.0)	4 (3.5)	19 (16.5)	0.29
	No	64 (55.7)	32 (27.8)	96 (83.5)	

Table 3: Associated risk factor for dental caries in patients attending dental clinic of Debre Berhan referral hospital from March 2017 to April 2018.

Clinical data on oral health

In this study, a total of 115 participants 25 (21.7%) had gem bleeding and 47 (40.9%) of the participants had previous tooth decay. Nearly more than half the respondents had oral debris covering not more than one third of the tooth surface. Only 42 (36%) were free from oral debris. Oral debris has statistically significance association with *S. mutans* dental caries (P=0.022). Most of the participants 55 (47.8%) had normal gingival index and 50 (43.5%) had mild inflammation but only 1 (0.9%) had sever inflammation. Gingival index has statistically significant association with *S. mutans* dental caries (P=0.002). Fifty eight (50.4%) of the participant had no calculus index and 41 (35.7%) had mild super gingival calculus. Only few 3 (2.6%) had excessive supra and sub gingival calculus as shown in Table 4.

Clinical finding		**Result**			**p–value**
		Positive No (%)	**Negative No (%)**	**Total No (%)**	
Gem bleeding	Yes	18 (15.7)	7 (6.1)	25 (21.7)	0.69
	No	61 (53.0)	29 (25.2)	90 (78.3)	
Previous tooth decay	Yes	35 (30.4)	12 (10.4)	47 (40.9)	0.27
	No	44 (38.3)	24 (20.9)	68 (59.1)	
Oral debris	No debris	22 (19.1)	20 (17.4)	42 (16.5)	0.022
	Soft Debris covering not more than 1/3 of the tooth surface	47 (40.9)	14 (12.2)	64 (53.0)	
	Soft debris covering more than 1/3 but not more than 2/3 of the exposed tooth surface	9 (7.8)	1 (0.9)	10 (8.7)	
	soft debris covering more than two third of exposed tooth surface	1 (0.9)	1 (0.9)	2 (1.8)	
Plaque index	no plaque	1 (27.0)	20 (17.4)	51 (44.4)	0.23
	plaque adhering to the free gingival margin which cannot be seen by naked eye	39 (33.9)	12 (10.4)	51 (44.3)	
	moderate accumulation of deposits on the gingival margin which can be seen with naked eye	9 (7.8)	4 (3.5)	13 (11.3)	
Gingival index	Normal	30 (26.1)	25 (21.7)	55 (47.8)	0.002
	mild inflammation	40 (34.8)	10 (8.7)	50 (43.5)	
	Moderate inflammation	9 (7.8)	0 (0)	9 (7.8)	
	sever inflammation	0 (0)	1 (0.9)	1 (0.9)	
Calculus index	No calculus	36 (31.3)	22 (19.1)	58 (50.4)	0.24
	Mild super gingival calculus	29 (25.2)	12 (10.4)	41 (35.7)	
	Moderate supra & sub gingival calculus	11 (9.6)	2 (1.7)	13 (11.3)	

	Excessive supra & sub gingival calculus	3 (2.6)	0 (0)	3 (2.6)	

Table 4: Clinical finding in patients attending dental clinic of Debre Berhan referral hospital from March 2017 to April 2018.

Class of tooth decay

From the total 47 tooth decay cases, 21 (44.7%) of them had class I followed by class II which was 17 (36.2%) as shown in Table 5.

Class of tooth decay	Frequency No (%)
Class I	21 (44.7)
Class II	17 (36.2)
Class III	4 (8.5)
Class IV	2 (4.3)
Class V	3 (6.4)
Total	47 (100)

Table 5: Frequency of class of tooth decaying patients attending dental clinic of Debre Berhan referral hospital with culture results for *S. mutans* from March 2017 to April 2018.

Discussions

In Ethiopia, there is scarcity of data on *Streptococcus mutans* dental caries. In this study *Streptococcus mutans* dental caries is the major public health problem among patients attending dental clinic of Debre Berhan referral hospital. In this study, the prevalence of *Streptococcus mutans* dental caries was found to be (68.7%) which is comparable with a study conducted in Brazil (68.5%) [11], China (67.5%) [12] and Srilanka (68.8%) [13]. However, it was lower than study conducted in Qatar (85%) [14], Saudi Arabia (80%) [15]. It was higher than study conducted in other parties of Ethiopia particularly in Gondar (36.3%) [15].The difference could be due to the difference in knowledge and practice on oral hygiene.

Habit of taking soft drink was found to be statistically significance association with *Streptococcus mutans* dental caries. This also supported by similar findings done in India and Zimbabwe respectively [16,17]. This also might be associated with acid production by cariogenic organism such as *Streptococcus mutans* that adherent to teeth as result of fermentation of soft drink. Later the enamel of tooth went to tooth decay.

In this study, the highest prevalence was seen in urban area 41 (35.7%) than rural 38 (33.0%). This finding was in agreements with a study done in Zimbabwe [17]. The possible reason for this also might be due to the habit of urban population taking soft drink and food.

Oral debris is a major risk factor for dental caries; that has statistically significant association with *Streptococcus mutans* dental caries than those who had no oral debris. This finding also confirms other findings [18]. Moreover; gingival index was significance association with *Streptococcus mutans* dental caries. Patients with gingival index were more likely to have dental caries of *Streptococcus mutans*. This also might be a good indicator of poor oral hygiene practices [19]. Because gingival index increase *Streptococcus mutans* colonization and in severe cases it involves loses of the enamel.

In this study drinking alcohol, smoking cigarette, taking soft intake, plaque index and calculus index and chewing chat has no significant association with *Streptococcus mutans* dental caries [20]. The reason for this discrepancy might be short data collection period and small number of the study population.

Conclusions and Recommendations

Dental caries of *Streptococcus mutans* is the common public health problem among patients attending at dental clinic of Debre Berhan referral hospital. Soft drinks, oral debris and gingival index were the associated risk factor for dental caries of *Streptococcus mutans*. Health education on oral hygiene, dietary habit and dental visit should be given to prevent and control *Streptococcus mutans* dental caries. Moreover, further studies using all diagnostic method should be done.

Conflict of Interests

The authors declare that they have no conflict of interests.

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Authors' Contributions

DS performed the laboratory activities. DS analyzed the data. TA wrote the manuscript. All authors read and approved the final manuscript.

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