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Original Research Article

Dental caries and fissure sealant prevalence in first permanent molars among school boys aged 9 to 12 in Riyadh city, Kingdom of Saudi Arabia

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ABSTRACT

Background: Dental caries is a major global public health concern. This study assessed dental caries prevalence and the use of fissure sealants on first permanent molars among Saudi Arabian boys aged 9–12 attending elementary schools to establish effective caries prevention strategies.
Methods: Cluster probability sampling was employed to select public and private male elementary schools from five distinct geographic regions in Riyadh city, KSA; 601 male students in the fourth grade (aged 9–10 years), fifth grade (aged 10–11 years), and sixth grade (aged 11–12 years) were included. Only the first permanent molars' occlusal surfaces were evaluated. Data management was performed using Microsoft excel, statistical analyses were conducted using the statistical package for the social sciences (SPSS), and the chi-square test was utilized.
Results: The outcome demonstrated that 67.7% (n=407 children) had decayed, missing, or filled first permanent molars, indicating the presence of caries, while 32.3% (n=194) had caries-free first permanent molars. Only 6.8% (n=41) of children had received fissure sealants. At the tooth level, 37.7% (n=906) of examined teeth had decayed, and 8.1% (n=194) had fillings. The utilization rate of fissure sealants remained low at 3.9% (n=93), with 50.4% (n=1211) of first permanent molars remaining intact.
Conclusions: This cross-sectional study highlights a significant prevalence between caries and the limited utilization of fissure sealants on first permanent molars among Saudi Arabian boys, underscoring the urgent need for proactive preventative measures and educational initiatives.

Keywords: Dental caries, Permanent molars, Fissure sealants, Caries prevention, School boys

INTRODUCTION

Dental caries is a major global public health concern, and the Kingdom of Saudi Arabia (KSA) is not an exemption from this issue.[1-3] This chronic condition, predominantly affecting children, persists despite being preventable. The occlusal pits and fissures present in the first permanent molars (FPMs) are among the many factors that lead to the development of dental caries. These factors include morphological characteristics, eruption timing, and intraoral location.[4,5] A child's future dental well-being may be negatively impacted if they lose their FPMs too soon as a result of caries.[6] Research conducted by McDonald and Sheiham highlights the significant prevalence of occlusal caries across various age groups, especially following the eruption of the FPMs, affirming their status as the primary site of decay.[7]

For many children, seeking dental professionals for restorative or extraction procedures related to these molars can be distressing and detrimental.[8] Several studies have shown the importance of oral hygiene guidelines, systemic

and topical fluoride application, and fissure sealant use in the prevention of dental caries, specifically in FPMs.[9,10] Therefore, dental professionals play a pivotal role in averting dental caries. Given the heightened susceptibility of FPMs to caries, it is imperative to seal their occlusal surfaces since these remain the most frequently affected sites soon after eruption.[11-13]

Numerous investigations have revealed a noteworthy incidence of dental caries in schoolchildren in the KSA and other developing nations.[14-20] In the KSA, many untreated carious lesions continue to exist, which frequently leads to the extraction of primary teeth because of caries.[21] Surprisingly, the prevalence of dental caries and fissure sealants on the FPMs in boys aged 9–12 years attending elementary schools in Riyadh city, KSA, has not been examined in any previous studies. Gathering baseline data on their oral health conditions is paramount for the effective implementation of treatment and prevention strategies. Therefore, the primary objective of this cross-sectional study is to evaluate the prevalence of dental caries and the use of fissure sealants in FPMs among Saudi Arabian boys enrolled in primary schools aged 9 to 12 to lay a strong basis for the development of efficient caries prevention plans.

METHODS

Ethical considerations

The institutional review board (IRB) and the ethics committee of the College of Dentistry Research Center (CDRC), Riyadh City, KSA, granted ethical approval for this study (IRB number E-23-7469 and CDRC No. IR 0455). Official notifications were submitted to the Ministry of Education and school administrators, and the requisite permissions for conducting the study were obtained. Informed written consent was also acquired from the parents for data collection.

Sample and study design

Regarding this cross-sectional study conducted in January and February of 2023, we employed cluster probability sampling to select public and private male elementary schools from five distinct geographic locations in Riyadh City, KSA (East, West, North, South, and Central). In total, 601 male students from the fourth, fifth, and sixth grades participated in the examination, with age groups corresponding to the respective grades. The fourth-grade students were aged between 9 and 10 years, the fifth-grade students between 10 and 11 years, and the sixth-grade students between 11 and 12 years. Before the examination, the students underwent a brief orientation and received oral hygiene instructions, and their informed consent was obtained.

Oral screening

The oral screening was conducted by four male dental interns who underwent training and calibration. These examiners were divided into two teams, each comprising two members. During the examination, one examiner conducted the assessment, while the other assisted with data input using a customized data-gathering form. The examinations occurred in the school clinic, with the child comfortably seated on a semi-reclined, pre-adjusted mattress chair. In compliance with infection control measures, the examination utilized disposable mouth mirrors, gloves, a portable light source (a halogen 40 W lamp), a cotton roll, and gauze. Only the occlusal surfaces of the first permanent molars were evaluated in this study (FPMs). All FPMs with occlusal surfaces fully exposed were screened and recorded. However, FPMs that were unerupted partially erupted, or missing were excluded from the study. The evaluation of dental caries followed the diagnostic criteria for oral health surveys as outlined by the World Health Organization.[22] Carious FPMs were identified as such, regardless of the stage lesion stage. Furthermore, the presence or absence of fissure sealants was also noted, irrespective of whether they were fully or partially intact. It is important to mention that no X-rays were taken during the examination.

Statistical analysis

The reliability of both intra-examiner and inter-examiner assessments was evaluated using Kappa statistics. A group of 50 male students was re-examined four weeks after the study's initiation, and a high level of agreement (kappa >0.80) was observed.

Data records were managed using Microsoft® excel® (Microsoft® Office 2018, Microsoft® Corp., Redmond, WA, USA), and all statistical analyses were carried out using the statistical package for the social sciences software (IBM SPSS Statistics 20.0; Armonk, NY, USA). Frequencies and descriptive statistics were computed. The sample size of 601 was determined with G*Power® (G*Power® 3.1.9.7, Heinrich Heine University Düsseldorf, Germany) at an alpha level of 0.05, a power of 0.95, and an effect size of 0.1815.

To ascertain the significance of differences in proportions and prevalence at the tooth level, the chi-square test was employed, with an acceptable margin of error set at p=0.05. Comparisons were made between the maxillary and mandibular FPMs, as well as among the different grades (fourth, fifth, and sixth) corresponding to the respective age groups.

RESULTS

In total, 2,404 first permanent molars (FPMs) were assessed in 601 male students aged 9 to 12, spanning the fourth, fifth, and sixth grades, to investigate the prevalence of caries, restorations, fissure sealants, and sound teeth. No teeth meeting the exclusion criteria (partially erupted, unerupted, or missing FPMs) were identified. The study sample was representative of various regions within Riyadh city, with 26.1% (n=157) from the western region,

24.6% (n=148) from the central region, 24.1% (n=145) from the eastern region, 18% (n=108) from the northern region, and 7.2% (n=43) from the southern region (Table 1).

The prevalence of one or more decayed, missing, or filled (DMF) FPMs, indicative of caries, was 67.7% (n=407 children). Consequently, 32.3% of the children (n=194) displayed caries-free FPMs, with only 6.8% (n=41) having received at least one fissure sealant. At the tooth level, decayed FPMs constituted 37.7% (n=906) of the total teeth examined, and only 8.1% (n=194) of FPMs had fillings. The utilization rate of fissure sealants on FPMs remained low at 3.9% (n=93). The remaining 1,211 FPMs (50.4%) were intact, signifying sound teeth (Table 2).

Analyzing the maxillary and mandibular FPMs (Table 2), the prevalence of caries and filled teeth in the mandibular FPMs was 55.2% (n=663), significantly higher than that in the maxillary FPMs, which was 36.4% (n=437) ($p<0.01$). Furthermore, a statistically significant difference in the proportion of sound FPMs existed between the maxillary (60.3%, n=725) and mandibular FPMs (40.4%, n=486) ($p<0.01$), with higher occurrences of sound FPMs in the maxillary region ($p<0.01$). However, there was no significant difference in the percentage of fissure sealants between the maxillary and mandibular FPMs, at 3.3% and 4.4%, respectively ($p>0.05$).

The results and comparisons among the three grade/age groups are presented in Table 3. The proportion of male students with carious FPMs significantly increased with age ($p<0.05$). This percentage rose from 36.5% in the fourth grade to 41.2% in the sixth grade, with a decrease to 34.3% in the fifth grade. Furthermore, a significant difference was observed in the proportion of filled FPMs among the three grade/age groups ($p<0.05$). The presence of filled FPMs decreased with age, with percentages of 53.8%, 51%, and 46.5% in the fourth, fifth, and sixth grades, respectively.

Regarding the association between age and fissure sealant utilization, the results revealed a relatively consistent prevalence of fissure-sealed FPMs among the different grade/age groups: 5.3%, 10.2%, and 8.5% for the fourth, fifth, and sixth grades, respectively. No relationship was found between the percentage of decayed FPMs and the presence of fissure sealants (Table 3).

Table 1: Distribution of the study sample of different Riyadh city regions by grades.

Region	Grades, N (%)			Total, n (%)
	Fourth	Fifth	Sixth	
Eastern	46 (23.8)	49 (23.8)	50 (24.8)	145 (24.1)
Central	47 (24.4)	51 (24.8)	50 (24.8)	148 (24.6)
Western	56 (29.0)	50 (24.3)	51 (25.2)	157 (26.1)
Northern	34 (17.6)	37 (18.0)	37 (18.3)	108 (18.0)
Southern	10 (5.2)	19 (9.2)	14 (6.9)	43 (7.2)

Table 2: Evaluation of caries and the presence of fissure sealants in maxillary and mandibular FPMS.

FPMS	No. of examined FPMs	Decayed teeth N (%)	Filled teeth N (%)	Fissure sealed teeth n (%)	Sound teeth n (%)
Maxillary	**1202**	373 (31)	64 (5.3)	40 (3.3)	725 (60.3)
Mandibular	**1202**	533 (44.3)	130 (10.8)	53 (4.4)	486 (40.4)
Total	**2404**	906 (37.7)	194 (8.1)	93 (3.9)	1211 (50.4)
Comparison (95% confidence interval)		Chi-squared =55.8 p<0.01	Chi-squared =26.7 p<0.01	Chi-squared=4.2 p>0.05	Chi-squared =60.2 p<0.01

Table 3: Distribution and comparative analysis of caries and fissure sealant prevalence in FPMS within different age groups.

Grade (age in years)	No. of male students	No. of examined FPMs	Decayed teeth N (%)	Filled teeth N (%)	Fissure sealed teeth N (%)	Sound teeth N (%)
Fourth grade (9–10)	193	772	282 (36.5)	41 (5.3)	34 (4.4)	415 (53.8)
Fifth grade (10–11)	206	824	291 (35.3)	84 (10.2)	29 (3.5)	420 (51)
Sixth grade (11–12)	202	808	333 (41.2)	69 (8.5)	30 (3.7)	376 (46.5)
Total	601	2404	906 (37.7)	194 (8.1)	93 (3.9)	1211 (50.4)
Comparison (95% confidence interval)			Chi-squared =13.8 p>0.05	Chi-squared=10.2 p>0.05	Chi-squared=10.6 p>0.05	Chi-squared=9.4 p>0.05

DISCUSSION

In this cross-sectional study, we evaluated the occurrence of caries and the fissure sealant application on the FPMs in male schoolchildren aged 9 to 12, representing five regions in Riyadh City, KSA. We focused on evaluating the health of these molars, given their significance as the initial permanent teeth to erupt and their function in preserving both oral and overall health. This investigation is particularly relevant due to their susceptibility to caries, offering valuable insights into the oral health status of these children.[23]

While previous research has explored the prevalence of dental caries in children, there remains a noticeable research gap concerning the specific examination of FPMs among 9–12-year-olds in KSA. As far as we currently know, this study is the first attempt to assess the occurrence of caries and the fissure sealant application on FPMs within this age group in Riyadh city, KSA. Our findings have revealed a marked prevalence of dental caries and limited usage of dental restorations. Although the fissure sealant application was minimal, a substantial proportion of FPMs were discovered to be healthy. Importantly, none of the FPMs were found to be absent due to caries. Notably, direct comparisons between our results and earlier global and national studies are challenging due to variations in study designs, age categories, and other pertinent variables.

In our investigation, we observed that 67.7% of the children (n=407) had FPMs with decay or fillings, while 32.3% (n=194) exhibited FPMs free from caries. These figures notably surpass the reported caries prevalence in previous studies conducted in Riyadh, where the range was between 16.5% and 35.4% among children aged 6–9 years.[24,25]

Furthermore, variations in caries prevalence have been noted across different regions of Saudi Arabia. For instance, a study in Jeddah, involving 9–12-year-old children, identified a higher caries prevalence of 75.5%.[8] In Skaka, among children aged 7–8 years, a study reported a caries prevalence of 75% in FPMs, predominantly affecting the enamel.[26] In the eastern province of Dammam, it was reported that among children aged 8–12 years, there is caries prevalence of 49.8% in FPMs.[27] Down in the southern province, a study conducted in Abha reported a caries prevalence of 66.4% among children aged 7–10 years.[28]

From a global perspective, research conducted on Moroccan children aged 6–15 years reported a caries prevalence of 77% for FPMs, while a study in Tunisia involving children aged 6–13 years found a prevalence of 35.8% for carious FPMs.[29,30] Conversely, a study in China reported a prevalence of 72% for decayed or filled FPMs among children aged 7–12 years old.[31]

Concerning the utilization of fissure sealants, our study revealed that only 6.8% (n=41) of the children had received at least one fissure sealant. In comparison, two studies conducted in Riyadh among 6–9-year-old children reported fissure sealant usage rates of 0.8% and 1.3%, respectively.[24,25] Notably, none of the participants in Skaka had employed fissure sealants.[26] These findings underscore the inadequacy of the use of fissure sealants for caries prevention in children, which is a matter of concern given the demonstrated effectiveness of sealants in preventing occlusal caries.[11] The limited adoption of sealants may be attributed to factors like a lack of awareness among parents and dental professionals, constrained resources, or potential misconceptions regarding their effectiveness and necessity.

Conversely, in Germany, a study conducted among children aged 8 to 12 reported a usage rate of fissure sealants of 55.6%.[32] Similarly, in Portugal, a study conducted among adolescents aged 12–18 years reported fissure sealant of 58%.[33] These variations in caries prevalence can be attributed to differences in socioeconomic status, access to dental care, and dietary habits, which vary across nations.

At the tooth level, the collective prevalence of decayed, missing, or filled FPMs was 45.8%, with caries alone accounting for 37.7% of these cases. This signifies that 54.2% of the examined FPMs were unaffected by caries. Our findings exhibit a lower caries prevalence compared to other local studies. For instance, a study conducted in Jeddah reported a higher caries prevalence of 75.5% among children, displaying an increasing trend from 67% at 9 years of age to 83.5% at 12 years of age.[8] Similarly, a study in Abha, KSA, identified prevalence rates of 56.9% and 60.1% among 9-year-old and 10-year-old children, respectively.[28]

Our study revealed a notably higher prevalence of caries in mandibular FPMs compared to maxillary FPMs (44.3% versus 31.0%). This finding aligns with prior research and can be attributed to disparities in morphology and a difference in eruption timing between mandibular and maxillary FPMs.[24-26,28] The substantial disparity in caries prevalence between maxillary and mandibular FPMs may be attributed to the anatomical differences and areas where food retention is more likely, rendering mandibular FPMs more susceptible to decay.

The statistical analysis has revealed that caries prevalence increases with age, a pattern consistent with prior research on children.[8,24,25,28] The rise in caries prevalence with age can be attributed to extended exposure of teeth to the oral environment, suboptimal oral hygiene habits, and dietary choices that promote caries progression. These findings emphasize the significance of early interventions and educational initiatives for young children. The recommendation to apply fissure sealants when a child's first tooth emerges serves as an effective strategy for caries prevention.[34,35] These preventative measures have the

potential to significantly diminish the probability of dental caries and other oral health issues in children. Parental and caregiver education is crucial about proper oral hygiene practices to ensure the dental well-being of their children. Considering the favorable outcomes of school-based fissure sealant programs in other nations, it is reasonable to propose their inclusion in preventive programs within the KSA.[36-39]

The development of a comprehensive nationwide preventative program utilizing fissure sealants necessitates a thorough understanding of caries epidemiology, the present prevalence, and the utilization of fissure sealants. Fissure sealants constitute a critical component of preventive care for children, serving both individual and public health objectives.[40]

According to the findings of our study, it is apparent that there is a notable deficiency in the utilization of fissure sealants among children. This shortfall may be linked to inadequate awareness among the general public and dental professionals concerning the advantages and effectiveness of sealants in caries prevention or their insufficient application despite their known efficacy. This supposition is corroborated by the findings of global studies examining the knowledge and attitudes of dentists regarding the application of fissure sealants.[41-43]

Considering the elevated occurrence of caries in FPMs among young children, it is imperative to conduct additional research spanning diverse regions in Saudi Arabia. Combining health education programs with preventive dental interventions can yield substantial advantages for students in both public and private schools. Through the adoption of preventive strategies, there is substantial potential for a noteworthy reduction and control of dental caries prevalence in Saudi Arabia.

The limitations of this study are as follows: the cross-sectional design only provides a snapshot, making it challenging to determine causation; as this study examined males in Riyadh city, the findings may not be representative of the entire KSA or females, warranting further investigation; as no X-rays were taken, interproximal caries might have been missed; and only the FPMs were examined, providing a limited perspective on overall dental health.

CONCLUSION

The results of this cross-sectional investigation indicate a noteworthy occurrence of caries and limited usage of fissure sealants on FPMs among 9–12-year-old boys attending public and private schools in five regions of Riyadh city, Saudi Arabia. These findings emphasize the significance of implementing preventive measures and educational programs at an early age.

The insufficient application of fissure sealants underscores the necessity for the implementation of school-based or public preventive programs to effectively combat dental caries in Saudi Arabia. Parents play a pivotal role in promoting good oral health in their children by actively advocating for proper brushing of permanent molars and considering sealants as a preventive measure. Future research should concentrate on exploring the factors contributing to the limited nationwide usage of fissure sealants by dentists and parents alike. Moreover, additional studies in diverse regions of Saudi Arabia are warranted to formulate targeted strategies for controlling dental caries.

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