

ORIGINAL

Dental Care Behaviors and Oral Health Challenges in School-Age Populations

Conductas de cuidado dental y problemas de salud bucal en poblaciones en edad escolar

Ahmad Mahmoud Saleh¹ , Aishah Al Daragemeh² , Asmaa Morgan Farahat Khatap¹ , Prakash Palanivelu¹ , Arul Vellaiyan¹ , Elturabi Elsayed Ebrahim¹ , Ahmad Rayan³ , Nermen Abdelftah Mohamed¹ 

¹Nursing College, Prince Sattam bin Abdulaziz University. Al-Kharj 11942, Saudi Arabia.

²Department of Pharmacy, Al-Zaytoonah University of Jordan. Amman, Jordan.

³Faculty of Nursing, Zarqa University. Amman, Jordan.

Cite as: Mahmoud Saleh A, Al Daragemeh A, Farahat Khatap AM, Palanivelu P, Vellaiyan A, Elsayed Ebrahim E, et al. Dental Care Behaviors and Oral Health Challenges in School-Age Populations. Salud, Ciencia y Tecnología. 2025; 5:1372. <https://doi.org/10.56294/saludcyt20251372>

Submitted: 19-06-2024

Revised: 03-10-2024

Accepted: 29-05-2025

Published: 30-05-2025

Editor: Prof. Dr. William Castillo-González 

*Corresponding author: Ahmad Mahmoud Saleh 

ABSTRACT

Introduction: oral health is vital for overall well-being, especially in childhood, as early habits influence lifelong dental health. This survey aims to evaluate oral hygiene habits and patterns among schoolchildren in Saudi Arabia.

Method: the survey utilized a school-based, point-in-time analysis conducted from October 15 to December 15, 2024. Participants were selected using a pure random sampling method to ensure a representative group of schoolchildren. Each participant completed an anonymous, detailed survey on oral hygiene habits, including tooth brushing, flossing, toothbrush ownership, and sharing toothbrushes with family members. The data were coded for analysis.

Results: the study revealed poor oral hygiene practices among schoolchildren, with only 369 (23,9 %) brushing their teeth twice daily, while 343 (22,2 %) never brushed, particularly in western areas 216 (23,2 %). Dental flossing was rare (1 503 (97,4 %) never used floss), 18,9 % lacked a toothbrush, and 292 (14,9 %) shared one with family members. Infrequent brushing was significantly linked to gum bleeding, highlighting a greater risk of dental issues and the urgent need for community-focused oral health interventions.

Conclusion: this study underscores the need for community-based oral health education programs, early interventions, and increased awareness to improve oral hygiene and prevent dental diseases in the population.

Keywords: Dental Care; Dental Flossing; Oral Hygiene; Schoolchildren; Tooth Brushing Habits.

RESUMEN

Introducción: la salud bucal es vital para el bienestar general, especialmente en la infancia, ya que los hábitos tempranos influyen en la salud dental de por vida. Esta encuesta tiene como objetivo evaluar los hábitos y patrones de higiene bucal entre los escolares de Arabia Saudita.

Método: la encuesta utilizó un análisis puntual en la escuela realizado del 15 de octubre al 15 de diciembre de 2024. Los participantes fueron seleccionados utilizando un método de muestreo aleatorio puro para asegurar un grupo representativo de escolares. Cada participante completó una encuesta anónima y detallada sobre los hábitos de higiene bucal, incluido el cepillado de dientes, el uso de hilo dental, la propiedad del cepillo de dientes y el uso compartido de cepillos de dientes con miembros de la familia. Los datos se codificaron para el análisis.

Resultados: el estudio reveló malas prácticas de higiene bucal entre los escolares, ya que solo 369 (23,9 %) se cepillaban los dientes dos veces al día, mientras que 343 (22,2 %) nunca se cepillaban, particularmente en

las áreas occidentales 216 (23,2 %). El uso del hilo dental fue poco frecuente (1 503 (97,4 %) nunca lo usaron), el 18,9 % no tenía cepillo de dientes y 292 (14,9 %) compartían uno con miembros de la familia. El cepillado poco frecuente se relacionó significativamente con el sangrado de las encías, lo que destaca un mayor riesgo de problemas dentales y la necesidad urgente de intervenciones de salud bucal centradas en la comunidad. **Conclusión:** este estudio subraya la necesidad de programas de educación sobre salud bucal basados en la comunidad, intervenciones tempranas y una mayor concienciación para mejorar la higiene bucal y prevenir enfermedades dentales en la población.

Palabras clave: Dental Care; Dental Flossing; Higiene Oral; Hábitos de Cepillado Dental; Niños en Edad Escolar.

INTRODUCTION

Early childhood periodontal disease is a major global health issue, shaped by a range of influencing factors involving oral health behaviors, socioeconomic status, and community awareness.⁽¹⁾ Understanding these dynamics is essential for developing effective oral health services.⁽²⁾ Research indicates that caregivers' knowledge and practices significantly impact children's oral health. A study found that while caregivers recognized the importance of oral hygiene, their practices varied, highlighting the need for targeted educational interventions.⁽³⁾ Socioeconomic factors act as an essential factor in maintaining children's oral health. A study in India revealed that lower parental education levels correlated with higher rates of dental caries, emphasizing the need for tailored interventions that address these disparities.⁽⁴⁾ In addition, community context significantly affects oral health outcomes. A multilevel analysis in Taiwan demonstrated that factors at the community level, including access to dental services, are critical in reducing dental caries prevalence among preschoolers.⁽⁵⁾

Literature has appeared that Gum bleeding is a critical indicator of oral health, emphasizing the need for effective oral hygiene practices. While tooth brushing is essential, it often fails to adequately clean interdental areas, necessitating the use of adjunctive tools like dental floss and mouth rinses to prevent periodontal diseases.^(6,7,8) A study done by Umalkar et al.⁽⁶⁾ indicates that interdental brushes are more efficient than dental floss in minimizing plaque and gingival problems, significantly improving oral health outcomes.⁽⁶⁾ In addition, Mancinelli-Lyle et al.⁽⁸⁾ found that water flossers significantly reduced gingival bleeding compared to interdental brushes, showcasing their efficacy in maintaining gum health.⁽⁸⁾ The effectiveness of interdental floss is heavily reliant on patient compliance, which can be enhanced through proper dental health education.⁽⁷⁾ Educating patients about the importance of using interdental aids alongside brushing can lead to better oral hygiene practices and reduced periodontal disease risk.⁽⁷⁾

While many studies underscore the importance of comprehensive oral care, some argue that the effectiveness of these adjuncts may vary based on individual habits and preferences, suggesting a need for personalized oral hygiene strategies.^(9,10,11) In Saudi Arabia, like many developing countries, faces a growing challenge with dental health, particularly among children. The prevalence of dental issues such as cavities and periodontal diseases has been on the rise, especially in younger populations.⁽¹²⁾ Studies indicate that poor oral hygiene habits, restricted access to preventive services, and a deficiency of awareness about proper dental practices contribute to the high incidence of dental problems.^(13,14,15) This situation is further exacerbated by high sugar consumption and inadequate public health programs addressing oral health.⁽¹³⁾ Consequently, An immediate requirement for community-based initiatives to foster better oral care and prevent future dental issues in Saudi Arabia's youth.^(13,14)

Al Kharj, located in the Riyadh Province of Saudi Arabia, is a significant agricultural and industrial hub, particularly known for its dairy farming. With a population of approximately 376,000, its proximity to Riyadh (77 km) has facilitated growth and economic development.⁽¹⁶⁾ The occurrence of dental issues in Al-Kharj, Saudi Arabia, reflects a significant public health concern, particularly among specific demographics. While direct statistics from Al-Kharj are limited, insights from broader studies in Saudi Arabia provide valuable context. Al-Malik and Rehbin⁽¹⁷⁾ found that 56 % of children in Jeddah visit the dentist only when facing serious issues.⁽¹⁷⁾ Almutairi et al.⁽¹⁸⁾ reported that 80 % of schoolchildren sought dental care solely during emergencies, highlighting a reactive rather than proactive approach to dental health.⁽¹⁸⁾ Another study by Almutairi et al.⁽¹⁹⁾ emphasized inadequate attitudes toward oral health among both children and parents, necessitating improved educational initiatives.⁽¹⁹⁾ Furthermore, A study in Al Qassim revealed that only 39 % of students had satisfactory oral hygiene knowledge, with many never having sought dental care.⁽²⁰⁾

The occurrence of dental issues in Saudi Arabia, presents a significant public health concern, particularly among schoolchildren. Therefore, this study seeks to assess oral care practices amongst students in Al Kharj schools, Saudi Arabia. These trends indicate a need for improved oral health education and preventive measures, as well as increased awareness regarding the importance of regular dental check-ups to prevent long-term

dental problems in the population.

METHOD

Design

This research was an analytical cross-sectional study conducted from 15 October to 15 December 2024.

Sampling

The study population included children enrolled in elementary schools in Al Kharj. Using simple random sampling, 6 schools were selected from a total of 22 elementary schools. The sample consisted of 1,542 students from first to sixth grade, comprising 828 boys and 714 girls.

Setting

The study was conducted in Al Kharj, Saudi Arabia, an important agricultural and industrial hub located approximately 48 miles southeast of Riyadh, the capital. With a population of around 376,000, Al Kharj is a significant contributor to the country's agricultural production, particularly in dairy farming. At the time of the research, approximately 24,000 children (6,4 % of the region's community) were enrolled in primary schools.

Ethical Considerations

Permissions were secured from the regional education authority and school administrators. Informed consent was obtained from both parents and children prior to participation.

Data Collection and Procedure

Data collection involved the use of a structured questionnaire administered to students during school hours. Data collectors collaborated with school administrators to schedule appropriate days for data collection. Responses were compiled and analyzed using statistical software to identify trends and associations.

Measures

Following a comprehensive examination of the pertinent literature on dental hygiene, a team of three academic colleagues assessed the questionnaire in regard of dental hygiene. The questionnaires were structured into two sections, consisting of an overall total of 11 questions. The introductory section included six questions focusing on participants' sociodemographic information, such as their residence, grade, school, age, gender. The subsequent section comprised 5 questions related to dental hygiene practices, including How often teeth are brushed, Incidence of haemorrhage during brushing in the past calendar month, dental floss usage, application of a specialized mouthwash, and possession of a personal toothbrush. Most questions were presented in a multiple-choice format (e.g., almost daily, sometimes, and never response) with only one option permitted per question. All participants received comprehensive instructions on how to complete the questionnaire.

A preliminary study was carried out involving 130 school children who had participated in the initial survey. The completion time for all questions ranged from 8 to 11 minutes. Each child was informed about the significance of offering precise and truthful answers. Additionally, the questionnaires were filled out under the supervision of caregivers to encourage accurate answers and clarify any uncertainties. Two caregivers, trained in The questionnaire methods, gathered all the information. Each participated student filled out a comprehensive questionnaire with assistance from the caregivers. The total response rate for the study was Ninety-six point six percent.

Statistical analysis

The data were coded and analyzed using SPSS software version 27.⁽²²⁾ Means, standard deviations, and frequency distributions were calculated. Chi-square tests were employed to compare categorical variables, with a significance level set at $p < 0,05$. Univariate analysis was conducted to calculate the odds ratio (OR) and the 95 % confidence intervals (CI) for the predictor factors that may influence gum bleeding.

RESULTS

Participant Characteristics

The schoolchildren ranged in age from 6 to 11 years old, with an average age of 6,53 years (SD = 0,54). According to table 1, 23,9 % of the children brush their teeth twice or more daily, while 37,1 % brush their teeth only once a day. Additionally, 22,2 % of the schoolchildren never brush their teeth at all, with girls brushing their teeth more frequently than boys. The percentage of schoolchildren who brush their teeth twice or more daily is similar between the two age groups. However, 26,0 % of children aged nine and under never brush their teeth, compared to 19,9 % of older students. There is a slight difference in tooth brushing habits between western and northern children, with a higher proportion of western children (23,2 %) never brushing their teeth

compared to northern children (20,7 %) ($p < 0,0001$).

Table 1. Tooth Brushing Habits Among Primary Schoolchildren in Al Kharj Governorate, Saudi Arabia					
Characteristics of the Subjects	How Often do the Schoolchildren Brush Their Teeth?			Value	X ² ; P Value
	Twice or More (Regular)	Once a Day	Never		
Gender					
Boys (n = 828)	190 (22,9 %)	253 (30,5 %)	234 (28,2 %)	151 (18,3 %)	51,45; 0,001
Girls (n = 714)	179 (25,0 %)	319 (44,6 %)	109 (15,2 %)	107 (13,8 %)	
Total (n = 1 542)	369 (23,9 %)	572 (37,1 %)	343 (22,2 %)	258 (16,7 %)	
Age group					
6-9 (n = 583)	124 (21,2 %)	161 (27,6 %)	152 (26,0 %)	146 (25,0 %)	41,21; 0,001
10-15 (n = 959)	209 (21,7 %)	411 (42,8 %)	191 (19,9 %)	148 (15,5 %)	
Total (n = 1 542)	335 (21,7 %)	574 (37,2 %)	345 (22,3 %)	296 (19,1 %)	
Place of residence					
Northern (n = 614)	146 (23,7 %)	252 (41,0 %)	127 (20,7 %)	89 (14,4 %)	16,44; 0,001
Western (n = 928)	187 (20,1 %)	320 (34,4 %)	216 (23,2 %)	205 (22,1 %)	
Total (n = 1 542)	335 (21,7 %)	574 (37,2 %)	345 (22,3 %)	296 (19,1 %)	

Dental Flossing

Table 2 shows that dental flossing among primary schoolchildren in Al-Kharj province is very rare: 97,4 % of the children stated that they had never used dental floss in their life.

Table 2. Teeth Flossing Habit Among Primary Schoolchildren in Al Kharj Governorate, Saudi Arabia				
Gender	Use of Dental Flossing			X ² , P Value
	Almost Daily	Sometimes	Never	
Boys (n = 828)	1 (0,12 %)	16 (1,9 %)	811 (97,9 %)	1,43; 0,32
Girls (n = 714)	1 (0,14 %)	21 (2,9 %)	692 (96,9 %)	
Total (n = 1,542)	2 (0,13 %)	37 (2,4 %)	1,503 (97,4 %)	

Own Toothbrush

Table 3 shows that only 66,1 % of them have their own toothbrush, and a proportion of 18,9 % did not have access to a toothbrush in the home. 14,9 % of the schoolchildren in Al-Kharj have a shared toothbrush with their families.

Table 3. Having Tooth Brush Among Primary Schoolchildren in Al Kharj Governorate, Saudi Arabia				
Gender	Have Own Tooth Brush			X ² ; P Value
	Yes	No	Shared	
Boys (n = 828)	516 (62,3 %)	202 (23,9 %)	110 (13,3 %)	34,02, 0,001
Girls (n = 714)	504 (70,5 %)	90 (12,6 %)	120 (16,8 %)	
Total (n = 1 542)	1,020 (66,1 %)	292 (18,9 %)	230 (14,9 %)	

Oral Hygiene Habits And Gum Bleeding Among Primary Schoolchildren In Al-Kharj Governorate

Table 4 illustrates the correlation between oral hygiene habits and gum bleeding among primary schoolchildren in Al-Kharj Governorate. Of the schoolchildren interviewed, 22,6 % complained of gum bleeding. Notably, 82,8 % of children who brushed their teeth regularly did not report any gum bleeding. Additionally, 81,8 % of children who used a special mouth rinse did not complain of gum bleeding. A large proportion of children who flossed their teeth (89,7 %) did not report any gum bleeding. Odds ratio analysis indicates that the highest risk of gum bleeding is associated with never using dental floss (OR: 1,9). Other oral hygiene habits, such as infrequent tooth brushing and not using mouthwash, were also associated with increased gum bleeding risk, though to a lesser extent (OR: 1,8 and OR: 1,25, respectively).

Table 4. Complaint of Gum Bleeding by Oral Hygiene Habits Among Primary Schoolchildren in Al Kharj Governorate, Saudi Arabia			
Oral Hygiene Habits	Complained of Gum Bleeding		OR (95 % CI), P Value
	Yes	No	
Tooth brushing			
Regular (n = 331)	57 (17,2 %)	274 (82,8 %)	1,8 (1,89-2,066); 0,002
Not regular (n = 1 211)	293 (32,4 %)	918 (75,8 %)	
Total (n = 1 542)	350 (22,6 %)	1,192 (77,3 %)	
Oral mouth rinsing with special rinse			
Yes (n = 286)	52 (18,1 %)	234 (81,8 %)	1,25 (1,25-1,79); 0,043
No (n = 1 256)	298 (23,7 %)	958 (76,2 %)	
Total (n = 1 542)	350 (22,7 %)	1,192 (77,3 %)	
Teeth flossing			
Yes (n = 39)	1 (2,5 %)	35 (89,7 %)	1,9 (0,79-4,67); 0,047
No (n = 1 503)	347 (23,0 %)	1,156 (76,9 %)	
Total (n = 1 542)	348 (22,5 %)	1,196 (77,5 %)	

DISCUSSION

Today, tooth brushing is regarded as an easy, widely accepted, and affordable practice for everyone. It is considered the most effective method for cleaning teeth and maintaining good oral hygiene, particularly when done correctly and consistently.^(23,24)

In this study, only 22,9 % of boys and 25 % of girls followed a regular oral hygiene routine by brushing their teeth more than a twice times a day. Additionally, 22,2 % of participants reported never brushing their teeth. These findings are consistent with earlier research. In a study conducted by Abe et al.⁽²⁵⁾, it was found that Japanese males brushed their teeth less often than females, with 22,9 % of males brushing once or less per day, compared to 11,2 % of females.⁽²⁵⁾ Similarly, a Lithuanian study by Kudirkaite et al.⁽²⁶⁾ revealed that females had a more consistent brushing routine, with statistically significant differences in brushing frequency between genders.⁽²⁶⁾ Moreover, a global analysis of toothbrushing behavior showed that while girls consistently brushed more than boys, boys demonstrated an increasing trend in brushing frequency over time.⁽²⁷⁾ These findings align with the reported low adherence to regular oral hygiene practices in both boys and girls in the current study. Research suggests that boys are generally less concerned about maintaining their oral health compared to girls, which could explain observed gender differences in oral hygiene practices.^(25,26,27) These gender differences are consistent with broader societal norms that encourage girls to adhere more strictly to personal hygiene standards, while boys may feel less pressure to do so.⁽²⁶⁾ Furthermore, girls have a stronger social and familial reinforcement of health-related habits.⁽²⁸⁾

Children aged 10 and older show a greater commitment to tooth brushing compared to younger peers, largely due to increased awareness of personal grooming and health education. This shift is influenced by exposure to health care programs in schools and media, which emphasize the importance of oral hygiene.^(29,30)

In the current study, the survey shows that flossing is rarely practiced, consistent with the low usage rates noted by Alhababeh et al.⁽³¹⁾, indicating a regional trend of inadequate flossing habits.⁽³²⁾

Recent studies continue to affirm the benefits of mouth rinses in reducing plaque and bacteria, emphasizing their role in maintaining oral hygiene.^(33,34)

The current study revealed that only about 18,5 (286 out of 1 542) of the schoolchildren utilized mouth rinse. This result is consistent with an international survey conducted across 20 countries revealed that only 12,8 % of children consistently used mouthwash. The study found significant variations in usage patterns based on economic status and geographic regions. It emphasized the pressing need for heightened awareness, particularly in lower-income areas, where access to and knowledge about the benefits of mouthwash were more limited.⁽³⁵⁾ Thus, raising awareness about oral health and the advantages of using mouthwash, particularly in school settings and low-income areas, remains a critical step toward improving global oral hygiene standards.

A surprising result highlighted in Table 3 revealed that almost a quarter of the schoolchildren lacked their own toothbrush, and 15 % shared a toothbrush with family members. This underscores the need to boost oral health awareness among children, parents, and the wider community, while also fostering more positive attitudes toward dental hygiene.^(36,37) Furthermore, it is crucial to integrate key knowledge and promote positive attitudes about oral care into school curricula to improve oral health practices among children.^(38,39)

The prevalence of gum bleeding during oral hygiene practices among schoolchildren in Al Kharj, Saudi Arabia, highlights significant oral health concerns. The study found that 22,8 % of children reported gum bleeding, aligning closely with findings from Jordan and previous Saudi studies. This underscores the need for effective

oral health education and preventive measures. The reported 22,8 % prevalence in Al Kharj is similar to the 25 % in Jordanian adults and consistent with a study at King Saud University indicated approximately 21 % of undergraduates experienced gum bleeding⁽¹⁷⁾ In contrast, a Lithuanian study found over 50 % of schoolchildren reported gum bleeding, suggesting regional differences in oral health practices⁽²⁶⁾ These results underscore the importance of regular flossing, brushing, and the use of mouth rinse as preventive measures for gum bleeding among primary schoolchildren in Al Kharj.

A potential limitation of this study in Al Kharj, Saudi Arabia, could be the variation in ages and grade levels of the participating schoolchildren. Additionally, the reliance on self-reported data about their oral hygiene habits may not accurately represent the children's actual practices. Furthermore, the results of the screening may only be applicable to schools with similar sizes and demographic characteristics, limiting the generalizability of the findings.

Health professionals such as nurses, physicians, health educators, and teachers must collaborate to convey the importance of oral hygiene habits to schoolchildren. Schools are an ideal setting for delivering health education, both in health classes and clinical interactions. The findings from this study hold significant implications for school administrators and policymakers within the Ministries of Education and Health. Furthermore, ensuring that all schoolchildren adopt good oral hygiene practices will enable them to grow into healthy adults, contributing more productively to their communities.

School health workers, particularly nurses, can play a pivotal role as change agents by enhancing the availability and accessibility of oral health services and resources (toothbrushes, floss, mouthwash, toothpaste, etc.) for schoolchildren. This can be achieved through partnerships with community organizations.

CONCLUSIONS

The findings from this study suggest that oral health habits among schoolchildren in Al Kharj are inadequate and in need of significant improvement. Practices such as brushing twice daily, flossing, and using mouthwash remain uncommon and are far from being standard. In light of these results, it is recommended that community-based oral health programs be developed. Additionally, parental involvement should be a key component of any national oral hygiene initiatives, alongside integrating oral health education into the school curriculum. Lastly, the findings stress the importance of implementing health campaigns that prioritize oral health screenings and treatments for all schoolchildren at the start of each academic year.

REFERENCES

1. Nazir M, Al-Ansari A, Al-Khalifa K, Alhareky M, Gaffar B, Almas K. Global prevalence of periodontal disease and lack of its surveillance. *The Scientific World Journal*. 2020;2020(1):2146-2160. <https://doi.org/10.1155/2020/2146160>
2. Broomhead T, Baker SR. Systems science and oral health: implications for dental public health. *Community Dent Health*. 2019;36(1):55-62. https://10.1922/CDH_4470Broomhead08
3. Shams M, Bhamani S, Sheikh S, Aslam K, Rehman A, Raza A. Exploring Oral Health Knowledge and Practices among Early Childhood Caregivers: A Cross-Sectional Survey. *Academy of Education and Social Sciences Review*. 2024;4(2):174-83. <https://doi.org/10.48112/aessr.v4i2.764>
4. Abbass MMS, Mahmoud SA, El Moshly S, Rady D, AbuBakr N, Radwan IA, et al. The prevalence of dental caries among Egyptian children and adolescences and its association with age, socioeconomic status, dietary habits and other risk factors. A cross-sectional study. *F1000Res*. 2019;8. <https://doi.org/10.12688/f1000research.17047.1>
5. Lin YC, Huang ST, Yen CW, Huang YK, Shieh TM, Chi WH, et al. Comparing individual-, family, and community-level effects on the oral health of preschool children: a multilevel analysis of national survey data. *BMC Oral Health*. 2023;23(1):353. <https://doi.org/10.1186/s12903-023-03077-w>
6. Umalkar YN, Jadhav V V, Paul P, Saoji KP. Comparative Evaluation of Cleaning Efficacy of Interdental Brush and Interdental Floss in Orthodontics Patients From Vidarbha Region: An Interventional Study. *Cureus*. 2023;15(9). <https://doi.org/10.7759/cureus.46191>
7. Chipre SR, Shah M. Evaluation of Clinical Efficacy and Patient Compliance of Interdental Floss as an Adjunct to Toothbrushing for Control of Dental Plaque: A Comparative Study. *Journal of Integrated Health Sciences*. 2024;12(1):36-41. https://doi.org/10.4103/jihs.jihs_4_24

8. Mancinelli-Lyle D, Van der Weijden F, Slot DE. Efficacy of a water flosser compared to an interdental brush on gingival bleeding and gingival abrasion: A 4 week randomized controlled trial. *Int J Dent Hyg.* 2024; <https://doi.org/10.1111/idh.12817>
9. Yoon MN. Oral Health for Long-term Care Populations: From Pneumonia Pathogenesis to Front-line Oral Care Provision. University of Toronto; 2011. <https://utoronto.scholaris.ca/server/api/core/bitstreams/375813cb-76ce-417a-986b-5cf51152202a/content>
10. Chan CCK, Chan AKY, Chu CH, Tsang YC. Theory-based behavioral change interventions to improve periodontal health. *Frontiers in Oral Health.* 2023;4:1067-1092. <https://doi.org/10.3389/froh.2023.1067092>
11. ALGhamdi A, Almarghlani A, Alyafi R, Ibraheem W, Assaggaf M, Howait M, et al. Prevalence of periodontitis in high school children in Saudi Arabia: a national study. *Ann Saudi Med.* 2020;40(1):7-14. <https://doi.org/10.5144/0256-4947.2020.7>
12. Nazir MA. Prevalence of periodontal disease, its association with systemic diseases and prevention. *Int J Health Sci (Qassim).* 2017;11(2):72. https://doi.org/10.4103/mdj.mdj_1_24
13. Bersell CH. Access to oral health care: a national crisis and call for reform. American Dental Hygienists' Association. 2017;91(1):6-14. <https://pubmed.ncbi.nlm.nih.gov/29118145/>
14. Jain N, Mitra D, Ashok KP, Dundappa J, Soni S, Ahmed S. Oral hygiene-awareness and practice among patients attending OPD at Vyas Dental College and Hospital, Jodhpur. *J Indian Soc Periodontol.* 2012;16(4):524-8. <https://doi.org/10.4103/0972-124x.106894>
15. Poudel P, Griffiths R, Wong VW, Arora A, Flack JR, Khoo CL, et al. Oral health knowledge, attitudes and care practices of people with diabetes: a systematic review. *BMC Public Health.* 2018;18:1-12. <https://doi.org/10.1186/s12889-018-5485-7>
16. Patil VC, Al-Gaadi KA, Madugundu R, Tola EHM, Marey S, Aldosari A, et al. Assessing agricultural water productivity in desert farming system of Saudi Arabia. *IEEE J Sel Top Appl Earth Obs Remote Sens.* 2014;8(1):284-97. <https://doi.org/10.1109/jstars.2014.2320592>
17. Almalki SA, Adil AH, Mustafa M, Karobari MI. Assessing oral health knowledge among public school children in Saudi Arabian subpopulation. *J Health Popul Nutr.* 2024;43(1):126. <https://doi.org/10.1186/s41043-024-00617-0>
18. Almutairi B, Adam TR, Bustami R. Caries prevalence among children at public and private primary schools in Riyadh: a retrospective study. *BMC Oral Health.* 2024;24(1):809. <https://doi.org/10.1186/s12903-024-04570-6>
19. Almutairi B, Conway D, Ross A, Hattan M, Almogren F, McMahon AD. Toothbrushing programme in Saudi Arabia 'TOPS': a study protocol for a cluster randomised controlled trial in kindergartens, Riyadh. *BMJ Open.* 2024;14(8):e083504. <https://doi.org/10.1136/bmjopen-2023-083504>
20. Alwadie SAM, Al Mastur AA, Alkhars FAJ, Alenezi SA, Alqhtani ESM, Alaqade AM, et al. Saudi School Children's Oral Health and Hygiene Literacy and Behaviors. *International Journal of Medical Science and Clinical Research Studies.* 2023;3(12):2947-54. <https://doi.org/10.47191/ijmscrs/v3-i12-04>
21. El-Metwally A, Shaikh Q, Aldiab A, Al-Zahrani J, Al-Ghamdi S, Alrasheed AA, et al. The prevalence of chronic pain and its associated factors among Saudi Al-Kharj population; a cross sectional study. *BMC Musculoskelet Disord.* 2019;20:1-9. <https://doi.org/10.1186/s12891-019-2555-7>
22. SPSS IBM. Statistics for Windows Version, 27.0. In. Armonk, NY: IBM Corp; Released. In : 2020. <https://doi.org/10.4324/9781003205333-2>
23. Association CS. Preserving Natural Teeth to Maintain Oral Health. *Chin J Dent Res.* 2024;27(1):11-2. <https://doi.org/10.1186/s12903-022-02404-x>

24. Kramer A, Splieth C. Health promotion through structured oral hygiene and good tooth alignment. *GMS Hyg Infect Control*. 2022;17. <https://10.3205/dgkh000411>
25. Abe M, Mitani A, Hoshi K, Yanagimoto S. Large gender gap in oral hygiene behavior and its impact on gingival health in late adolescence. *Int J Environ Res Public Health*. 2020;17(12):4394. <https://doi.org/10.3390/ijerph17124394>
26. Kudirkaite I, Lopatiene K, Zubiene J, Saldunaite K. Age and gender influence on oral hygiene among adolescents with fixed orthodontic appliances. *Stomatologija*. 2016;18(2):61-5. <https://pubmed.ncbi.nlm.nih.gov/27649721/>
27. Honkala S, Vereecken C, Niclasen B, Honkala E. Trends in toothbrushing in 20 countries/regions from 1994 to 2010. *The European Journal of Public Health*. 2015;25(suppl_2):20-3. <https://doi.org/10.1093/eurpub/ckv013>
28. Barbosa CM, Scatolin RS, Vieira-Junior WF, Tanaka MH, Ferraz LN. Impact of combined at-home bleaching and whitening toothpaste use on the surface and color of a composite resin. *Restor Dent Endod*. 2023;48(3). <https://doi.org/10.5395/rde.2023.48.e26>
29. Siddika N, Apu EH. Toothbrushing frequency among children and adolescents in 72 countries: Findings from the Global School-based Student Health Survey. *Dent Med Probl*. 2024;61(4):495-506. <https://doi.org/10.17219/dmp/185842>
30. Kim EJ, Ko GW, Seong EJ, Lee SJ, Lee YS, Lee CR, et al. Relationship between Tooth Brushing and Hand Washing by Family Type among Adolescents: A 2020 Nationally Representative Korean Survey. *Hygiene*. 2024;4(3):317-25. <https://doi.org/10.3390/hygiene4030025>
31. Alhababbeh R, Alryalat SA, Al-Jaghbir MT. Oral Health Knowledge Attitudes and Practices of Parents of Preschool Children in Amman, Jordan 2019: A Descriptive Cross-Sectional Study: Children's Oral health knowledge in parents. *Jordan Med J*. 2024;58(2). <https://doi.org/10.35516/jmj.v58i2.714>
32. Abuhaloob L, Tabche C, Amati F, Rawaf S. Provision of oral healthcare services in WHO-EMR countries: a scoping review. *BMC Oral Health*. 2024;24(1):705. <https://doi.org/10.1186/s12903-024-04446-9>
33. Milleman J, Bosma ML, McGuire JA, Sunkara A, McAdoo K, DelSasso A, et al. Comparative Effectiveness of Toothbrushing, Flossing and Mouthrinse Regimens on Plaque and Gingivitis: A 12-week virtually supervised clinical trial. *American Dental Hygienists' Association*. 2022;96(3):21-34. <https://jdh.adha.org/content/jdenthyg/96/3/21.full.pdf>
34. Rahman MH, Antonio JM, Lee YS, Fadriqela A, Kim SM, Han SY, et al. Oral health effect of an oral rinse containing cetylpyridinium chloride: a randomized clinical trial. *Mol Cell Toxicol*. 2024;20(3):671-8. <https://doi.org/10.1007/s13273-023-00385-8>
35. Elkhodary HM, Abdelnabi MH, Swelem AA, Sabbagh HJ, El Meligy OAES, Talaat IM, et al. Individual, familial and country-level factors associated with oral hygiene practices in children: an international survey. *BMC Oral Health*. 2023;23(1):50. <https://doi.org/10.1186/s12903-023-02746-0>
36. Verma S, Sangha KS, Singh P, Mustilwar R, Francis J, Nasser N. Comparative Evaluation of Dental Hygiene Awareness among Student Population Studying in Various Technical and Nontechnical Courses. *J Pharm Bioallied Sci*. 2024;16(Suppl 3):S2533-6. https://doi.org/10.4103/jpbs.jpbs_347_24
37. Novildan NHS, Khairunnisa DS, Giovan MA, Nugroho DA, Utami S, Puspita S. Education and training on dental and oral health as well as clean and healthy lifestyle for children. *Community Empowerment*. 2024;9(5):789-96. <https://doi.org/10.31603/ce.11233>
38. Abbas H, Roshan R, Nasir MZ. AWARENESS AND HEALTH SEEKING BEHAVIOUR OF PARENTS REGARDING THEIR CHILDREN'S ORAL HEALTH AND PROFESSIONAL DENTAL CARE IN ISLAMABAD, PAKISTAN. *Pakistan Oral & Dental Journal*. 2017;37(4). <https://doi.org/10.54112/bcsrj.v2024i1.664>

39. Zafar H, Akbar MS, Mehmood MS, Ahmad M. Oral hygiene knowledge, practices, attitude, and awareness among primary school students in a rural area of mardan, pakistan. *Afghanistan Journal of Basic Medical Science*. 2024;1(2):53-64. <https://doi.org/10.62134/ajbms/v2.i2.khatamuni.8>

FINANCING

This project was supported by the Deanship of Scientific Research at Prince Sattam Bin Abdulaziz University under the research project number (PSAU/2024/03/31825).

CONFLICT OF INTEREST

The author declares that they have no competing interests.

ACKNOWLEDGEMENTS

The authors extend their appreciation to Prince Sattam bin Abdulaziz University for funding this research work through the project number (PSAU/2024/03/31825).

AUTHORSHIP CONTRIBUTION

Conceptualization: Ahmad Mahmoud Saleh.

Data curation: Aishah Al Daragemeh and Ahmad Rayan.

Formal analysis: Asmaa Morgan Farahat Khatap and Ahmad Rayan.

Methodology: Prakash Palanivelu, Arul Vellaiyan and Ahmad Mahmoud Saleh.

Validation: Ahmad Mahmoud Saleh, Elturabi Elsayed Ebrahim and Ahmad Rayan.

Drafting - original draft: Ahmad Mahmoud Saleh and Nermen Abdelftah Mohamed.

Writing - proofreading and editing: Ahmad Mahmoud Saleh, Aishah Al Daragemeh and Asmaa Morgan Farahat Khatap.