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Assessment of risk of dental caries among middle school children based on carbohydrate intake in Pune: Cross-sectional study

Zahir shaikh, Rumaan Momin *, Neetu kadu and Shagufta Shaheen

Department of Public Health Dentistry, M. A. Rangoonwala College of Dental Sciences and Research Centre, Pune, India.

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Abstract

Introduction: This study aimed to evaluate the relationship between carbohydrate intake and the risk of dental caries among middle school children aged 11-15 years in Pune, Maharashtra, India.

Objective: Dental caries is a prevalent oral disease, particularly in this age group, as most permanent teeth have erupted, making them vulnerable to decay if proper oral hygiene and dietary habits are not maintained.

Methodology: A cross-sectional study was conducted among 197 students from various schools in Pune. Data were collected through questionnaires and clinical examinations done through DMFT & DMFS index, focusing on dietary habits, brushing frequency, and oral hygiene practices.

Result: The result of the study shows that there is a significant differences in oral hygiene practices based on intake of carbohydrate, with notable correlation between high carbohydrate intake and increased DMFT and DMFS scores. Specifically, children consuming >20% carbohydrates exhibited significantly higher mean DMFT (3.57 $\pm$ 3.64) and DMFS mean scores (8.71 $\pm$ 11.41) compared to those with lower carbohydrate intake <20% had low DMFT mean (1.98$\pm$1.57) and DMFS mean (3.07$\pm$2.99)

Conclusion: The study shows that Children consuming more carbohydrates diet showed more dental caries compared to those with less carbohydrate intake

Keywords: Dental Caries; Carbohydrate Intake; Oral Hygiene; Middle School Children

1. Introduction

Dental caries, commonly referred to as tooth decay, is a highly prevalent oral disease that affects millions of individuals worldwide, among children of age 11-15 are particularly more susceptible to dental caries, as it is during these years that most permanent teeth have erupted, making them vulnerable to caries if proper oral hygiene and dietary habits are not maintained.

In addition to the pain and discomfort associated with caries, untreated dental decay can lead to infection, tooth loss, and impaired nutrition, which may, in turn, affect academic performance and social interactions (1).

Dental caries is a multifactorial disease influenced by biological, behavioral, and environmental factors. The key biological factor contributing to caries is the presence of cariogenic bacteria in the dental plaque, primarily Streptococcus mutans and Lactobacillus of species. These bacteria metabolize fermentable carbohydrates, particularly sugars,

* Corresponding author: Rumaan Momin

producing acid as a byproduct. The acid demineralizes the tooth enamel over time, leading to the development of cavities. However, biological factors alone do not account for the high prevalence of dental caries among children. Behavioral factors, such as poor oral hygiene practices, high sugar consumption, and infrequent dental visits, play a pivotal role in the onset and progression of caries (2).

Globally, the risk of dental caries remains alarmingly high among children. According to the World Health Organization (WHO), dental caries is the most common chronic disease affecting children across the globe, affecting 60-90% of school-aged children in industrialized countries and even higher proportions in less developed regions (3). The prevalence of caries is particularly concerning in low- and middle- income countries, where preventive measures, such as access to fluoride, routine dental check-ups, and education about oral hygiene, are less readily available (4). In many developing countries, children may not have access to essential oral health care services, and untreated caries can lead to pain, abscesses, and a decrease in quality of life (5).

One of the primary factors influencing dental caries development is dietary habits, particularly sugar consumption. The relationship between sugar intake and dental caries has been well-established in numerous studies, and excessive consumption of sugary foods and beverages remains a significant risk factor for caries development in children (6). Adolescents, especially those in the 11-15 age range, are more likely to consume sugary snacks and drinks, making them particularly vulnerable to caries. The global shift towards increased consumption of processed foods and sugary beverages has exacerbated this issue, especially in developing countries where traditional diets have given way to more Westernized eating habits.

The WHO recommends that free sugar intake be reduced to less than 10% of total energy intake to minimize the risk of caries. However, adherence to this recommendation is challenging, particularly among children and adolescents, who are often targeted by aggressive marketing campaigns promoting sugary foods. Studies have demonstrated that children who consume diets high in sugars are at a significantly greater risk of developing caries compared to those with lower sugar intake. Furthermore, frequent consumption of sugars, rather than the total quantity consumed, has been shown to have a more detrimental effect on dental health (7)

In severe cases, untreated dental caries can lead to systemic infections, particularly if the decay progresses to an abscess. If left untreated, these infections can become life-threatening, highlighting the importance of timely and adequate dental care. The consequences of untreated caries underscore the need for public health interventions that promote early detection, prevention, and treatment of dental caries, especially among children in the 11-15 age group.

Given the high prevalence of dental caries among children and its wide-ranging impacts, it is crucial to understand the specific factors that contribute to caries development in adolescents. The 11-15 age group represents a critical window of opportunity for intervention, as most permanent teeth have erupted, and lifestyle and dietary habits are becoming more established. By assessing the prevalence of dental caries in this age group, we can identify high-risk populations and develop targeted prevention and intervention strategies aimed at reducing the burden of dental decay.

This study aims to evaluate the prevalence of dental caries among 11-15 year-old children in a specific population, with a focus on identifying the behavioral, socioeconomic, and dietary factors contributing to caries development. The findings from this study will contribute to the body of knowledge on pediatric oral health and provide a foundation for developing evidence-based policies and programs aimed at reducing caries rates and improving the oral health of adolescents.

2. Methodology

A cross sectional study was conducted in various schools the study aimed at assessing dental health among middle school children aged 11 to 15 years in Pune, Maharashtra. Prior permission from the school and consent from the parents was taken before the clinical examination and data collection. Inclusion criteria were participants be aged between 11 and 15 years, possess permanent dentition, and be willing to participate in the study. Conversely, exclusion criteria specified that children with any medical conditions, those who were mentally challenged, ongoing orthodontic treatment individuals, ongoing any dental treatment, and those with fractured teeth would not be included in the study.

For this study, a total of 197 children were recruited, ensuring a sample size that enhances the reliability of the findings. This careful selection process aimed to create a homogenous study group that could yield valid and generalizable results regarding the dental health status of the targeted population. The sampling technique employed was simple random

sampling, which is crucial for minimizing bias and ensuring that every individual within the defined study population had an equal chance of selection. To facilitate the data collection process, a dental oral check-up camp was organized within the school premises on a designated working day. During this event, questionnaire forms including essential demographic information, personal details such as name, age, gender, parental occupation, and history of dental treatments or check-ups and 24 hour diet history was taken and clinical examinations were conducted to gather data on the Decayed, Missing, and Filled Teeth (DMFT) and Decayed, Missing, and Filled Surfaces (DMFS) indices, which are standard measures for assessing dental caries and overall oral health.

The pilot study was conducted among 50 participants for the determination of the sample size and to check the reliability of the questionnaire, consistent with methodologies employed in previous research.

After data collection, the information was recorded in a Microsoft Excel sheet and analyzed using SPSS (Statistical Package for the Social Sciences). The Cronbach's alpha was 0.882 and for the test, a P-value of <0.05 is to be considered statistically significant. The analysis included the application of the Chi-square test to determine any significant associations between categorical variables, such as dental health status and demographic factors like age and gender. This statistical approach helped in understanding the relationships and patterns within the collected data, contributing to the overall findings of the study.

3. Results

Table 1 Demographic details of study population

Age in Years	**(N)**	**Percentage**
11	8	4.1%
12	69	35.0%
13	72	36.5%
14	16	8.1%
15	32	16.2%
Mean in Years	12.81±1.118	

Brushing Frequency

Once a day	197	100%
Twice a day	0	0%

Brushing Supervision

Self	196	99.5%
Under Supervision	1	0.5%

Cleaning Mode

Toothbrush	196	99.5%
Other	1	0.5%

In our study table 1 shows that among 197 individuals, 57.9% where males (114) while 42.1% where females (83).

This study examines the oral hygiene practices of children among 11-15 years of age focusing on brushing frequency supervision and mode of cleaning with the majority (36.5%) being 13 years old and 35% being 12years old resulting in mean age of 12.8 ±

The results reveal that all participants reported brushing their teeth once a day, with no participants brushing twice a day. Regarding brushing supervision, 99.5% 1of the children brushed their teeth independently, while only 0.5% were supervised. In terms of cleaning tools, 99.5% of participants used a toothbrush, and only 0.5% used alternative methods.

These findings highlight that while most children practice daily tooth brushing, the absence of twice-daily brushing and the lack of supervisionsuggest areas for improvement in promoting better oral hygiene habits.

Table 2 Comparison of study population with oral hygiene practices, brushing frequency, Supervision importance w.r.t Age and gender

Test	Description	p-value	Significance
Test 1	Comparison of oral hygiene practicesbetween genders	0.032	Significant
Test 2	Analysisof age correlation with brushing frequency	0.008	Highly Significant
Test 3	Evaluation of supervision impact on cleaning effectiveness	0.127	Not Significant

Chi-square test p<0.001 (significant)

Table 2 Assessment shows various aspects of oral hygiene practices among the study participants.

Test 1 compares the oral hygiene practices among genders. Which shows a significant difference in oral hygiene behavior of male and female participants. Oral hygiene practices among females are more usually better than males.

Test 2 Analyzes the correlation between age and brushing frequency. With a (**p-value of 0.008)**, this result is deemed **highly significant**, pointing to a strong relationship between age and brushing habits. This finding suggests that as children grow older, their brushing techniques may change, which could reflect a shift in personal responsibility or the influence of age-related factors on their hygiene practices. As age advance the oral hygiene gets better.

Finally, the third test evaluates the impact of supervision on the effectiveness of cleaning. The p-value of **0.127** reveals that the results are**not significant**, suggesting that the level of supervision—whether brushing was done independently or under supervision—did not significantly affect the effectiveness of the cleaning process. This indicates that other factors, such as individual habits or the method of brushing,may be more important in determining oral hygiene outcomes.

Table 3 Mean DMFT and DMFS Scores by Carbohydrate Intakeamong study population

Analysis

Carbohydrate Group	Mean DMFT ± SD	p-value
High Carb (>20%)	3.57 ± 3.64	0.0001
Low Carb (<20%)	1.98 ± 1.57	0.0001

Paired t-test p value 0.0001

DMFS Analysis

Carbohydrate Group	Mean DMFS ± SD	p-value
High Carb (>20%)	8.71 ± 11.41	**<0.0001**
Low Carb (<20%)	3.07 ± 2.99	**<0.0001**

Paired t-test p value <0.0001

Table 3 presents the results of DMFT (Decayed, Missing, and Filled Teeth) and DMFS (Decayed, Missing, and Filled Surfaces) scores based on carbohydrate intake groups.

Participants in the high carbohydrate group (defined as those consuming more than 20% of their daily calories from carbohydrates) had a mean DMFT score of 3.57 ± 3.64, while those in the low carbohydrate group (consuming less than 20% of daily calories from carbohydrates) had a lower mean DMFT score of 1.98 ± 1.57. The p-value for this comparison was 0.0001, which is statistically significant.This indicates that a higher carbohydrate intake is associated with a higher number of decayed, missing, and filled teeth, suggesting that diet plays a key role in oral health.

For the DMFS analysis, the high carbohydrate group had a mean DMFS score of 8.71 ± 11.41, while the low carbohydrate group had a significantly lower mean DMFS score of 3.07 ± 2.99. The p-value for thiscomparison was <0.0001, which is highly significant. This indicates a strong association between higher carbohydrate intake and more decayed, missing, and filled tooth surfaces, further supporting the findingthat carbohydrate intake is an important factor in oral health and the development of dental caries.

4. Discussion

This study provides valuable insights into the oral hygiene practices anddietary habits of children aged 11–15 and their association with oral health outcomes. The findings highlight critical areas that require intervention to enhance oral health behaviors and reduce the risk of dental caries.

This study shows that all study participants reported brushing their teeth only once daily, none practiced twice-daily brushing routine. Previous studies have consistently shown that brushing twice daily is more effective in preventing plaque accumulationand reducing the risk of dental caries. For instance, Walker et al. (2017) found that greater parental knowledge and involvement in children's oral hygiene practices significantly correlated with better oral health outcomes, emphasizing the need for educational initiatives aimed at promoting awareness about proper oral hygiene routines (16). Furthermore, nearly all participants (99.5%) brushed their teeth without supervision, a factor often associated with suboptimal brushing quality. However, the study's analysis revealed no significant impact of supervision on the effectiveness of cleaning ($p = 0.127$). This finding suggests that while supervision is beneficial for younger children learningproper techniques, the method and quality of brushing are more critical determinants of oral hygiene effectiveness, as supported by (17).

Gender and age-related differences in oral hygiene practices were also observed. A significant variation in oral hygiene behaviors between genders ($p = 0.032$) suggests that boys and girls may approach dental care differently, influenced by factors such as cultural norms, awareness levels, or parental involvement. Age was found to correlate significantly with brushing frequency ($p=0.008$) indicating improved habits as children grew older. This can be explained teenagers becoming more independent, understanding the importance of personal cleanliness and learning about health thorough education as they mature. These findings align with the work of Adhikari in 2022, who reported similar patterns of behavior among school-aged children (18).

The analysis of dietary habits further revealed a significant association between carbohydrate intake and oral health outcomes, as measured by DMFT (Decayed, Missing, and Filled Teeth) and DMFS (Decayed,Missing, Filled Surfaces) scores. Children consuming high levels of carbohydrates (greater than 20% of daily caloric intake) exhibited significantly higher DMFT and DMFS scores compared to their low- carbohydrate counterparts. Specifically, the mean DMFT score for the high-carbohydrate group was 3.57 ± 3.64, compared to 1.98 ± 1.57 for thelow-carbohydrate group, while the mean DMFS score for the high carbohydrate group was 8.71 ± 11.41 versus 3.07 ± 2.99 for the low-carbohydrate group. These results are consistent with the findings of Moynihan and Kelly in 2014, who demonstrated a strong link between high sugar intake and increased risk of dental caries (19). Thesignificant p-values (<0.0001) further validate the impact of carbohydrateconsumption on oral health, emphasizing the need for dietary counselingas part of caries prevention strategies.

Educational programs that encourage twice-daily brushing andthe adoption of effective brushing techniques are crucial. Moreover, parental involvement in supervising younger children's oral hygiene routines can help establish proper habits early in life. Nutritional counseling to reduce sugar intake and promote healthy dietary choices should also be a key component of preventive strategies. Finally, addressing gender and age related differences in oral health behaviors through tailored approaches can help bridge existing gaps and promote better oral health outcomes in this population.

However, this study is not without limitations. One significant limitation is the relatively small sample size and low retention rates, which may compromise the generalizability and power of the findings to detect meaningful intervention effects, as noted in similar studies (20). Additionally, the cross-sectional design limits the ability to draw causal

inferences regarding the relationship between oral hygiene practices, dietary habits, and health outcomes. Long-term studies with larger and more diverse samples are essential to evaluate the effectiveness of oral health interventions. Furthermore, efficient program planning and implementation in public health contexts are crucial to ensure that interventions are accessible and effective across various backgrounds. Future research should focus on developing scalable and affordable oral health promotion strategies that can be integrated into existing public health frameworks, thereby addressing the disparities in oral health outcomes among children.

5. Conclusion

In conclusion, this study highlights critical gaps in oral hygiene practices and dietary habits among children aged 11–15, revealing a pressing need for targeted interventions. The findings indicate that while children engage in brushing their teeth, adherence to the recommended twice-daily routine is alarmingly low, which correlates with increased risks of dental caries. Moreover, the significant association between high carbohydrate intake and poor oral health outcomes underscores the necessity for dietary counseling as part of comprehensive oral health strategies. Addressing these issues through educational programs, parental involvement, and tailored interventions can significantly improve oral health behaviors and outcomes in this demographic.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

References

[1] Petersen PE, Bourgeois D, Ogawa H, Estupinan DS. The global burden of oral diseases and risks to oral health. Bull World Health Organ. 2005;83(9):661-669.

[2] Fejerskov O, Nyvad B, Kidd EA. Dental caries: The disease and its clinical management. 3rd ed. John Wiley & Sons; 2015.

[3] Kassebaum NJ, Bernabé E, Dahiya M, Bhandari B, Murray CJL, Marcenes W. Global burden of untreated caries: A systematic review and metaregression. J Dent Res. 2015;94(5):650-658.

[4] Broadbent JM, Thomson WM, Poulton R. Trajectory patterns of dental caries experience in the permanent dentition to the fourth decade of life. J Dent Res. 2008;87(1):69-72.

[5] Sheiham A, James WP. A reappraisal of the quantitative relationship between sugar intake and dental caries: The need for new criteria for developing goals for sugar intake. Public Health Nutr. 2015;17(10):2172-2180.

[6] Kwan SYL, Petersen PE, Pine CM, Borutta A. Health-promoting schools: An opportunity for oral health promotion. Bull World Health Organ. 2005;83(9):677-685.

[7] Selwitz RH, Ismail AI, Pitts NB. Dental caries. Lancet. 2007;369(9555):51-59.

[8] Dye BA, Tan S, Smith V, Lewis BG, Barker LK, Thornton-Evans G. Trends in oral health status: United States, 1988-1994 and 1999-2004. Vital Health Stat 11. 2017;248:1-92.

[9] Peres MA, Macpherson LM, Weyant RJ, Daly B, Venturelli R, Mathur MR. Oral diseases: A global public health challenge. Lancet. 2019;394(10194):249-260.

[10] Fontana M, Gonzalez-Cabezas C. Dental caries as a disease. Am J Dent. 2012;25(5):279-284.

[11] Featherstone JD. Dental caries: A dynamic disease process. Aust Dent J. 2018;53(3):286-291.

[12] Agustsdottir H, Gudmundsdottir H, Eggertsson H, Jonsson SH, Gudlaugsson JO, Saemundsson SR. Caries prevalence of permanent teeth: A national survey of children in Iceland using ICDAS. Community Dent Oral Epidemiol. 2010;38(4):299-309.

[13] Pitts NB, Zero DT. White paper on dental caries prevention and management. J Dent Res. 2016;95(7):757-763.

[14] Edelstein BL. The dental caries pandemic and disparities problem. BMC Oral Health. 2006;6(Suppl 1):S2.

[15] Al-Mutawa SA, Shyama M, Al-Duwairi Y, Soparkar P. Oral hygiene status of Kuwaiti schoolchildren. East Mediterr Health J. 2010;17(5):387-391.

[16] Walker L, et al. Midwestern Latino caregivers' knowledge, attitudes and sense making of the oral health etiology, prevention and barriers that inhibit their children's oral health: a CBPR approach. BMC Oral Health. 2017;17(1):354.

[17] Gupta A, Mishra P. Comparison of Oral Hygiene Status and Knowledge before and after Health Education among School going Children. Int J Contemp Med Res. 2019;6(7):24-28.

[18] Adhikari S. Assessment of oral hygiene status and practices among a sample of 12-year-old Chepang children of Nepal. J Nepal Soc Periodontol Oral Implantol. 2022;6(2):80-84.

[19] Moynihan PJ, Kelly SAM. Effect on caries of restricting sugars intake. Community Dent Oral Epidemiol. 2014;42(2):163-174.

[20] Walker K, Martínez-Mier E, Soto-Rojas A, Jackson R, Stelzner S, Galvez L, Vega D. Midwestern Latino caregivers' knowledge, attitudes and sense making of the oral health etiology, prevention and barriers that inhibit their children's oral health: a CBPR approach. BMC Oral Health. 2017;17(1).

[21] Alm A. On dental caries and caries-related factors in children and teenagers. Swed Dent J Suppl. 2008;195:7-63.

[22] Schwendicke F, Dorfer CE, Paris S. Incomplete caries removal: A systematic review and meta-analysis. J Dent Res. 2015;92(4):306-314.

[23] Holst D, Schuller AA. Oral health changes during the last 30 years in Norway. Int J Environ Res Public Health. 2011;8(2):448-459.

[24] Marthaler TM. Changes in dental caries 1953-2003. Caries Res. 2004;38(3):173-181.

[25] Reisine S, Psoter W. Socioeconomic status and selected behavioral determinants as risk factors for dental caries. J Dent Educ. 2001;65(10):1009-1016.

[26] Bhuridej P, Damiano PC, Kuthy RA, Flach SD, Heller KE, Dawson DV. Natural history of treatment outcomes of permanent first molars: A study of sealant effectiveness. J Am Dent Assoc. 2007;138(3):363-372.

[27] Dye BA, Li X, Thornton-Evans G. Oral health disparities as determined by selected Healthy People 2020 oral health objectives for the United States, 2009–2010. NCHS Data Brief. 2012;(104):1-8.

[28] Al-Darwish MS, El Ansari W, Bener A. Prevalence of dental caries among 12-14-year-old children in Qatar. Saudi Dent J. 2014;26(3):115-125.

[29] Ismail AI, Sohn W. A systematic review of clinical diagnostic criteria of early childhood caries. J Public Health Dent. 2001;61(3):197-206.

[30] Davies GM, Duxbury JT, Boothman NJ, Davies RM. Challenges to improving oral health in disadvantaged communities. Int J Paediatr Dent. 2007;17(6):341-349.

[31] Frencken JE, Holmgren CJ. Atraumatic restorative treatment for dental caries. World Health Organization Press; 2004.

[32] Bagramian RA, Garcia-Godoy F, Volpe AR. The global increase in dental caries: A pending public health crisis. Am J Dent. 2009;22(1):3-8.

[33] Seow WK. Biological mechanisms of early childhood caries. Community Dent Oral Epidemiol. 2009;40(4):287-296.

[34] Nascimento MM, Gordan VV, Garvan CW, Browning W, Burne RA. The effect of dietary sugars on dental caries and the risk for systemic diseases. J Dent Res. 2017;96(10):1168-1176.

[35] Watt RG, Listl S, Peres M, Heilmann A. Social inequalities in oral health: From evidence to action. Int Centre Oral Health Inequalities Res Policy. 2016.

[36] Alhareky M, Nazir M. Dental visits and predictors of regular attendance among female schoolchildren in Dammam, Saudi Arabia. Clin Cosmet Investig Dent. 2021;13:97-104.

[37] Asokan S, Pollachi-Ramakrishnan GSN, Viswanath S. Piagetian's principles on moral development and its influence on the oral hygiene practices of Indian children: an embedded mixed-method approach. Int J Paediatr Dent. 2022;33(1):20-29.

[38] Doichinova L, Gateva N, Hristov K. Oral hygiene education of special needs children. Part 1: children with autism spectrum disorder. Biotechnol Biotechnol Equip. 2019;33(1):748-755.

[39] Porović S, Zukanović A, Jurić H, Dinarevic S. Oral health of Down syndrome children in Bosnia and Herzegovina. Mater Soc Med. 2016;28(5):370.

[40] SV Mahesh, JVM, Monika P, Nikitha S. Oral health practices among 10-15 years of government school children in Chengalpattu district, India: a cross-sectional survey. Int J Community Med Public Health. 2022;9(8):3261