Journal of Health, Population and Nutrition

RESEARCH

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The impact of food-based incentive behaviors on oral health among Saudi children: a cross-sectional study

Yasir Dilshad Siddiqui[1*], Saud Hamdan Almaeen[1], Ahmed Shawkat Hashem[2], Ahmed Ali Ahmed Almuntashiri[3], Mohammed Nadeem Baig[1], Abdullah Hammad Alshammari[4], Rital Jamal Alwaqid[4], Haifa Ali Almutairi[4], Raha Ahmed[4], Rakhi Issrani[1] and Farooq Ahmad Chaudhary[5*]

Abstract

Background Childhood dental caries is a common and significant oral health issue globally, resulting in pain, infection, and difficulties in eating and speaking. This study aimed to investigate the impact of food-based reward behaviors on the oral health of Saudi children.

Methods An observational cross-sectional study was conducted at Jouf University Hospital, Saudi Arabia. The study included 316 medically healthy children aged 4 to 10 years and their Arabic or English-speaking guardians. Data were collected through a structured questionnaire based on the Comprehensive Feeding Practices Questionnaire (CFPQ), gathering information on socio-demographic characteristics, dietary habits, oral hygiene practices, and the use of food as a reward. Clinical examinations by specialist pediatric dentists assessed the plaque index and decayed-missing-filled tooth (dmft/DMFT) scores. Statistical analyses included descriptive analysis, the Mann-Whitney test, the Kruskal-Wallis test, Spearman's correlation, and linear regression analysis.

Results Significant correlations were found between food rewards and poor oral health outcomes. Food rewards were positively associated with higher dmft/DMFT scores ($r=0.43$, $P<0.001$) and plaque index scores ($r=0.17$, $P=0.002$). Socio-demographic factors, such as parental education level and the amount of time spent with the child, were significant predictors of both food reward behaviors and oral health outcomes. Female and younger parents reported higher food reward scores, which correlated with poorer oral health in their children.

Conclusion The study underscores the significant impact of food-based reward behaviors on the oral health of Saudi children. These findings highlight the need for targeted educational and intervention strategies that address cultural practices and promote healthier reward systems. By reducing sugary food rewards and encouraging non-food-based incentives, improvements in children's oral health can be achieved.

Keywords Food-based incentives, Oral health, Saudi children, DMFT index, Plaque index

*Correspondence:
Yasir Dilshad Siddiqui
ydsiddiqui@ju.edu.sa
Farooq Ahmad Chaudhary
chaudhary4@hotmail.com
[1]Department of Preventive Dentistry, College of Dentistry, Jouf University, Sakaka, Saudi Arabia
[2]Department of Oral Medicine & Periodontology, Faculty of Dentistry, Damanhour University, Damanhour, Egypt
[3]Department of Public Health - Dental and Oral Health program, College of Applied Medical Sciences, Qassim University, Buraydah, Saudi Arabia
[4]College of Dentistry, Jouf University, Sakaka, Saudi Arabia
[5]School of Dentistry, Shaheed Zulfiqar Ali Bhutto Medical University, Islamabad, Pakistan

Background

Childhood dental caries is a widespread and persistent public health concern, that significantly impacts children's oral health and overall well-being globally. Dental caries is a multifactorial disease influenced by various biological, behavioral, and environmental factors, with diet playing a critical role. High consumption of sugary foods and drinks is a primary risk factor, contributing to the proliferation of cariogenic bacteria, ultimately leading to tooth decay [1].

The relationship between diet and dental caries is well-documented. High sugar intake fosters the growth of *Streptococcus mutans* and other acidogenic bacteria, leading to the demineralization of tooth enamel and dentin [2]. Studies have shown a direct correlation between sugar consumption and the prevalence of dental caries in children [3]. Reduced sugar intake significantly lowers the incidence of dental caries, emphasizing the importance of dietary modifications for dental health. Similarly, children with high-sugar diets exhibit substantially higher caries rates than those with limited sugar consumption [4]. It can be extrapolated that food-based reward behavior, which often involves sugary treats, could also be a risk factor for dental caries.

In Saudi Arabia, cultural practices and societal norms significantly influence dietary habits [5, 6]. The Jouf region, located in the northern part of Saudi Arabia, is known for its unique cultural and social practices, including the widespread consumption of dates and other sugary foods as part of traditional hospitality. The use of food as a reward is a common practice among parents and caregivers, often employed to encourage desired behaviors such as academic achievements or good conduct. While this practice may provide short-term behavioral benefits, its long-term implications on oral health are concerning. The frequent use of sugary treats as rewards contributes to poor dietary habits and increases the risk of dental caries [7, 8].

Local evidence underscores the severity of this issue in Saudi Arabia. Al Agili reported that Saudi children have one of the highest rates of dental caries globally, with dietary habits being a significant contributing factor [9]. A study by Wyne et al. revealed that the prevalence of dental caries among Saudi preschool children was alarmingly high, primarily due to the frequent consumption of sugary snacks [10]. These findings highlight the urgent need for targeted interventions that address both dietary behaviors and cultural practices to improve oral health outcomes.

Despite the growing body of evidence on the adverse effects of sugary foods on dental health, there remains a significant gap in research specifically addressing the impact of food-based incentive behaviors on the oral health of children in the Jouf region of Saudi Arabia. Understanding the intricate relationship between food-based reward behaviors and oral health is critical for developing effective preventive strategies. Parental practices and cultural norms must be addressed to mitigate the adverse effects of food rewards on dental health. This study aims to fill this gap by investigating the relationship between food-based rewards and oral health outcomes in Saudi children in the Jouf region. By focusing on a culturally relevant practice, this research seeks to provide insights that can inform public health authorities to formulate strategies and educational programs that could improve oral health behaviors.

Methods

This descriptive cross-sectional study was approved by the Research Ethics Committee of Jouf University, Saudi Arabia (Reference No. 2-09-45). It was conducted from April 2024 to July 2024 at Jouf University Hospital, Saudi Arabia. The sample of the study was recruited using convenience sampling due to time and resource constraints. The sample size was determined by the availability of participants during the study period and the need to achieve sufficient variation in variables. Children were recruited from among those visiting Jouf University Hospital. To ensure eligibility, participants were required to meet the inclusion criteria, which specified that they should be medically healthy, within the age range of 4 to 10 years, and of either gender. The Arabic or English-speaking guardians of these children were also included, who participated in a survey based on the Comprehensive Feeding Practices Questionnaire (CFPQ) [9]. Children with systemic illnesses, developmental disorders, special healthcare needs, or those undergoing orthodontic or dental treatments were excluded to maintain consistency in oral health assessments. Written informed consent was obtained from both the children and their parents or guardians after thoroughly explaining the study's purpose and procedures.

The study consisted of two parts: questionnaire administration and clinical examination of the children. To better understand parental feeding practices and their impacts on children's dietary habits and oral health outcomes, the validated CFPQ questionnaire was adopted [11]. The questionnaire was administered in both English & Arabic language to ensure accessibility and comprehensibility for the study participants. A rigorous translation and back-translation process was performed by bilingual experts fluent in both languages, ensuring semantic and conceptual equivalence between the original English and the Arabic versions.

To standardize the translated questionnaire, a pilot study was conducted with a subset of participants ($n = 30$). This helped verify the reliability and validity of the Arabic version. Cronbach's alpha value (0.78) was

calculated to assess internal consistency, and adjustments were made to address any identified ambiguities in phrasing. These steps ensured that the questionnaire maintained its reliability and validity in the context of the target population.

Before data collection, parents and caregivers received detailed training on how to accurately document their children's dietary habits and oral health behaviors. This training included clear instructions, practical examples, and practice sessions to enhance understanding of the data collection tools. A structured questionnaire based on the CFPQ [11] was administered to parents and caregivers. The questionnaire gathered information on sociodemographic characteristics, dietary habits, oral hygiene practices, and the use of food-based rewards (e.g., cookies, cakes, ice cream, cold drinks) and non-food rewards (e.g., video games, staying up late, toys). The questionnaire was originally designed to capture detailed data on the frequency and types of food-based rewards given to children, as well as their oral health status, including the Decayed, Missing, Filled Teeth (dmft/DMFT) index and plaque index.

Both dmft (decayed, missing, and filled teeth in primary dentition) and DMFT (decayed, missing, and filled teeth in permanent dentition) scores were recorded separately for each child, depending on the dentition present (primary, permanent, or mixed). For reporting purposes, a single combined mean (dmft/DMFT) was calculated to provide an overview of the total caries burden in the cohort. Clinical examinations were conducted by specialist pediatric dentists, including determining a plaque index following the method described by Dababneh et al. [12]. The plaque index was recorded for specific teeth and surfaces: A (Buccal), E (Facial), J (Buccal), K (Lingual), P (Facial), and T (Lingual). Each tooth surface received a score of up to 10, with the mesial, distal, and cervical areas scoring up to 3 points each, and the center area scoring 1 point for the presence of plaque. The total plaque score was calculated by summing the scores for all teeth, with a maximum possible score of 60. If a tooth was missing due to extraction, the nearest adjacent tooth was examined. Caries experience was recorded as a Decayed, Missing, Filled Teeth (dmft/DMFT) score.

Statistical analyses for this study included descriptive analysis, the Mann-Whitney test, the Kruskal-Wallis test, Spearman's correlation, and linear regression analysis. Descriptive analysis presented the means, standard deviations, frequencies, and percentages. The Mann-Whitney test was used to determine the mean differences in food rewards, non-food rewards, dmft/DMFT index, and plaque index across participants' sociodemographic characteristics (e.g., parent gender, child gender, and whether the child stays home). The Kruskal-Wallis test was used to assess the mean differences in food rewards, non-food rewards, dmft/DMFT index, and plaque index across parents' levels of education. Spearman's correlation was performed to assess the relationship between rewards and oral health outcomes. Furthermore, linear regression analyses were conducted to identify significant predictors of the dmft/DMFT index and total plaque index. All statistical analyses were performed using SPSS version 27, with a significance level set at $p < 0.05$.

Results

Table 1 summarizes the general characteristics of the study participants. A total of 316 individuals participated in the study. Among the parents, 54.7% were female and 45.3% were male, while the children included 54.1% females and 45.9% males. The mean age of the parents was 34.57 years (SD = 3.31), and the mean age of the children was 6.06 years (SD = 1.42). Additionally, 79.1% of the parents had obtained a university degree, 86.4% reported dedicating most of their time to their children, 41.8% characterized the fathers as supportive caretakers and 31.6% of families reported a monthly income ranging from 5,000 to 10,000 Saudi Riyal (SAR).

Table 2 provides an overview of the oral habits of the study participants. Approximately half of the participants 51.3% of the participants reported brushing their teeth once a day, while 46.5% were unsure of the contents of their toothpaste. Additionally, 43.4% of parents believed that food-based rewards had contributed to their child's dental issues.

Table 3 presents data on food rewards and oral health outcomes among the participants. The mean dmft/DMFT score was 5.60, and the mean Plaque Index (PI) score was 23.60. The mean scores for food rewards and non-food rewards were 20.22 and 16.98, respectively.

Table 4 illustrates the mean differences in food and non-food reward scores across various socio-demographic characteristics. Female parents reported a significantly higher mean food reward score (21.68) compared to male parents (18.45), with a statistical significance of $P < 0.001$. A significant negative correlation was observed between parents' age and food reward score (r = -0.24, $P < 0.001$), indicating that as parents aged, they were less likely to use food based rewards. Additionally, significant differences in food reward scores were observed across different education levels of parents $P < 0.001$. Post-hoc analysis revealed significant differences between those with elementary and high school degrees, as well as between those with elementary and university degrees $P < 0.05$ for both comparisons).

Conversely, parents' age showed a significant positive correlation with non-food reward scores ($r = 0.14$, $P = 0.014$), indicating that older parents tended to give more non-food rewards. There were also significant differences in non-food reward scores across different

Table 1 General characteristics of the study participants ($n=316$)

Variables	*N* (%)	Mean (SD)
Gender of parents	173 (54.7)	
Female	143 (45.3)	
Male		
Gender of child	171 (54.1)	
Female	145 (45.9)	
Male		
Age of parents		34.57 (5.31)
Age of child		6.06 (1.42)
Level of education	28 (8.9)	
Elementary	38 (12.0)	
High school	250 (79.1)	
University		
Monthly income	100 (31.6)	
5,000–10,000	93 (24.9)	
10,000–15,000	1 (0.3)	
15,000–20,000	95 (30.1)	
20,000–50,000	27 (8.5)	
> 50,000		
Are you the person who spends the most time with the child?	43 (13.6)	
No	273 (86.4)	
Yes		
Other caretakers	36 (11.4)	
NA	132 (41.8)	
Father	90 (28.5)	
Mother	34 (10.8)	
Houseworker	24 (7.6)	
Sister		

Table 2 Oral hygiene habits of the study participants

Habits	*N* (%)
How often does your child brush their teeth?	87 (27.5.)
Never/Rarely	162 (51.3)
Once a day	67 (21.2.)
Twice a day/More than twice a day	
Do you use fluoride toothpaste for your child?	64 (20.3)
No	147 (46.5)
Not sure	105 (33.2)
Yes	
Do you believe that food-based rewards have contributed to any dental issues your child has experienced?	65 (20.6)
No	114 (36.1)
Not sure	137 (43.4)
Yes	

Table 3 dmft/DMFT, plaque indexes, food reward, and non-food reward scores

	Mean	SD	Range
dmft/DMFT index	5.60	3.32	1–25
Total PI	23.60	12.40	2–53
Food reward	20.22	4.84	9–31
Non-food reward	16.98	4.48	5–26

education levels ($P=0.028$). Post-hoc analysis revealed a significant difference between those with high school and university degrees $P<0.05$P. Moreover, parents who spent the most time with their children reported a significantly lower mean non-food reward score (16.52) compared to those who spent less time with their children (19.88), with a significance level of $P<0.001$.

Table 5 presents the mean differences in dmft/DMFT (Decayed, Missing, Filled Teeth) index and plaque index scores across various socio-demographic characteristics of the participants. Children with female parents had a significantly higher mean dmft/DMFT index (6.25) compared to those with male parents (4.81), with a significance level of $P<0.001$. Additionally, significant

Table 4 The effect of socio-demographic characteristics on food & non-food-based rewards

Variables	Food based reward			Non-food based rewards		
	Mean (SD) / *r*	Z	*P*-value	Mean (SD) / *r*	Z	*P*-value
Gender of parents	21.68 (4.63)	-5.131	**< 0.001**	16.49 (5.23)	-1.567	0.117
Female	18.45 (4.51)			17.57 (3.28)		
Male						
Gender of child	20.61 (4.70)	-1.327	0.185	17.44 (4.17)	-0.256	0.798
Female	19.76 (4.98)			16.43 (4.78)		
Male						
Age of parents	-0.24		**< 0.001**	0.14		**0.014**
Age of child	0.09		0.104	-0.02		0.675
Level of education	21.46 (4.98)[a]	24.795	**< 0.001**	17.00 (3.83)	7.184	**0.028**
Elementary	24.03 (4.51)[b]			14.58 (5.57)[a]		
High school	19.50 (4.59)[a]			17.34 (4.27)[b]		
University						
Are you the person who spends the most time with the child?	20.30 (2.22)	-0.821	0.411	19.88 (3.03)	-4.317	**< 0.001**
No	20.21 (5.14)			16.52 (4.51)		
Yes						

SD = standard deviation, r = Spearman's rho

Table 5 The effect of socio-demographic characteristics on dmft/DMFT and plaque index

Variables	dmft/DMFT Index			Plaque Index		
	Mean (SD) / *r*	Z	*P*-value	Mean (SD) / *r*	Z	*P*-value
Gender of parents	6.25 (4.14)	-3.510	**< 0.001**	25.80 (14.08)	-2.476	**0.013**
Female	4.81 (1.60)			20.94 (9.38)		
Male						
Gender of child	5.46 (2.18)	-1.182	0.237	24.48 (12.24)	-1.355	0.176
Female	5.77 (4.30)			22.57 (12.54)		
Male						
Age of parents	-0.07		0.223	-0.11		0.054
Age of child	0.01		0.861	0.20		**< 0.001**
Level of education	9.54 (7.26)[a]	14.751	**0.001**	25.04 (6.56)[b]	17.789	**< 0.001**
Elementary	6.05 (3.31)			15.55 (13.09)[a]		
High school	5.09 (2.14)[b]			24.67 (12.37)[b]		
University						
Are you the person who spends the most time with the child?	3.44 (0.77)	-6.654	**< 0.001**	14.19 (5.77)	-6.049	**< 0.001**
No	5.94 (3.44)			25.09 (12.52)		
Yes						

differences in the dmft/DMFT index were observed across different education levels of parents ($P = 0.001$). Post-hoc analysis indicated a significant difference in the dmft/DMFT index between those with elementary and university degrees $P < 0.05$.

Parents who spent the most time with their child had a significantly higher mean dmft/DMFT index (5.94) compared to those whose parents spent less time (3.44), with $P < 0.001$.

Regarding plaque index scores, children with female parents also reported a significantly higher mean plaque index score (25.80) compared to those with male parents (20.94), with $P = 0.013$P = 0.013P = 0.013. The child's age showed a significant positive correlation with the total plaque index score ($r = 0.20$, $P < 0.001$), indicating that older children had higher plaque index scores. There were significant differences in total plaque index scores across different parental education levels $P < 0.001$. Post-hoc analysis revealed significant differences between those with elementary and high school degrees and between those with high school and university degrees ($P < 0.05$ for both comparisons). Furthermore, parents who spent the most time with their children had significantly higher total plaque index scores (25.09) compared to those whose parents spent less time with their child (14.19), with $P < 0.001$.

Table 6 illustrates the relationship between reward types and oral health outcomes. The analysis reveals that food rewards are significantly and positively correlated with both the dmft/DMFT index ($r = 0.43$, $P < 0.001$) and the total plaque index score ($r = 0.17$, $P = 0.002$). This suggests that higher food reward behaviors are associated with increases in both the dmft/DMFT index and the total plaque index, indicating poorer oral health outcomes. Conversely, non-food rewards show a significant and negative relationship with the total plaque

Table 6 Relationship between rewards and oral health outcomes

Spearman's rho		dmft/DMFT	Plaque index
Food reward	Correlation coefficient	0.43	0.17
	P-value	**< 0.001**	**0.002**
Non-food reward	Correlation coefficient	0.07	0.13
	P-value	0.205	**< 0.001**

Table 7 Oral health behaviors as predictors of dmft/DMFT and plaque index

Variables	dmft/DMFT Index					Plaque Index				
	Coeff:	SE	P-value	95% CI		Coeff:	SE	P-value	95% CI	
				Lower	Upper				Lower	Upper
Frequency of tooth brushing Constant $R^2 = 0.002$	-0.157 5.90	0.223	0.482	-0.595	0.281	0.310 23.014	0.831	0.710	-1.325	1.945
Use of fluoride toothpaste Constant $R^2 = 0.006$	-0.346 5.999	0.259	0.183	-0.856	0.164	-0.371 24.024	0.970	0.702	-2.281	1.538
Food reward Constant $R^2 = 0.228$	0.327 -1.019	0.034	**< 0.001**	0.261	0.394	0.282 17.898	0.144	0.050	0.000	0.565
Non-food reward Constant $R^2 = 0.022$	0.110 3.728	0.041	**0.008**	0.029	0.192	0.721 11.369	0.151	**< 0.001**	0.424	1.017

SE = standard error, CI = confidence interval

index score (r = -0.13, $P < 0.001$), suggesting that as non-food reward behaviors increase, the total plaque index decreases, indicating better oral health outcomes.

Table 7 presents the influence of oral behaviors on the dmft/DMFT index and plaque index score. The findings indicate that both food rewards and non-food rewards are significant predictors of the dmft/DMFT index. Specifically, each unit increase in the food reward score is associated with a 0.3-point increase in the dmft/DMFT index ($\beta = 0.327$, $P < 0.001$), while each unit increase in the non-food reward score is associated with a 0.1-point increase in the dmft/DMFT index ($\beta = 0.110$, $P = 0.008$).

For the total plaque index, only non-food rewards emerged as a significant predictor. Each unit increase in the non-food reward score is associated with a 0.7-point increase in the total plaque index ($\beta = 0.721$, $P < 0.001$).

Discussion

This study investigated the effects of food-based incentive behaviors on the oral health of Saudi children, focusing on key oral health indicators such as the Decayed, Missing, Filled Teeth (dmft/DMFT) index and the plaque index. The results revealed significant correlations between food-based rewards and poor oral health outcomes, with food rewards positively associated with higher dmft/DMFT scores ($r = 0.43$, $P < 0.001$) and plaque index scores ($r = 0.17$, $P = 0.002$). Additionally, socio-demographic factors, such as parental education level and the amount of time spent with the child, were significant predictors of both food reward behaviors and negative oral health outcomes. Notably, female and younger parents reported higher food reward scores, which were linked to poorer oral health outcomes in their children.

These findings align with the existing research, demonstrating that high/frequent sugar intake is a major contributor to dental caries in children [13, 14]. This reinforces the notion that even moderate reductions in the amount/frequency of sugar intake can significantly lower the prevalence of dental caries. Research by Moynihan and Kelly has shown that high-sugar diets have substantially higher caries rates than those with limited sugar consumption [4, 15]. Additionally, other studies have demonstrated that dietary habits, including the frequency and type of sugar consumption, are critical determinants of dental caries in children [16–18]. Collectively, these studies emphasize the importance of dietary interventions in preventing dental caries. Our study supports this evidence by establishing a link between food-based rewards, often involving sugary treats, and higher dmft/DMFT and plaque index scores.

Research by Vann et al. highlights the critical role of caregivers' health in influencing children's oral health outcomes. Their findings suggest that caregivers with higher levels of oral health literacy are more likely to engage in practices that promote better oral health in their children, such as implementing effective oral hygiene routines and making informed decisions about diet and dental care [19]. This aligns with our finding that 43.4% of parents acknowledged the contribution of

food-based rewards to their child's dental issues. Additionally, studies by Alshammari et al. and Al-Johari et al. indicate that parental knowledge about the implications of oral health intervention can significantly reduce the prevalence of unhealthy reward practices, ultimately benefiting children's oral health [20–22].

However, this study diverges from previous research in some respects. For instance, Chinnakotla et al. reported that higher parental education generally correlates with better oral health and outcomes [23]. In contrast, our study revealed that even among educated parents, food reward behaviors were prevalent and negatively impacted children's oral health. This discrepancy may be due to cultural practices and societal norms in Saudi Arabia, which prioritize food as a form of reward and expression of care, regardless of parental education level [24]. Furthermore, our findings highlight that higher education does not necessarily equate to adequate oral health literacy. This underscores the need for universally implemented oral health education interventions to ensure that all parents, irrespective of their education level, are equipped with adequate baseline oral health knowledge. Such interventions can help address gaps in knowledge and promote healthier reward systems that support better oral health outcomes for children.

Proper oral hygiene habits, such as brushing teeth twice a day, are crucial for the prevention of caries and for maintaining the overall health of the oral cavity [25]. However, our findings revealed that only 51.3% of children brushed their teeth once a day and 22% brushed rarely. This negligence in oral hygiene practices leads to an increased risk of dental caries, gum disease, and other oral health issues. To mitigate these risks, it is essential to encourage children to brush their teeth twice a day with fluoride toothpaste, floss daily, and maintain regular dental check-ups. Educating both children and parents about the importance of these practices can significantly improve oral health outcomes [25].

Parental presence and involvement, while generally beneficial, can lead to higher dmft/DMFT scores if accompany dietary habits and oral health practices [8, 26]. Our study supports this, finding that children whose parents spent the most time with their child had significantly higher scores (5.94 vs. 3.44, $P < 0.001$) and plaque index scores (25.09 vs. 14.19, $P < 0.001$) compared to those whose parents spent less time with their child. Additionally, our findings reveal a significant positive relationship between food rewards and the dmft/DMFT index ($r = 0.43$, $P < 0.001$) and total plaque index score ($r = 0.17$, $P = 0.002$). Therefore, promoting comprehensive oral health education and healthy behaviors among parents is crucial in mitigating these risks.

Using the dmft/DMFT score allows for a unified representation of dental caries experience across the entire cohort, facilitating comparisons and reducing complexity in analyzing caries data across different age groups. However, this approach may mask differences between primary and permanent dentition. For example, primary teeth are more prone to caries due to their anatomical and structural properties, which could result in an overrepresentation of caries burden in younger children.

Extensive reviews on the risk factors for dental caries in young children emphasize the need for comprehensive preventive measures [27]. Beverage consumption and dietary determinants, particularly in young children, play a significant role in dental caries prevalence. The studies that show a significant association between food-based rewards and poor oral health outcomes suggest that current dietary practices are implemented through targeted educational programs [28]. Nutritional education should emphasize the importance of reducing sugary food rewards and promoting healthier alternatives. Public health campaigns can focus on educating parents about the long-term consequences of food-based incentives on their children's oral health and encouraging the adoption of non-food-based reward systems [29]. Culturally sensitive interventions should be developed, considering societal norms and practices influencing dietary behaviors. Engaging community leaders and using local media can help educate a broader audience, and schools and healthcare providers should collaborate to foster environments that support healthy eating habits.

Future research should focus on longitudinal studies to establish causal relationships between food-based reward behaviors and oral health outcomes. Investigating other socio-cultural factors, such as parental attitudes and beliefs about oral health, could provide a more comprehensive understanding of food reward behaviors and inform the development of tailored interventions.

Despite its contributions, this study has limitations. The use of convenience sampling limits the generalizability of our findings to the wider population, and may introduce selection bias, as participants were chosen based on their availability and willingness to participate rather than through random selection. The cross-sectional design limits causal inferences, and self-reported data from parents may introduce reporting bias. Future research should incorporate objective measures and longitudinal designs to validate and extend these findings.

Conclusion

In conclusion, this study underscores the significant impact of food-based incentive behaviors on the oral health of Saudi children. By highlighting the correlations between food rewards and poor oral health outcomes. Addressing cultural practices and promoting healthier reward systems are crucial steps toward improving

children's oral health in Saudi Arabia. Further research is needed to explore the outcome of such interventions.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s41043-024-00734-w.

Supplementary Material 1

Supplementary Material 2

Author contributions

Y.D.S, F.A.C, M.N.B, A.H.A, A.S.H, and A.E collected the data and performed data analyses and wrote the first draft of the manuscript. Y.D.S, F.A.C, S.H.A, and R.J.A, were involved in the conceptual development of this paper and provided feedback and revised the final manuscript. F.A.C, Y.D.S, H.A.A, R.A, and R.I, co-supervised the project and revised the final manuscript. All authors read and approved the final manuscript.

Funding

This work was funded by the Deanship of Graduate Studies & Scientific Research at Jouf University under grant No. (DGSSR-2023-01-02293).

Data availability

Data is provided within the manuscript in supplementary information files.

Declarations

Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki, and the ethical approval of this study was taken from the Research Ethics Committee of Jouf University, Saudi Arabia (Reference No. 2-09-45), and written consent was taken from the participant's and their parents/caretakers after providing them with all the information about the study.

Consent for publication

The written consent for publication of data was taken from the participant's after providing them with all the information about the study.

Competing interests

The authors declare no competing interests.

Received: 21 August 2024 / Accepted: 27 December 2024
Published online: 07 February 2025

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