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Oral hygiene practice and the relationship between sugary food intake and dental caries among adults in Mbeya, Southwest Tanzania

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Abstract

Background: Dental caries is a common dental health issue, but its prevalence varies across countries due to differences in oral healthcare programmes, lifestyles, and socio-economic status. Diet and fluoride exposure are major factors influencing the caries process. Sugars in the diet provide a substrate for bacteria in dental plaque, leading to tooth demineralisation. Our study assessed oral hygiene practice and the relationship between dental caries and sugary food intake among adults in Mbeya, Tanzania.

Methods: A community-based cross-sectional study was conducted among healthy adults in Mbeya selected through random sampling. The questionnaire was used to collect information on oral health practices and dental caries risk factors through interpersonal conversations. Oral cavity physical examinations were also conducted to assess oral cleanliness based on visible plaque presence and dentition status classified by the number of decayed, filled, and missing teeth due to caries. Data was analysed using SPSS version 23. $\chi 2$-test and logistic regression were used for studying associations.

Results: Our study included 168 participants. Nearly all 166 (98.8%) reported brushing their teeth. All participants reported sugary food intake, with 143 (85.1%) consuming sugary foods more than three times daily and 25 (14.9%) less than three times daily. Decayed teeth were present in 126 (75%) participants. Among those eating sugary foods over three times daily, 112 (66.7%) had dental caries versus 31 (18.5%) without caries ($\chi 2=5.655$, $p=0.017$). Reduced toothbrushing frequency is associated with increased decay (COR 2.839, 95% CI 1.172-6.873, $p<0.05$). The mean decayed, missing, and filled teeth score was 1.45 (± 0.45).

Conclusion: Findings indicate a positive oral hygiene practice overall. High sugar intake and inadequate brushing contributed to a high dental caries prevalence, indicating the need for improved oral health education, preventive efforts, and better access to dental services to address the substantial tooth decay burden.

Keywords: dental caries, sugary diet intake, adults, Mbeya, Tanzania

Introduction

Dental caries, also known as tooth decay, is caused by specific oral bacteria that feed on carbohydrates on the tooth surface. This produces acid and waste that dissolves tooth minerals (Balakrishnan et al., 2000). Caries is a multifactorial disease affecting people of all ages, leading to the irreversible destruction of dental tissue through prolonged interaction with food, dental plaque, and microorganisms (Caufield et al., 2005). It involves the breakdown of dental hard tissues by acidic by-products from bacterial fermentation of dietary carbohydrates, especially sucrose (Fejerskov, 2004; Yadav & Prakash, 2016). Refined sugary foods are strongly linked to caries (Gupta et al., 2013; Moynihan, 2016).

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Studies show higher caries rates in those with elevated free sugar intake from sources like cakes, biscuits, sucrose, sweetened beverages, and 100% fruit juices (Moynihan, 2016). Poor oral hygiene is also an established risk factor, with the American Dental Association recommending brushing at least twice daily with fluoride toothpaste (Kahar et al., 2019). Additionally, socio-economic status, insufficient oral health education, and detrimental habits influence caries development (Gathecha et al., 2012).

Dental caries is a major global public health issue and the most widespread non-communicable disease (NCD). The 2015 Global Burden of Disease study ranked it first for permanent tooth decay (2.3 billion affected) and 12th for primary tooth decay (500 million children) (Moynihan, 2016). The WHO average DMFT index is 3, but significant variations exist. Some places have minimal DMFT versus the WHO standard, while others have higher DMFT values. In developing countries, untreated caries drive adulthood caries severity. Teeth with caries or other conditions often get extracted when painful, partly due to low dentist density (1 per 150,000 people). This makes dental services hard to access (Moynihan, 2016).

Dental caries remains a global pandemic with differing occurrences and severity based on sociocultural practices and socioeconomics (Gathecha et al., 2012). Developing countries face high rates of untreated decay and extractions due to limited dental access. The disease remains a major global health challenge, requiring socio-culturally appropriate interventions.

There is limited data on dental caries concerning sugary food intake in Mbeya, with most studies focused on children aged 2-4 years (Mwakayoka et al., 2017). Previous research (Masumo et al., 2012; Matee et al., 1994) examined early childhood caries and factors in under 3s. Since dental caries affects children differently across ages (Braimoh et al., 2014), more studies are needed in various locations and WHO age groups to address risk factors.

Previous studies were conducted among adolescents in the Maasai (Simangwa et al., 2018) and 12-year-olds in Dar es Salaam (Mwakatobe & Mumghamba, 2007). However, systematic research is required to generate valuable data for planning oral healthcare and services per population. This study helps provide data the Tanzanian Ministry of Health can use to determine problem severity and implement control measures in this area. The findings will benefit authorities in tailoring regional oral health services and planning.

Methods

Study area

Mbeya region is located in the southern highlands of Tanzania and is named after its capital city, Mbeya. As the largest city in the region, Mbeya serves as the administrative centre. The Mbeya region covers approximately 62,420 square kilometres and has a population of 2,343,754, with 1,123,828 males and 1,219,926 females (URT, 2022). Agriculture is the predominant economic activity in Mbeya, with major crops including coffee, tea, maize, and beans. Other key social and economic activities include trade, small-scale farming, tourism and livestock rearing.

Study design

A community-based cross-sectional study was conducted among healthy adults in Mbeya, Tanzania.

Study population

The study participants included all adult males and females living in Mbeya. The inclusion criteria were for all male and female adults residing in Mbeya. The exclusion criteria were adults with mental disabilities, speech impairments or hearing difficulties and adults who were uncooperative or declined to participate.

Sample size estimation

The estimated minimum sample size was 168. The sample size was calculated using the Kish formula (Wiegand, 1968) obtained from the average prevalence of dental caries in different studies, p = 12.5% = 0.125 (Carneiro et al., 2011; Mashoto et al., 2010; Simangwa et al., 2018). The margin of error allowed was 0.05% and a 95% confidence interval (Z=1.96) was used.

Sampling technique

The investigation team was stationed in several selected wards located mainly in urban areas. Random sampling was used to select participants in selected wards. Primary data was used in this study.

Data collection

The questionnaire was used for data collection. The questionnaire was originally developed in English and then translated into Swahili. Open-ended and closed-ended questions were asked in Swahili to participants, with responses translated into English. Information on oral health practices and dental caries risk factors was gathered through interpersonal conversations. Oral cavity physical examinations were also conducted to assess oral cleanliness and dentition status. Oral cleanliness was evaluated based on visible plaque presence. Dentition status was classified by the number of decayed, filled, and missing teeth due to caries. The questionnaire had three sections. The first collected participant demographics like gender, age, and residence. The second assessed dental caries risks such as oral hygiene, cariogenic diet frequency, use of mouthwash and fluoride toothpaste. The third section documented results from oral cavity examinations on dentition status (WHO, 2013).

Data analysis

Data collected was imported to Microsoft Excel version 2019 and analysed using SPSS version 23. Frequency tables and figures were then generated and descriptive statistics were presented. The association between the frequency of sugary food intake and dental caries was tested using logistic regression analysis and $\chi 2$-test at a significant level of p=0.05.

Ethical consideration

The study was approved by the University of Dar es Salaam, Mbeya College of Health and Allied Science Research Ethical Clearance Sub-Committee (Ref No.: 2018-04-13276). Permission to conduct the study was taken from Mbeya Regional administration. Confidentiality and privacy of participants' information were observed. Names and other identifying information were not included.

Results

Demographic characteristics

Our study included 168 participants ranging in age from 19 to 79 years. The average age of the respondents was 39 years old, with a standard deviation of 14.5. The largest proportion of participants were between 29 and 38 years old (n=50, 29.8%), followed by those between 19 and 28 years old (n=48, 28.6%). There were more female participants (n=97, 57.7%) than male (n=71, 42.3%). The smallest age group represented was 69 to 79 years old, with only 7 participants (4.2%) in this range (Table 1).

Table 1: Demographic characteristics of the study participants (N=168)

Demographic characteristics		Frequency (n)	Percent (%)
Gender	Males	71	42.3%
	Females	97	57.7%
Age group	19 – 28	48	28.6%
	29 – 38	50	29.8%
	39 – 48	30	17.9%
	49 – 58	19	11.3%
	59 – 68	14	8.3%
	69 – 79	7	4.2%

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Oral hygiene practice

Of the 168 study participants, 166 (98.8%) reported brushing their teeth, while only 2 (1.2%) did not brush at all. Of those who brushed, 111 (66.1%) brushed once daily, 36 (21.4%) brushed twice daily and 21 (12.5%) did not brush daily. The majority (159 or 94.6%) used commercial toothbrushes and toothpaste, while 9 (5.4%) used other methods like chewing sticks, charcoal or fingers without toothpaste. Most participants (159 or 94.6%) used toothpaste and only 9 (5.4%) did not. All participants reported consuming sugary foods or snacks. However, 143 (85.1%) ate these more than three times per day, while just 25 (14.9%) ate them less than three times daily. After eating sugary snacks, 141 participants (83.9%) did not brush their teeth afterwards, while only 27 (16.1%) sometimes brushed post-snack.

Table 2: Frequency of oral hygiene practice among adults in Mbeya, Tanzania

	Response	Frequency (n)	Percent (%)
Do you brush your teeth?	Yes	166	98.8%
	No	2	1.2
How many times a day?	Not daily	21	12.5%
	Once per day	111	66.1%
	Twice daily	36	21.4%
What instrument do you use to brush your teeth?	Toothbrush	159	94.6%
	Others	9	5.4%
Are you using toothpaste during brushing?	Yes	159	94.6%
	No	9	5.4%
Are you using mouthwash after brushing?	Yes	9	5.4%
	No	159	94.6%
Do you eat sugary food or snacks?	Yes	168	100%
	No	0	0.0%
If yes, how many times a day?	Less than three times	25	14.9%
	More than three times	143	85.1%
Do you brush your teeth after eating sugary food or snacks?	No	141	83.9%
	Sometimes	27	16.1%

Relationship between frequency of sugary food intake and decayed or caries teeth

Out of 168 participants, 126 (75%) had decayed teeth, while 42 (25%) had no decay. 120 (71%) had no filled teeth, and 48 (29%) had fillings. 54 (32.1%) were missing teeth due to decay, while 114 (67.9%) had no missing teeth from decay. Of the 25 (14.9%) who consumed sugary snacks less than three times daily, 14 (8.3%) had dental caries and 11 (6.5%) did not. Of the 143 (85.1%) who ate sugary snacks more than three times daily, 112 (66.7%) had dental caries and 31 (18.5%) did not. There was a significant association between sugary snack frequencies and dental caries ($X2 = 5.655$, $p=0.017$). Reduced toothbrushing frequency was associated with increased decay (COR 2.839 at 95% CI 1.172-6.873, $p<0.05$) (Table 3, Figures 1 and 2).

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Table 3: Frequency of sugary food intake and tooth decay status by gender and age groups

Demographic characteristics	Frequency of sugary food intake per day	Teeth decay status		Total (n/%)	X^2 (p-value)
		No decay	Decayed		
Gender					
Males	Less than three times	2 (2.8%)	13 (18.3%)	15 (21.1%)	0.693 (0.405)
	More than three times	13 (18.3%)	43 (60.6%)	56 (78.9%)	
Females	Less than three times	9 (9.3%)	1 (1.0%)	10 (10.3%)	21.415 (0.000)
	More than three times	18 (18.6%)	69 (71.1%)	87 (89.7%)	
Total	Less than three times	11 (6.6%)	14 (8.3%)	25 (14.9%)	5.655 (0.017)
	More than three times	31 (18.4%)	112 (66.7%)	143 (85.1%)	
Age group					
19–28	Less than three times	1 (2.1%)	4 (8.3%)	5 (10.4%)	0.045 (0.833)
	More than three times	7 (14.6%)	36 (75.0%)	43 (89.6%)	
29–38	Less than three times	3 (6.0%)	4 (8.0%)	7 (14.0%)	2.658 (0.103)
	More than three times	7 (14.0%)	36 (72.0%)	43 (86.0%)	
39–48	Less than three times	0 (0.0%)	2 (6.7%)	2 (6.7%)	0.779 (0.377)
	More than three times	8 (26.7%)	20 (66.7%)	28 (93.3%)	
49–58	Less than three times	3 (15.8%)	2 (10.5%)	5 (26.3%)	0.148 (0.701)
	More than three times	7 (36.8%)	7 (36.8%)	14 (73.7%)	
59–68	Less than three times	4 (28.6%)	1 (7.1%)	5 (35.7%)	10.080 (0.001)
	More than three times	0 (0.0%)	9 (64.3%)	9 (64.3%)	
69–79	Less than three times	0 (0.0%)	1 (14.3%)	1 (14.3%)	0.467 (0.495)
	More than three times	2 (28.6%)	4 (57.1%)	6 (85.7%)	
Total	Less than three times	11 (6.6%)	14 (8.3%)	25 (14.9%)	5.655 (0.017)
	More than three times	31 (18.4%)	112 (66.7%)	143 (85.1%)	

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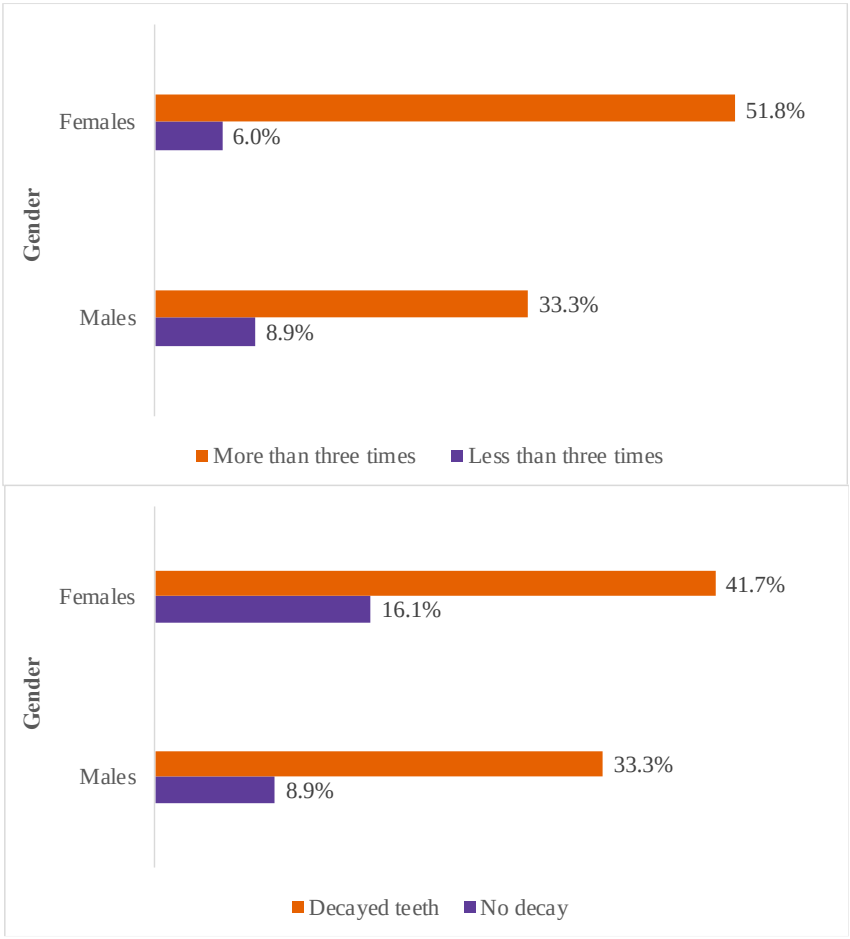

Figure 1: Gender and frequency of sugary food consumption in relation to dental caries.

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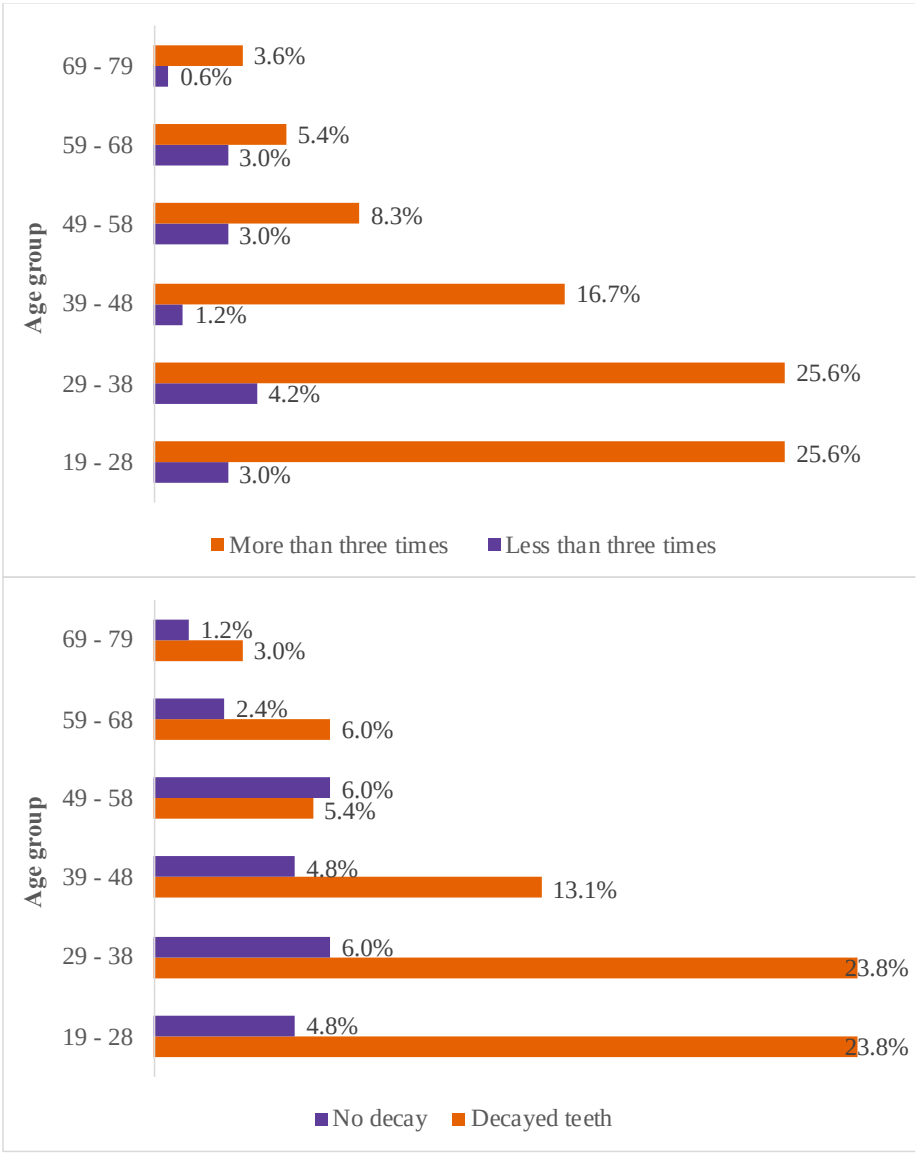

Figure 2: Age group and frequency of sugary food consumption in relation to dental caries

Mean DMFT Value

The mean decayed, missing, and filled teeth (DMFT) score for study participants was 1.45 (± 0.45). The decayed component (DT) contributed the most to the DMFT value, accounting for 95.2% or 1.75 of the mean DMFT, indicating some study participants with multiple teeth complications. Missing teeth accounted for 1.32 and filled teeth accounted for 1.28 of the mean DMFT value. Looking at DMFT scores by gender, females had a higher mean DMFT of 0.75, while males had a lower mean DMFT of 0.6.

Discussion

The findings from this study suggest that most participants (98.8%) reported brushing their teeth and using commercial toothpaste, which is positive for maintaining good oral hygiene. However, it is concerning that a large number of participants brushed only once daily, which may be insufficient to prevent tooth decay and other dental issues. Additionally, a small percentage used unconventional brushing methods like charcoal and fingers without toothpaste, which is worrying. This study showed little difference in oral hygiene practices compared to a previous cross-sectional study among adults in Misungwi district, Tanzania. In that study, most participants also used

toothpaste while brushing (82.7%), but less than half (46.4%) brushed twice or more daily (Nyorobi et al., 2018). Proper brushing technique and frequency is essential to remove plaque and prevent decay. In general, while toothbrushing habits were fairly positive, the low frequency and inadequate methods in a subset of participants highlighted the need to promote proper toothbrush and toothpaste use and brush at least twice daily for optimal oral health.

An important finding from this study is that nearly all participants reported consuming sugary foods or snacks, with the majority eating these more than three times daily. This high sugar intake is concerning, as it can lead to tooth decay and other health issues. Moreover, it is alarming that most participants did not brush after eating sugary foods, a crucial time when teeth are vulnerable to plaque and decay. Brushing immediately after sugary foods can help remove bacteria and prevent buildup. Similar studies have shown that natural sugars and refined carbs increase decay risk, supporting the link between sugary diets and dental caries (Gupta et al., 2013). Research in Nigeria also found that adults consuming around 2 grammes of sugar daily had dental caries in half their permanent teeth after decades of exposure (Sheiham & James, 2014). The frequent sugary snack intake and lack of post-snack brushing demonstrate the need for education on limiting sugar consumption and proper oral hygiene habits to protect against tooth decay.

The study reveals concerning findings about the high prevalence of dental caries among participants. A large majority (75%) had decayed teeth, with over half missing teeth due to decay. A positive association was found between sugary food frequencies and increased DMFT scores, regardless of gender, aligning with other research (Bernabé et al., 2014; Sheiham & James, 2014). Our findings were similar to a study at a Regional Referral Hospital in Musoma, Tanzania, showing dental caries as the predominant oral disease correlating with dietary patterns and oral hygiene (Singh et al., 2014). This highlights the urgent need for improved oral health education and preventive measures to address the population's high tooth decay rates. Furthermore, increased sugary food intake was significantly associated with more dental caries. Those eating sugary foods/snacks over three times daily had a higher decay likelihood than less frequent consumers. This finding emphasises reducing sugar intake as a key preventive approach for tooth decay.

Additionally, the study found that participants who brushed less frequently had a higher decay risk. This emphasises the importance of regular brushing and good oral hygiene in preventing caries. Another notable finding was that most with dental caries left decayed teeth unfilled rather than undergoing extraction. This indicates a lack of access to dental care and highlights the need to improve access to dental services to address decay and oral health issues. Overall, the study highlights the urgent need for enhanced oral health education, preventive efforts, and access to dental care to tackle the high incidence of tooth decay in this community. Reducing sugar consumption, maintaining oral hygiene, and obtaining timely dental treatment are key to preventing and managing dental caries. The high rate of unfilled cavities also underscores the importance of improving access to professional dental services for managing tooth decay and related problems. A multi-pronged approach is needed to promote oral health at individual and community levels.

The study indicated that the mean DMFT value of the participants was 1.45, which is considered relatively low compared to some other communities. However, the majority of the DMFT score was attributed to the decayed component, which accounted for 95.2% of the mean DMFT value. This percentage contribution was due to individuals with decayed teeth. Some of their teeth are filled and some suffer recurrence of tooth decay after filling. Our study also noted the interaction between some data because one individual had multiple teeth complications. This finding suggests that dental caries is the participants' most prevalent oral health problem. The missing and filled teeth components of DMFT value were relatively low, indicating that tooth extraction and restoration were not the primary reasons for tooth loss among the participants.

This finding may be due to a lack of access to dental services or poor dental health-seeking behaviour among the participants. Interestingly, the study revealed that females had a slightly lower mean DMFT value than males, indicating better oral health among females. This finding is

consistent with previous studies showing that females tend to have better oral health habits than males (Singh et al., 2014). However, further research is needed to explore the factors contributing to gender differences in oral health.

Our study had some limitations worth acknowledging. First, the scope was restricted to randomly selected adults living in urban areas where the investigation team was located. As done in previous work, no comparisons could be made between rural and urban populations. This focused geographic area was necessitated by limited funding and time constraints for conducting the research. Additionally, we examined fewer variables compared to previous studies in this domain. For example, our analysis did not include participant education level as a potential factor.

This narrower set of variables was another compromise imposed by resource limitations. While restricted to these aspects, this study still provides valuable initial insights into dental caries prevalence among adults in the region. Further research with a broader and more diverse participant sample and a more extensive set of variables would allow for deeper understanding and robust comparisons across geographic residence and socio-economic factors. Building on the groundwork from this study, future work can continue to elucidate the complex interplay between demographic, socio-economic and health factors related to dental caries.

Conclusion

Despite most participants having good oral hygiene practices, our study revealed concerning data about oral hygiene habits, sugar consumption and the high prevalence of dental caries. While most reported brushing with toothpaste, the low brushing frequency and improper methods among some highlight the need to promote proper brushing techniques and twice-daily brushing. The frequency of sugary foods and inadequate post-snack brushing demonstrated the importance of limiting sugar and brushing after consumption.

The high rate of decayed teeth and the association between sugary diets and increased caries indicates an urgent need for preventive efforts and improved access to dental services. Reducing sugar intake and maintaining diligent oral hygiene are critical for preventing tooth decay. The findings underscore the value of oral health education, preventive measures and expanding access to dental care to combat the population's substantial dental caries burden. A multi-faceted approach is imperative to promote oral health through enhancing individual habits, services and community-level interventions.

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Author contributions

DD and CNM designed the study. DD conducted and contributed to data analysis. DD and CNM interpreted the data. CNM prepared the original manuscript. All co-authors contributed to subsequent revisions. All authors read and approved the final manuscript.

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Conflict of interest

The authors declare that they have no financial and non-financial competing interests.

Availability of data and material

All data generated or analysed during this study is included in this published article.

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