Original Article

Profiles of Sugar Fermenting Bacteria of the Oral Cavity among Children with Dental Caries Attending Stomatology Services at Ruhengeri Referral Hospital in Musanze District, Northern Rwanda

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Abstract

Background: Dental caries remains a public health threat of concern among children. About 2.3 billion people are affected by dental caries, of which 530 million are children globally. **Objective:** This study was carried out to identify sugar fermenting bacteria in the oral cavity and their antibiotic susceptibility pattern, assess the association with sugar fermenter bacteria and dental caries and evaluate dental caries outcomes among children. **Materials and Methods:** This was a cross-sectional study conducted between October 2021 and February 2022 at Ruhengeri Referral Hospital. About 136 oral swab samples were collected from children with and without dental caries at 1:1 ratio. The samples were put in Stuart sterile container and transported to INES-clinical microbiology laboratory for microbial identification. Logistic regression analysis of demographic characteristics was performed to study the relationship between demographic variables and dental caries. Chi-square test was performed for the association between variables. **Results:** About 67.6% were male, while children of age 7–9 years (64.7%) dominated the age groups. *Lactobacilli spp* (15.29%) and *Streptococcus mutans* (12.94%) were the most predominant microorganisms observed in the oral cavity among children with dental caries. The *S. mutans* (x^2 = 27.03, P < 0.00001, 95% confidence interval [CI]=0.2901–0.5785), *S. aureus* (x^2 = 34.59, P < 0.00001, 95% CI = 0.3541–0.6292), *Enterobacter aerogenes* (x^2 = 13.5, P = 0.000239, 95% CI = 0.151–0.4622), *Serratia marcescens* (x^2 = 11.64, P = 0.00645, 95% CI = 0.1275–0.4418) and *Klebsiella pneumonia* (x^2 = 13.51, P = 0.000237, 95% CI = 0.1511–0.4623) were significantly associated with dental caries. Teeth loss (x^2 = 51.04, P < 0.00001, 95% CI = 0.4757–0.7205), teeth pain (x^2 = 5.05, P = 0.0246, 95% CI = 0.0249–0.33499), and infection (x^2 = 4.73, P = 0.02964, 95% CI = 0.0186–0.3441) were dental outcomes associated with tooth decay. Ciprofloxacin, clindamycin, and amoxicillin were the most sensitive antibiotics, while vancomycin and chloramphenicol were the most resistant. **Conclusion:** Sugar consumption favours the growth of sugar fermenter bacteria that cause dental caries among children. Dental caries is associated with adverse oral health outcomes among children. Oral health education is recommended for children. Parents are advised to reduce the consumption of sugary food for their children for oral health safety.

Keywords: Bacteria, children, fermentation, sugar

Introduction

Dental caries is considered a public health concern among non-communicable diseases in the world. About 2.3 billion people are affected by tooth decay of the permanent teeth, while 530 million children suffer from caries of primary teeth globally.[1] The dose-response relationship between sugar consumption and tooth decay has been observed by researchers.[2] They indicate that the human oral cavity is colonised by 200–300 bacterial species, but

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few of them contribute to dental decay (caries) and periodontal disease.[3] *Streptococcus mutans* is the main contributor of tooth decay while various lactobacilli are associated with the progression of the tooth lesion.[4] Fermentation is the process by which sugars are broken down by enzymes of microorganisms in the absence of oxygen. Microorganisms possess genes that coordinate the production of enzymes responsible for the breakdown of sugars. Historically, fermentation was used in food preservation, however, this may change the nutritional quality of food in one way to another depending on the method used.[5] Sugars are carbohydrates, their fermentation by microorganisms leads to energy production in the form of adenosine triphosphate.[6] Fermentation of sugars leads to the production of organic acids or gas that corrodes teeth.[7] Fermentation patterns differ by species, genera or groups of organisms, making biochemical differentiation of microorganisms possible.[8] Tooth decay occurs when bacteria in the oral cavity produce acids that attack the outer layers of teeth and the enamel. It is also aggravated by the presence of food particles containing carbohydrates that get stuck on the teeth or in between teeth.[9] Foods such as milk, soda, raisins, candy, cake, fruit juices, cereals and bread are the main contributors of tooth decay among children because they are good medium for bacteria living in the mouth to make acids that facilitate dental plaque and facilitate tooth decomposition.[10] Acids produced by sugar fermenter bacteria destroy the enamel and creates small holes in teeth known as cavity. If dental caries remains untreated, it may contribute to tooth pain, infection and tooth loss.[11] Tooth decays cuts across all ages and gender and all can get affected mostly due to eating habits. However, children are at high risk of getting early childhood caries (ECCs). For older adults, receding of the gum may occur and enable for decay-causing bacteria to invade the tooth's root.[12] Dental caries is a key driver of high morbidity among patients and is a source of concern among professionals to take into consideration.[13] Early stages of dental caries are symptomatic, but the clinical stage is characterised by tooth pain, inflammation and abscesses, or widespread sepsis. If left untreated, dental health disorders may lead to adverse complications such as difficulties in eating, speaking, playing and learning.[14] Dental caries may cause adverse growth and development patterns in children and may sometimes cause absenteeism among school-going children.[15]

Materials and Methods

Ethical consideration

Ethical approval was sought and received from Ruhengeri Referral Hospital Ethical Review Board. The ethical approval letter (Ref/911/RRH/DG/2021) was provided on October 20, 2021. Informed consent was obtained from the parent before collecting oral swab samples from study participants. Patients' data were handled confidentially coupled with coding to identify patients from whom the data were obtained.

Study area

This study was carried out that carried out from September 2021 to January 2022 at Ruhengeri Referral Hospital in Muhoza sector, Musanze district in Northern Province of Rwanda.

Study design

This was a cross-sectional study.

Study population and sample size

A total of 136 children were recruited for this study, 68 of which had dental caries the remaining half constituted a control group who did not have dental caries.

Inclusion criteria

The study included both children with and without dental caries whose parents signed the written informed consent.

Exclusion criteria

We excluded children whose parents did not consent to participate in the study. Adolescents from 14 years and those with other oral health outcomes other than tooth decay were also excluded from the study.

Sample collection and bacterial identification

Samples were collected from decayed tooth and its surroundings swabbed with sterile cotton and transferred to a sterile screw-capped tube containing 5 ml of peptone water prepared under aseptic conditions, store at 4°C in the laboratory, and then vortexed for 1 min to spread the bacteria before processing.

Bacterial isolation and identification

Culture media such as blood agar (BA), MacConkey agar (MAC) and Mannitol Salt Agar were prepared for isolation of bacteria from dental caries samples and incubated as per standards. BA is a nutritious medium used for the growth of fastidious organisms and MAC was used to differentiate lactose fermenters from non-lactose fermenters bacteria. Urease, Kligler Iron Agar, Sulfide Indole Motility tests for Gram-negative bacteria and Catalase, coagulase tests for Gram-positive bacteria were performed to distinguish various bacterial reactions toward different chemicals depending on their nature and based on this bacterial identification was performed.

Antibiotic susceptible test

Antimicrobial susceptibility testing was performed using the Kirby–Bauer disk diffusion method according to Clinical Laboratory Standards Institute (CLSI) guidelines on Muller–Hinton Agar. The suspension of 3–5 colonies of freshly grown test organisms was prepared to the equivalent of 0.5 McFarland standard. The Muller–Hinton agar surface was covered by swirling the swab with the suspension. The plates were exposed to room temperature to dry for 3–5 min: Then, the discs were applied over the inoculated plates using sterile forceps and incubated at 37°C for 18–24 h. The diameter of the clear zone around the disc was measured using a ruler. Results were interpreted as sensitive, intermediate, and resistant according to CLSI 2020 recommendation.

Statistical analysis

We carried out logistic regression to test for the relationship between demographic characteristics and dental caries among

children. The Chi-square test was used to determine the association between sugar consumption and colonisation of oral sugar fermenting bacteria, and sugar fermenting bacteria and dental caries and associated outcomes. SPSS version 22 (IBM Company located in New York, USA) was used for analysis, while results were presented in the form of figures and tables.

Results

Demographic characteristics of participants

Our analysis showed that half of 34 (50.0%) had severe dental caries while almost a half, 32 (47.1%) of the cases were acute. Ages 7 and 8 years were the most affected with dental caries at 16 (23.6%) and 18 (26.5%), respectively. Males were the most affected 46 (67.6%) compared to females 22 (32.4%). The participants were grouped into Social economic classes of Rwanda, such as class (C) 21 (30.9%), Class B 20 (29.4%), Class (D) 16 (23.5%), and Class (A) stood at 11 (16.2%). More than three-quarters of the children, 56 (82.4%) had employed parents. Over a fifth, 16 (23.5%) had parents with bachelor's degree while 14 (20.6%) had parents with diploma. About half of the children, 36 (52.9%) were from urban areas while 28 (41.2%) were candy consumers [Table 1].

Bacteria isolated in both children with and without dental caries

Figure 1 shows comparison of sugar fermenter bacteria isolated from oral sample from children with and without dental caries. The microorganisms isolated among the two groups were *Lactobacilli spp (15.29%, 12.35%), Staphylococcus aureus (16.4%, 7.05%), S. mutans (12.94%, 0.00%), Enterobacter aerogenes (6.47%, 0.00%), Pseudomonas aeruginosa (5.29%, 3.52%), Streptococcus pneumonia (4.11%, 1.17%), Serratia marcescens (4.11%, 0.00%), Klebsiella pneumonia (3.52%, 0.58%), Streptococcus pyogenes (3.52%, 1.17%), Staphylococcus epidermidis (1.17%, 0.00%) and Citrobacter freundi (1.17%)*.

Logistic regression of demographic characteristics

Table 2 indicates the relationship between demographic characteristics and dental caries among children. The relationship was tested using a logistic regression model.

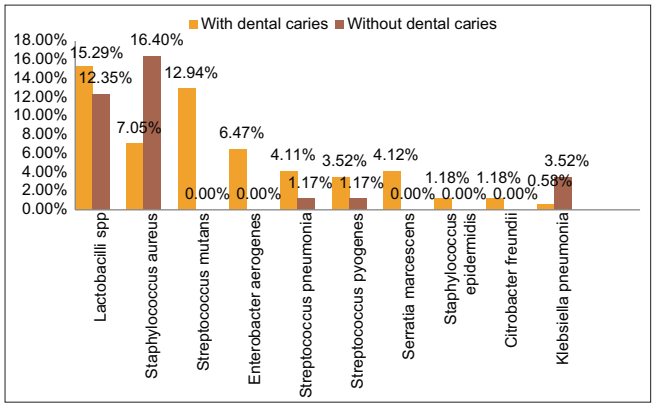

Figure 1: Identified bacteria in both case and control group

Among demographics, being a male gender (P = 0.02, 95% confidence interval [CI] = −5.266–0.376) and having primary level education (P = 0.008, CI = 1.470–10.023) were statistically significantly associated with having dental caries. Other demographic characteristics were not statistically significant.

Association with sugar fermenter bacteria and dental caries among children

S. aureus ($P < 0.00001$, 95% CI = 0.3541–0.6292), *S. mutans* ($P < 0.00001$, CI = 0.2901–0.5785), *E. aerogenes* (P = 0.000239, 95% CI = 0.151–0.4622), *S. marcescens* (P = 0.000645, 95% CI = 0.1275–0.4418) and *K. pneumonia* (P = 0.000237, *95% CI* = 0.1511–0.4623) were statistically significant. Other bacteria were not statistically significant. The overall association for sugar fermenter bacteria and dental caries among children was statistically significant (x^2 = 110.61, df = 11, $P < 0.00001$, 95% CI = 0.8354–0.9423) [Table 3].

Relationship between sugar consumption and colonisation of sugar fermenter bacteria

Chi-square test was performed to test for the relationship between sugar consumption and colonisation of sugar fermenter

Table 1: Demographic characteristics

Parameters	*n* (%)
Ages of participants	
4-6	18 (26.5)
7-9	44 (64.7)
10-13	6 (8.8)
Gender of participants	
Male	46 (67.60)
Female	22 (32.40)
Economic status of parents	
Category A	11 (16.20)
Category B	20 (29.40)
Category C	21 (30.90)
Category D	16 (23.50)
Employment status of parents	
Employed	56 (82.40)
Unemployed	12 (17.60)
Education level of parents	
None educated	7 (10.30)
Primary	11 (16.20)
Ordinary level	13 (19.10)
Advanced level	7 (10.30)
Diploma	14 (20.60)
Bachelor's	16 (23.50)
Residence of parent	
Rural	32 (47.10)
Urban	36 (52.90)
Kind of sugar consumed	
CD	28 (41.20)
JC	2 (2.90)
BC	10 (14.70)
CD and BC	16 (23.50)
JC, CD and BC	12 (17.60)

CD: Candy, BC: Biscuits, JC: Juice

Table 2: Logistic regression on demographic characteristics

Parameter	Estimate	SE	Wald	df	Significant (*P*)	95% CI
Age	0.148	0.354	0.174	1	0.677	−0.546-0.841
Gender						
Male	−2.821	1.247	5.113	1	0.024	−5.266-0.376
Female	0			0		
Economic status						
Category A	2.49	2.377	1.098	1	0.295	−2.168-7.148
Category B	3.884	2.546	2.327	1	0.127	−1.106-8.874
Category C	1.476	2.372	0.387	1	0.534	−3.173-6.125
Category D	0			0		
Education level						
Non-educated	3.759	2.048	3.367	1	0.067	−0.256-7.774
Primary	5.746	2.182	6.936	1	0.008	1.470-10.023
Ordinary level	0.153	1.445	0.011	1	0.916	−2.678-2.984
Advanced level	−1.255	1.636	0.588	1	0.443	−4.461-1.952
Diploma	1.004	1.23	0.666	1	0.415	−1.408-3.416
Bachelor's degree	0			0		
Residence						
Rural	0.363	1.651	0.048	1	0.826	−2.873-3.599
Urban	0			0		
Kind of sugar						
CD	1.387	1.506	0.848	1	0.357	−1.565-4.339
JC	0			0		
BC	1.728	2.384	0.525	1	0.469	−2.945-6.401
CD and BC	2.841	1.578	3.24	1	0.072	−0.253-5.935
JC, CD and BC	0			0		
Employment status						
Employed		1.152	2.016	0.327	1	−2.799-5.103
Unemployed		0			0	

CI: Confidence interval, SE: Standard error, CD: Candy, BC: Biscuits, JC: Juice

Table 3: Association of sugar fermenter bacteria and dental carries

Bacteria identified	Patients		Control		Total	χ^2	95% CI	*P*
	OV	EV	OV	EV				
Lactobacilli spp.	52	58.21	42	35.78	94	1.74	−0.0551-0.2751	0.187139
Staphylococcus aureus	24	49.54	56	30.45	80	34.59	0.3541-0.6292	<0.00001
Streptococcus mutans	44	27.25	0	16.74	44	27.03	0.2901-0.5785	<0.00001
Streptococcus pneumoniae	14	11.14	4	6.85	18	1.91	−0.0498-0.2802	0.166963
Streptococcus pyogenes	12	9.9	4	6.09	16	1.77	−0.0542-0.276	0.183382
Enterobacter aerogenes	22	13.63	0	8.37	22	13.5	0.151-0.4622	0.000239
Serratia marcescens	14	8.67	0	5.32	14	11.64	0.1275-0.4418	0.000645
Staphylococcus epidermidis	4	2.47	0	1.52	4	2.46	−0.0338-0.2953	0.116779
Klebsiella pneumoniae	2	8.67	12	5.32	14	13.51	0.1511-0.4623	0.000237
Citrobacter freundii	4	2.47	0	1.52	4	2.46	−0.0338-0.2953	0.116779
Total	192	191.95	118	117.96	310	110.61	0.8354-0.9423	<0.00001

OV: Observed values, EV: Expected values, CI: Confidence interval

bacteria. A significant association was observed for each sugar consumed where fruit juice ($x^2 = 27.905$, $P = 0.00099$) and candy with biscuit ($x^2 = 25.39$, $P = 0.00256$). Other sugars consumed did not have a significant effect on dental caries. The overall relationship between sugar consumption and colonisation of sugar fermenters among children with dental caries was statistically significant ($x^2 = 82.916$, $P < 0.00001$) [Table 4].

Outcomes associated with dental caries among children

Table 5 indicates the outcomes associated with dental caries. The Chi-square test was performed to test for this association. A significant association was observed to tooth loss ($P < 0.00001$, 95% CI = 0.4757–0.7205), tooth pain ($P = 0.024626$, 95% CI = 0.0249–0.3499) and infection ($P = 0.029641$, 95% CI = 0.0186–0.3441). Other

Table 4: Relationship between sugar consumption and colonization of oral sugar fermenting bacteria

Bacteria	*Lactobacilli*	*Staphylococcus aureus*	*Streptococcus mutans*	*Streptococcus pneumoniae*	*Streptococcus pyogenes*	*Enterobacter aerogenes*
Sugars						
CD	24	8	16	8	2	4
BC	8	4	8	0	2	6
JC	2	0	2	0	2	0
CD and BC	10	10	10	2	6	4
CD, BC and JC	8	4	10	2	2	6
Total	52	26	46	12	14	20

Bacteria	*Serratia marcescens*	*Staphylococcus epidermidis*	*Klebsiella pneumoniae*	*Citrobacter freundii*	Total	χ^2	95% CI	*P*
Sugars								
CD	8	2	0	0	72	11.85	0.18-0.602	0.2218
BC	0	0	0	0	28	9.142	0.13-0.56	0.4242
JC	0	2	0	0	8	27.905	0.44-0.77	0.00099
CD and BC	0	0	2	4	48	25.39	0.408-0.75	0.00256
CD, BC and JC	6	2	0	0	40	8.629	0.12-0.55	0.4722
Total	14	4	2	4	196	82.916		<0.00001

CD: Candy, BC: Biscuits, JC: Juice, CI: Confidence interval

Table 5: Outcomes associated with dental caries among children

Outcomes	Patients		Control		Total	χ^2	95% CI	*P*
	OV	EV	OV	EV				
Tooth loss	38	51.9	18	4.09	56	51.04	0.4757-0.7205	<0.00001
Tooth pain	64	59.3	0	4.68	64	5.05	0.0249-0.3499	0.024626
Tooth color change	28	27.8	2	2.19	30	0.017	0.1556-0.1774	0.896263
Infection	60	55.6	0	4.39	60	4.73	0.0186-0.3441	0.029641
Sensitive to food	62	59.3	2	4.68	64	1.65	0.0581-0.2723	0.198959
Regress in class performance	34	31.5	0	2.48	34	2.67	0.0281-0.3006	0.102256
Regress in speak	18	18.5	2	1.46	20	0.21	0.1281-0.2045	0.646767
Total	304	303.6	24	23.97	328	65.36	0.5697-0.7861	<0.00001

OV: Observed values, EV: Expected values, CI: Confidence interval

dental caries outcomes were not statistically significant. The overall association between adverse outcomes and dental caries was statistically significant ($P < 0.00001$, 95% CI = 0.5697–0.7861).

Antimicrobial susceptibility of isolated bacteria

Ciprofloxacin was the most sensitive to most of the bacteria isolated, followed by amoxicillin while chloramphenicol was most resistant followed by vancomycin [Table 6].

Discussion

Dental caries has been a global oral health burden on children and has a deleterious effect on the overall health and quality of life in Low and medium income Countries (LMIC). Dental caries affects all age groups, although children are affected to a greater extent than adults. The pre-primary school and lower primary school going children have higher prevalence of dental caries. At this age, parents likely feed their children with soothing sugary food before they take them to school, which encourages a culture of preference for sugary food among children. Children with parents who were in employment were the most affected by dental caries. Parents with good income have means to buy industrial sugary food compared to those with low economic status which justifies why dental caries was prevalent among children from families with employment income. This was also observed among children from urban residences and children with educated parents. Candy (41.2%) was the most consumed sugary food and its combination with biscuit was statistically significant to favor the growth of sugar fermenter bacteria in the oral cavity among children. Children in their early primary age (64.7%) were observed to be the most affected age group compared to other age groups. These children often share sweets while on their way to school which may be the cause of the increase of dental caries in this group of age [Table 1]. The study carried out to evaluate the effect and acceptance of silver diamine fluoride treatment on dental caries in primary teeth among children reported that 42% of children aged 2 to 11years have had dental caries in their primary teeth, with some 23% of them having untreated dental caries.[16] This was in agreement with the current study where almost a half of the children participating in the study

Table 6: Antimicrobial susceptibility of isolated sugar fermenter bacteria

Bacteria	Antibiotics																				
	CPR			VCM			AMX			GET			CHL			CD			LEV		
	R	S	IN	R	S	IN	R	S	IN	R	S	IN	R	S	IN	R	S	IN	R	S	IN
Staphylococcus aureus		40		7				38			19		10				22			30	
Enterobacter aerogenes		38		0				17		0			7				18		17		
Streptococcus pyogenes		39		12				25			23		10				28			30	
Streptococcus pneumoniae		35			23			36		12			11				28			29	
Citrobacter freundii		38		10				22		6			11				27			29	
Staphylococcus epidermidis		36		0			0			5			13				27			30	
Streptococcus mutans		40		10				32		19			9				28		14		
Serratia marcescens		39		12					16			16	10				30			31	
Streptococcus pneumoniae		33		9					14			20		23			29			30	
Lactobacilli spp.		38		11				21				16		18			27			36	

CRP: Ciprofloxacin, VCM: Vancomycin, AMX: Amoxicillin, GET: Gentamicin, CHL: Chloramphenicol, CD: Clindamycin, LEV: Levofloxacin, S: Sensitive, IN: Intermediate, R: Resistant

had severe dental caries while other had experienced tooth loss. Dental was more prevalent in urban population (58.9%) compared to rural population (51.4%), while males were the most affected than females.[17] The findings from the study carried out among children aging from 2 to 13 years reported a prevalence of 61.8% for the low socioeconomic status group and 49.1% for the high socioeconomic group,[18] This is unlike the current study, but this could be due to variations in population culture, location, and other factors. The study demonstrated that some 48% of the children with dental caries had the history of consuming sugary foods, thereby favoring the proliferation of sugar fermenting bacteria.[19] Logistic regression analysis model of demographic characteristics showed that being male and having a primary education level were related to dental caries among children [Table 2]. A study carried out in Ethiopia reported 36.5% prevalence of dental caries among urban school children,[20] this could have been due to the availability of sugary foods in urban areas simple street shops and supermarkets make them more accessible to children. Previous research has revealed that permanent dental caries occurred in 73% of lower primary school going age group of 6-9-year-old.[21] This is comparable to what was observed in the present study with a high prevalence of dental caries among lower primary school going age group [Table 2]. A prevalence of 94.3% was reported among children aged 5-7years.[22] This may be an indication of an upward trend in caries prevalence in developing countries. The same findings revealed that caries prevalence of 82.5% among children of ages 8-10 years,[23] 82.2% among 7-8 years old, and 82.6% among 9-10 years old.[24] Findings from other studies have shown a prevalence of caries at age of 2years (20%), 3years (36%), and 50% attributed to children aged 5 years.[25] The prevalence of dental caries between males and female children have been demonstrated by past studies when compared to females.[26-28] This is in agreement with a study that reported that 39.5% of male children had dental caries compared to female children (36.5%).[29] This high percentage boys being affected more than girls might be due to a combination of biological and gender related reasons including immune system factors, hormonal differences, and poor oral hygiene among boys. Dental caries develops when bacteria in the mouth metabolize sugars to produce acid that demineralizes the hard tissues of the teeth. In this study, sugar fermenter bacteria were investigated in the oral cavity. *Streptococcus mutans* which is the main contributor to the development of dental caries was isolated among children with dental caries. *Lactobacilli spp.* enhance the progression of dental caries. It had the highest growth during dental caries, a phenomenon that can explain its association with the progression of dental caries among children [Table 3]. The same study revealed that *Lactobacilli spp.* contributes to dental caries in human populations, and have been associated with dental caries for over a century. *Lactobacillus* is not the caries initiator but plays significant role in the progression of caries. About 93% of *Lactobacilli* were isolated from saliva samples and 66% of *Lactobacilli* in fecal samples of children with dental caries but not from those who were caries free.[30] The high prevalence of *S. mutans* might be due to the fact that they are initiators of dental caries among children. *S. mutans* was reported to rapidly colonize the rough defects of the enamel surface.[31] *Streptococcus mutans* which causes dental caries, splits the sucrose in food and uses one of the sugars to build its capsule, which sticks tightly to the tooth. The bacteria that are trapped in the capsule use the other sugar to fuel their metabolism and produce a strong acid (lactic acid) which attacks the tooth enamel.[32] Tooth decay was reported by previous studies carried out in Rwanda to be prevalent in young aged children, and *Streptococcus spp.* was reported as the main initiator of this dental health outcome.[33] *Enterobacter aerogenes* was also one sugar fermenter Bactria isolated in this study. It was found to be a contributor of dental caries among children [Table 3]. *Enterobacter species* (48.0%) among children with dental caries was reported to be high compared 27.1% in control group of normal children. These bacterial species also contribute to fool odor or halitosis emitted when dental caries occurs. *Enterobacter aerogenes* is the single bacteria which supports the emission of foul odor

to a large extent, but also *Klebsiella pneumonia* participates in this emission.[34] The oral cavity harbors sugar fermenters bacteria such as *S. aureus* and other *Staphylococcus spp.* they are mostly found in the mucosal membrane and oral cavity included.[33] The increase of *Staphylococcus aureus* during dental caries might be due to the high consumption of sugars which alter the normal metabolism of the normal flora and act as opportunistic pathogens [Figure 1 and Table 3]. Studies on the oral cavity microbiology among healthy children in other regions reported that *S. aureus* was rather high, in the range of 33% to 64%.[35]

Tooth pain, tooth discoloration, infection, Sensitivity to food, and regression in class performance can be attributed to dental caries [Table 5]. The high prevalence of severity (70% and moderate (51%) pain was reported among dental caries without dental self-care in India.[36] This implies that this outcome is common among dental caries patients. The incidence (51%) of tooth decay was reported among dental caries patients who did not seek for dental treatment.[37] Infection might be propagated by oral cavity tragedies such as caries and invade the oral tracts causing systemic infections. A study indicated that upper respiratory infections (58%) were reported among children with early childhood caries (ECC) compared to 47.6% attributed to children free from dental caries.[38] Most of the isolated sugar fermenter bacteria were primarily sensitive to ciprofloxacin, clindamycin and amoxicillin while Vancomycin and chloramphenicol were the most resistant antibiotics [Table 6]. Other studies reported that Amoxicillin in combination with Clavulanate are usually the primary choice for tooth infection treatment.[39] Clindamycin was reported to be used in treatment of dental infection caused by anaerobic bacteria.[40] Vancomycin resistance might be associated with altered peptidoglycan terminus (d-ala-d-lac instead of the usual d-ala-d-ala) resulting into reduced vancomycin binding and failure to prevent cell wall synthesis of bacteria. Studies have shown that antibiotics of the penicillin class, such as penicillin and amoxicillin, are most commonly used to help treat tooth infections.[41]

Limitations

Our study identified sugar fermenting bacteria profile among children with dental caries. The study was limited to molecular characterisation of isolated bacteria because of the lack of equipment. We were also limited in time, we only considered data of 3 months at one hospital, we cannot draw a countrywide conclusion based on the findings from this study.

Conclusion

The high sugar consumption harbours sugar benefits bacteria that drive the occurrence of dental caries among children. Tooth loss, tooth pain, and infection were the outcomes associated with dental caries among children. Juices and the combination of candy and biscuits were observed to be the shelter to the growth of sugar fermenter bacteria in the oral cavity. Ciprofloxacin and clindamycin were the most sensitive antibiotics to isolated bacteria. Parents and advised to reduce feeding sugars to their children, control their daily oral hygiene through brushing of teeth, flossing the mouth with water after meals and consulting a dentist for early diagnosis of dental caries.

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Conflicts of interest

There are no conflicts of interest.

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