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The relationship between Body Mass Index and dental anxiety among pediatric patients in Jeddah, Saudi Arabia: a crosssectional study

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Abstract

Background Studies suggested a relationship between anxiety and Body Mass Index (BMI). However, dental anxiety and BMI was not previously investigated. This cross-sectional study aimed to assess the impact of BMI levels on dental anxiety and behavior among pediatric patients.

Methods Children 6–11 years attending four-referral centers in Jeddah, Saudi Arabia and their parents were interrogated. The BMI level scores, child's behavior (Frankel's classification) and dental-anxiety (Abeer Dental Anxiety Scale (ACDAS)) were evaluated.

Results Out of 952 children participated in this study, 496 (52.1%) had normal BMI, 264 (27.7%) had high BMI (overweight), and 192 (20.2%) had low BMI (underweight). Regression analysis found that overweight was significantly associated with an increased adjusted odds ratio (AOR) of dental anxiety (AOR=3.018) and uncooperative dental behavior (AOR=8.714) with p < 0.001. Also, statistically significant increase in the odds ratio (OR) of the child feeling shy in the clinic (P=0.002; OR:2.113) and parents/operators reporting child behaving scared (P=0.004; OR:1.985 and p < 0.001; OR:3.03, respectively) when overweight compared to normal-weight.

Conclusions This study highlights the impact of overweight on the emotional and behavioral dimensions of the child's dental experience as they significantly increased the probability of dental anxiety and uncooperative behavior by three and eight times, respectively.

Keywords Anxiety children, Behavior, Body mass index, BMI, Dental, Overweight

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Background

Anxiety disorders are among the most prevalent mental health conditions, often manifesting before or during early adulthood [1]. It is common for children to experience worries and fears as a normal part of their developmental process. However, the nature and extent of these anxieties evolve with age, influenced and altered by cognitive, social development and inclinations [2].

Dental anxiety is a specific type of anxiety disorder characterized by an intense emotional response to dental treatment, affecting diverse populations globally [2]. It is defined as stress induced by dental treatment, triggering psychological and physiological reactions. There are consequences to dental anxiety, particularly in pediatric patients. Studies indicate that children with high levels of dental anxiety often exhibit poorer oral health outcomes [3]. Moreover, anxiety in these patients can hinder the ability to provide optimal dental care [4].

Although several risk factors for dental anxiety have been identified, many remain uncertain and require further investigation. These can range from well-defined, identifiable factors to more ambiguous causes that may arise without a clear trigger [5-9]. Therefore, this area warrants deeper exploration.

Research had shown a positive correlation between dental anxiety levels and patients' general anxiety [10, 11]. Several studies have explored the complex relationship between factors like weight status and overall health, reporting associations between general anxiety, depression, mood disorders, and body mass index (BMI) [12– 15]. Given the overlap in potential etiological factors for both general and dental anxiety, BMI may be related with dental anxiety, potentially through shared underlying mechanisms.

The BMI is a quantitative measure used to assess an individual's weight and height to approximate body fat in both men and females across all age groups [16]. The existing body of research suggest a correlation between BMI and anxiety [12, 14, 15], yet it remains unclear whether specific BMI categorization has a higher likelihood of exacerbating symptoms of anxiety. Research has delved into the relationship between anxiety and weight status, revealing a complex interplay that can vary across gender and age groups [12, 15, 16]. Further, a 2019 systematic review and meta-analysis by Amiri et al. focused specifically on the relationship between obesity and anxiety symptoms. Their findings consistently demonstrated a higher prevalence of anxiety symptoms among overweight individuals compared to those with a healthy weight [12].

While studies have investigated the relationship between general anxiety and BMI, the connection between BMI and dental anxiety, as well as its impact on behavior changes during dental visits, remains unclear, especially in children. Therefore, this study aims to evaluate if children aged 6 to 11 years with high or low BMI exhibit more dental anxiety, and/or behavioral challenges in the dental clinics compared to children with normal BMI.

Materials and methods

Study design and setting

This cross-sectional study enrolled children aged 6 to 11 years from various hospitals in Jeddah, Saudi Arabia, including King Abdulaziz University Dental Hospital (UDH), the Ministry of Health (MOH) (King Fahad General Hospital, North Jeddah Speciality Dental Center), King Fahad Armed Forces Hospital (KFAFH), and King Abdulaziz Medical City (KAMC). Data collection took place from December 2022 to November 2023. Approval for the research was obtained from the Research Ethics Committees of the Faculty of Dentistry at King Abdulaziz University [] and the National Guard at King Abdullah International Medical Research Center (1779/23). This study was conducted following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines to ensure methodological rigor and transparent reporting.

Study size

Using OpenEpi Version 3.01, the sample size was calculated based on Herhaus et al. [17] study which assessed the anxiety and health status across different BMI classes. According to 0.59 mean difference, 80% power, and 95% confidence interval (CI), the suggested sample size was 870.

Participants

Inclusion criteria involved children aged 6 to 11 years with no history of invasive dental treatment (not requiring local anesthesia). The exclusion criteria included children lacking in cooperative ability (unable to control their behavior) according to Wright (1975), such as children with mental disabilities and developmental delays [18]. Additionally, those with uncontrolled medical conditions, or those needing emergency dental treatment were excluded from this study.

Variables, data sources /measurements

Study technique included questionnaire with eligible children and their parents. Data were collected using a form with three parts:

Part 1: A questionnaire on sociodemographic variables, including the child's gender, age groups (7–6, 9–8 and 10–11), and family income (low: less than 7000 SAR, moderate: between 7000–12,000 SAR, or high: more than 12,000 SAR) [19].

Part 2: BMI calculation using the child's height (in centimeters) and weight (in kilograms) with categorization according to The Growth Charts for Saudi Children and Adolescents [20, 21] (Underweight: less than 5th percentile, Healthy: 5th percentile to less than 85th percentile, Overweight: 85th to less than 95th percentile, and Obese: 95th percentile or greater). For analysis, we combined the obese and overweight categories into a single group labeled 'Overweight'.

Part 3: Child's Dental anxiety and behavior in dental clinics.

- Abeer Children Dental Anxiety Scale (ACDAS) was used to assess dental anxiety. It consisted of three sections: child self-assessment (13 questions); cognitive components (three questions), and a parental-dentist evaluation of the child's behavior (three question). The first section is responsible for assess the child's dental anxiety by calculating the total score of the 13 questions, ranging from 13–39. A child was considered anxious when the total ACDAS score is 26 or more [22, 23].
- Frankel's classification was used to assess dental behavior. It is categorized as definitely negative, negative, positive, or definitely positive [24]. The child was considered un-cooperative when he was scored definitely negative or negative, and was considered cooperative when he was scored positive, or definitely positive.

Frankel and ACDAS scales were administered following simple prophylaxis and fluoride procedures. Face validity involved 10 participants not included in the main study, and content validity had a CVI score of 0.98. The internal consistency of ACDAS was assessed using Cronbach's alpha (0.91).

Statistical methods

Data analysis was conducted through SPSS version 20.0 (IBM Corp., Armonk, NY). Frequencies and percentages calculated for categorical variables, and group comparisons were performed using Chi-square test. Binary regression analysis was used to assess the relationship between both child's dental anxiety and uncooperative behavior in the dental clinics (dependent factors) and BMI classes (overweight, underweight, and normal), gender, family income, and child's previous treatment (yes/ no) (independent factors) through adjusting the Odds ratio (AOR) and removing the effect of confounders. Odds ratio (OR), and 95% Confidence interval (CI) were calculated for assessing the relationship between a child's BMI and the cognitive (part II) and behavior (part III) assessment of ACDAS scale. The significance set at a p-value of 0.05.

Results

A total of 952 children participated in the study. Among them, 394 (41.5%) were from KAU, 147 (15.4%) were from KFAFH, 209 (22.0%) were from KAMC, and 201 (21.1%) were from the MOH. There were 439 (46.1%) males, 513 (53.9%) females. Additionally, 264 (27.7%) were overweight, and 192 (20.2%) were underweight. Furthermore, 461 (48.4%) of the children experienced dental anxiety, and 333 (35%) were uncooperative during their dental visit (Table 1 and Fig. 1).

Table 2 presents the regression analysis results assessing the association between dental anxiety and dental behavior (dependent factors), with sociodemographic factors, and BMI (independent factors). Overweight was significantly associated with an increased AOR of dental anxiety (AOR=3.018) and uncooperative dental behavior (AOR=4.246) with p<0.001. on the other hand, underweight decreased the AOR of dental anxiety (AOR=0.673) and uncooperative behavior (AOR=0.617) with P=0.030 and 0.024, respectively. Previous dental visit decreased the AOR of dental anxiety (AOR: 0.753, P=0.045) but not the uncooperative behavior. Other variables, such as older age and higher family income decreased the AOR of dental anxiety and uncooperative behavior.

For parts II and III of ACDAS, assessing the child's cognitive and behavior, the results are presented in Table 3 and Supplementary Tables 1 and 2. There was a statistically significant increase in the OR of the child feeling shy in the clinic when overweight compared to normal weight (P=0.002; OR: 2.113). Additionally, parents and operators reported an increase in the child behaving scared with overweight compared to normal weight (P=0.004; OR: 1.985 and p<0.001; OR: 3.03, respectively).

Discussion

Dental anxiety is known to negatively impact children's oral health care and management [7]. Researchers have been investigating its associated risk factors to help control or even prevent it [4, 25, 26]. This study aims to introduce a potential risk factor that has not been previously evaluated in relation to dental anxiety and children's behavior in dental settings. Specifically, this research examines the correlation between BMI and both dental anxiety and behavioral responses in children during dental visits. The findings suggest that children with a higher

Table 1 Distribution of participants according to sociodemographic factors, BMI, dental anxiety and Frankel's classification

N Variable		Dental Anxiety ^A			Dental Behavior		
		Yes	No	<i>p</i> - value ^C	Uncooperative	Cooperative	<i>p</i> - value ^C
Gender	Male	206 (44.7)	233 (47.5)	0.392	143 (42.9)	296 (47.8)	0.150
	Female	255 (55.3)	258 (52.5)		190 (57.1)	323 (52.2)	
Age (years)	6–7	197 (42.7)	196 (39.9)	0.139	138 (41.4)	255 (41.2)	0.065
	8–9	162 (35.1)	159 (32.4)		125 (37.5)	196 (31.7)	
	10–11	102 (22.1)	136 (27.7)		70 (21)	168 (27.1)	
Father education	≤ High school	203 (44.0)	217 (44.2)	0.960	159 (47.7)	261 (42.2)	0.098
	> high school	258 (56.0)	274 (55.8)		174 (52.3)	358 (57.8)	
Mother education	≤ High school	197 (42.7)	205 (41.8)	0.759	142 (42.6)	260 (42.0)	0.849
	> high school	264 (57.3)	286 (58.2)		191 (57.4)	359 (58.0)	
Family income	Low	40 (8.7)	39 (7.9)	0.061	33 (9.9)	46 (7.4)	0.283
	Moderate	226 (49.0)	207 (42.2)		155 (46.5)	278 (44.9)	
	High	195 (42.3)	245 (49.9)		145 (43.5)	295 (47.7)	
Child aware of his dental problem	Yes	266 (70.9)	290 (77.1)	0.053	182 (72.5)	374 (74.8)	0.500
	No	109 (29.1)	86 (22.9)		69 (27.5)	126 (25.2)	
Previous dental treatment	Yes	163 (35.4)	210 (42.8)	0.019*	125 (37.5)	248 (40.1)	0.446
	No	298 (64.6)	281 (57.2)		208 (62.5)	371 (59.9)	
ВМІ	Overweight	182 (39.5)	82 (16.7)	< 0.001*	161 (48.3)	103 (16.7)	< 0.001*
	Underweight	68 (14.8)	124 (25.3)		37 (11.1)	155 (25.1)	
	Normal	211 (45.8)	284 (58.0)		135 (40.5)	360 (58.3)	
Total		461 (100)	491 (100)		333 (100)	619 (100)	

^C Chi square test

^A according to the total score of the 1st section of Abeer Children Dental Anxiety Scale (ACDAS), Body Mass Index (BMI)

* p value significant at 0.05



Fig. 1 Relationship between a child's BMI and his dental anixiety and behavior in dental setting

BMI are more likely to exhibit dental anxiety and uncooperative behavior during their dental appointments.

lthough the association between BMI and dental anxiety has not been previously studied, the findings of this research align with a growing body of evidence suggesting a significant relationship between general anxiety, behavior, and BMI [12, 14–16, 27, 28]. Overweight and obese children are consistently found to be at an

Variable		Dental Anxié	ity		Dental Behavior			
		<i>p-</i> value	AOR	95% CI	<i>p</i> - value	AOR	95% CI	
Gender	Male	0.454	0.903	0.691-1.180	0.163	0.815	0.61–1.09	
	Female		-			~		
Age (years)	6-7	0.025*	1.48	0.926-1.876	0.022*	1.554	1.065-2.266	
	8–9	0.125	1.32	0.926-2.1	0.27*	1.538	1.049–2.254	
	10-11		F			, -		
Previous den-	Yes	0.045*	0.753	0.570-0.993	0.609	0.925	0.686–1.247	
tal treatment	No		F			, -		
Family income	Low	0.221	1.372	0.827-2.277	0.098	1.201	0.921–2.654	
	Moderate	*600.0	1.452	1.097-1.921	0.235	1.201	0.888-1.623	
	High		,			-		
BMI	Overweight	< 0.001*	3.018	2.191-4.158	< 0.001*	4.246	3.1-5.854	
	Underweight	0.030*	0.673	0.471-0.962	0.024*	0.617	0.405-0.938	
	Normal		-			1		

Table 2 Regression analysis for the relationship between both child's dental anxiety according to Abeer Children Dental Anxiety Scale (ACDAS) and behavior (dependent factors),

* *p*- value significant at 0.05

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ACDAS		Overweight n(%)	Underweight n(%)	Normal n(%)	Total (100%)
Part II: Cognitive assessment of ASDAS scale					
The child feels shy in the clinic	Yes	70 (34.3)	28 (13.7)	106 (52)	204
	No	194 (26)	164 (22)	389 (52.1)	747
<i>p</i> -value, OR (95%CI)		0.002*, 2.113 (1.3–3.433)	0.113,1.324 (0.935–1.874)		
The child feels shy for his teeth look	Yes	42 (29.8)	22 (15.6)	77 (54.6)	141
	No	222 (27.4)	170 (21.0)	418 (51.6)	810
<i>p</i> -value, OR (95%CI)		0.178,1.462 (0.841–2.542)	0.898,1.027 (0.682–1.547)		
The child worried of losing control	Yes	109 (38.5)	30 (10.6)	144 (50.9)	283
	No	155 (23.2)	162 (24.3)	351 (52.5)	668
<i>p</i> -value, OR (95%CI)		0.0007*,1.714(1.254-2.343)	0.0003*, 0.451 (0.292–0.697)		
Part III: behavior assessment of ASDAS scale					
The child's behavior in his first visit (par-	scared	73 (35.6)	31 (15.1)	101 (49.3)	205
ents)	not scared	191 (25.6)	161 (21.6)	394 (52.8)	746
<i>p</i> -value, OR (95%CI)		0.004*, 1.985 (1.241-3.175)	0.024, 1.491, (1.054–2.11)		
The child's behavior in this visit (operator)	scared	90 (42.1)	28 (13.1)	96 (44.9)	214
	not scared	174 (23.6)	164 (22.3)	399 (54.1)	737
<i>p</i> -value, OR (95%CI)		< 0.001*, 3.03 (1.885-4.87)	< 0.001*, 2.15 (1.533-3.015)		

Table 3 Relationship between a child's BMI level and the cognitive (part II) and behavior (part III) assessment of Abeer Children Dental Anxiety Scale (ACDAS)

BMI Body Mass Index, OR Odds ratio, CI confidence interval

* *p*-value significant at 0.05

increased risk of experiencing anxiety compared to their normal-weight counterparts [12, 14]. Additionally, other studies have further solidified the connection between weight status and various pediatric dental conditions, such as dental caries [29] and dental fear [28].

Nevertheless, studies that did not find an association between anxiety and BMI were either conducted on adults or utilized different anxiety measurement tools, which may account for the discrepancies in findings [15, 30–32].

BMI with dental anxiety and behavior in the dental clinics

Evidence from this research indicates that subjects with high BMI levels are three times more likely to experience dental anxiety and four times more likely to exhibit uncooperative behavior in the dental clinic. This identified association between dental anxiety, behavioral responses, and BMI raises significant concerns for the oral health of overweight and obese children [14]. Dental anxiety can lead to avoidance of dental care, delaying the detection and treatment of oral health problems and resulting in a cascade of negative consequences, including dental caries, gum disease, and impaired oral health-related quality of life [14]. Moreover, uncooperative behavior in dental settings poses challenges for dentists in providing adequate care, further complicating oral health management [14]. Using the ACDAS framework to assess cognitive and behavioral aspects revealed additional dimensions of the relationship between weight status and dental experiences. The increased likelihood of overweight children feeling shy in the clinic, as reported by both parents and dental professionals, suggests a nuanced emotional impact that should be considered in clinical settings. This finding underscores the importance of creating a supportive and comfortable environment, particularly for overweight children, to address the emotional aspects of dental care.

The underlying mechanisms for this association are complex and likely involve multiple factors [14, 27]. Overweight and obese children may face increased stigmatization, negative body image, and fear of judgment from dental professionals, all of which can contribute to heightened dental anxiety [27]. Additionally, physical discomforts associated with overweight or obesity-such as increased pain sensitivity or difficulty maneuvering in the dental chair-may exacerbate anxiety and lead to uncooperative behavior [14]. Another potential explanation lies in the association between overweight/obesity and adverse childhood experiences (ACEs) [14]. ACEs, including neglect, abuse, and family conflict, have been linked to an increased risk of anxiety and depression, which may in turn contribute to dental anxiety and uncooperative behavior [14]. Therefore, the relationship between BMI and dental anxiety or behavior may be partially mediated by ACEs [14].

Mitigating factors for dental anxiety and behavior

In this study, various protective factors that may mitigate dental anxiety and uncooperative behavior in patients were explored. Notably, older age emerged as a significant factor, suggesting a decrease in dental anxiety with increasing age. This trend may be attributed to accumulated dental experiences over time, leading to familiarization and reduced fear. This finding aligns with a recent systematic review, which reported that younger patients tend to experience higher levels of anxiety than their older counterparts. This was attributed to the notion that cognitive development improves with age, enhancing awareness and understanding [33].

Additionally, our findings indicate that higher family income is inversely associated with dental anxiety and uncooperative behavior. This correlation may be explained by the increased access to dental care and educational resources afforded by higher income, leading to a better understanding of dental procedures and more regular visits, which, in turn, reduce fear and anxiety. This is consistent with a study conducted in Egypt, which found that negative behavior in dental settings was more prevalent among children from lower socioeconomic backgrounds [34].

Furthermore, this study observed that patients with extensive previous dental experiences exhibited a lower adjusted odds ratio (AOR) for dental anxiety, though this did not extend to behavior. Prior dental visits may improve a child's awareness of the dental setting, thereby decreasing anxiety, a finding supported by previous research [5, 35, 36]. However, the long-term impact of early dental experiences on behavior may be more complex. A previous study found that negative childhood dental experiences significantly increased the likelihood of dental fear in adulthood, with factors such as toothache, discomfort during treatment, and poor self-evaluation of oral health strongly associated with heightened dental fear and negative behavior [37]. The distinction between fear and anxiety, as well as the factors contributing to dental anxiety and uncooperative behavior, may be explained through classical and operant conditioning theories [38].

In conclusion, factors such as the influence of older age, higher family income, and previous dental experience act as protective elements, potentially contributing to a more positive dental experience. Understanding the role of these variables can inform targeted interventions to enhance the dental care experience for children, promoting cooperation and reducing anxiety.

In light of these findings, addressing dental anxiety and behavior in overweight and obese children is crucial for promoting their oral health. Early identification and intervention are essential to reduce anxiety levels, improve dental behavior, and prevent the onset of oral health problems [14, 39]. Several strategies can be employed to address dental anxiety in this population, including building rapport and trust, implementing behavior modification techniques, and considering anxiolytic agents for severe cases [14, 40–42]. Addressing the underlying factors contributing to dental anxiety in overweight and obese children is equally important. This may involve providing support for healthy lifestyle changes, addressing ACEs through trauma-informed care, and promoting body positivity interventions to enhance selfesteem and reduce stigmatization.

Limitations and strength

This study benefits from the objective assessment of BMI. Although the ACDAS is a subjective tool, it is a validated and reliable measure for assessing children's anxiety [23].

However, the study has certain limitations. It carries the inherent drawbacks of a cross-sectional design, which prevents causal inferences and may introduce selection bias. Additionally, the study was conducted in a specific population in Jeddah, Saudi Arabia, which may limit its generalizability to other populations or settings. To address this, participants were recruited from multiple centers, representing a heterogeneous sample from diverse areas and backgrounds.

Several methods were implemented to mitigate potential biases. Measurement bias was minimized by training data collectors to consistently administer the Abeer Children's Dental Anxiety Scale (ACDAS) and Frankel's behavior classification, as well as by using calibrated equipment for height and weight measurements. Recall bias was managed through structured questionnaires and by encouraging parents to refer to participants' dental records when needed. Response bias was reduced by assuring participants of confidentiality and fostering a supportive environment. Finally, confounding bias was addressed by collecting data on potential confounders such as family income, gender, parental education, age, and previous dental visits—and adjusting for these factors in the analysis.

Future research should explore the underlying mechanisms of the observed associations, including stigmatization, negative body image, and adverse childhood experiences. Additionally, expanding data collection to multiple centers across the Kingdom or throughout the Middle East could provide more robust insights. Longitudinal studies are needed to investigate the temporal relationship between BMI and dental anxiety, as well as to assess the impact of interventions aimed at improving both weight status and mental health on dental anxiety outcomes.

Implications and clinical significance

Nevertheless, this study contributes to the growing body of literature on pediatric dental care by emphasizing the need for tailored interventions that account for the various factors influencing dental anxiety and behavior. The findings have important clinical implications for dental practitioners, as they highlight a potential association between BMI, dental anxiety, and uncooperative behavior.

Dentists should recognize these connections and implement strategies that address the unique challenges faced by overweight children while also considering socioeconomic and experiential factors. A more patientcentered approach may include creating a supportive and non-judgmental environment, using positive reinforcement, and actively involving parents in the dental care process.

Collectively, these findings underscore the need for a holistic approach to pediatric dentistry—one that acknowledges the complex interplay between physical health, mental health, and social factors in shaping dental outcomes. By adopting this comprehensive approach, pediatric dentists can ensure that all children, regardless of weight status, receive the necessary oral health care to achieve optimal well-being.

Conclusion

The findings of this study suggest that pediatric dentists should consider BMI as a significant factor when assessing and managing young patients. Providing additional support and creating a more reassuring environment for those at higher risk of anxiety may enhance patient care. Moreover, these results highlight the need for a comprehensive approach that promotes both physical and emotional well-being in children, ensuring tailored interventions for those with a higher BMI. Future research could explore specific strategies, policies, and interventions aimed at reducing anxiety and improving cooperation in this demographic.

Abbreviations

BMI	Body Mass Index
ACDAS	Abeer Dental Anxiety Scale
AOR	Adjusted Odds Ratio
ACEs	Adverse childhood experiences

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12903-025-05813-w.

Supplementary Material 1.

Authors' contributions

NH: Conceptualization, Methodology, Supervision, Study design, Validation, Data curation, and Writing – review & editing; LYF: Methodology, Investigation, Data curation, Writing – original draft and Writing – review & editing; RAD: Methodology, Investigation, Data curation, Writing – original draft and Writing – review & editing; JT: Investigation, Data curation and Writing – review & editing; HT: Investigation, Data curation and Writing – review & editing; FMA: Methodology, Study design, Validation, Investigation, Data curation and Writing – review & editing; SIA: Data curation and Writing – review & editing; HJS: Conceptualization, Methodology, Project administration, Supervision, Study design, Validation, Investigation, Data curation, Formal analysis, Writing – original draft and Writing – review & editing. All authors reviewed and approved the final draft of the manuscript.

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Data availability

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

Approval for the research was obtained from the research ethical committees of the Faculty of Dentistry at King Abdulaziz University (162–12-22) and the National Guard at King Abdullah International Medical Research Center (1779/23). Consent to participate and for publication was obtained from the children's parents or guardians before their inclusion to the study.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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