

A survey of fissure sealants and dental caries prevalence in the first permanent molars among primary school girls in Riyadh, Saudi Arabia

Hessa M. Alwayli¹, Sattam A. Alshiha¹, Yazeed K. Alfraihi¹, Mohammed A. Hattan¹,
Abdullah A. Alamri¹, Mohammed S. Aldossary¹

Correspondence: Dr. Mohammed S. Aldossary
Email: msfd99@hotmail.com

¹Department of Dentistry, Ministry of Health, Riyadh, Saudi Arabia

ABSTRACT

Objectives: To investigate the prevalence of caries and fissure sealants on the first permanent molars (FPMs) among 6–9-year-old girls in Riyadh, Saudi Arabia. **Materials and Methods:** The FPMs of 17,891 school girls from 120 randomly selected public primary schools were evaluated by visual and tactile examination for the carious status and the presence of fissure sealants. Chi-square test was used to analyze the data at level of 5%. **Results:** A total of 58,140 FPMs were assessed in the 17,891 children. Nearly 64.6% of the children were caries free. Only 1.3% of the children had at least one fissure sealant applied. At tooth level, the decayed FPMs counted for 24.6%. There was obvious underutilization of fissure sealants on the FPMs; 0.8% ($n = 478$). The caries prevalence in the mandibular FPMs (33%) was significantly higher than in the maxillary FPMs, 18.2% ($P < 0.01$). The proportion of carious FPMs increased with age of the children significantly ($P < 0.01$). There was no significant difference in the proportion of the presence of fissure sealants among the three different grade/age groups ($P > 0.05$). **Conclusions:** Caries prevalence in the FPMs was high and serious among this cohort of young students. This was contrasting the very low prevalence of fissure sealants.

Key words: Dental caries, first permanent molar, fissure sealants, preventive dentistry

INTRODUCTION

Dental caries is a persistent public health problem worldwide. Although preventable, it is still considered the most chronic disease with high prevalence affecting many children in several countries including Saudi Arabia.^[1,2]

Dental caries is a multifactorial disease involving various risk and preventive factors. In the permanent dentition, the first permanent molar (FPM) exhibits an increased susceptibility to caries in the occlusal pits and fissures due to its morphological characteristics, the early time of its eruption, and its positioning in the oral cavity.^[3,4]

The FPM is important for the dentition and dental development, and early loss due to caries would have a significant impact on the future dental health of the child.^[5] In addition, this is considered as expensive, time-consuming, and traumatic for the young child.^[6]

Due to the higher frequency of caries on the FPMs, with the occlusal surface remains the most prevalent of carious area within a short period following its eruption, such surfaces would need to be sealed.^[7-9]

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

For reprints contact: reprints@medknow.com

How to cite this article: Alwayli HM, Alshiha SA, Alfraihi YK, Hattan MA, Alamri AA, Aldossary MS. A survey of fissure sealants and dental caries prevalence in the first permanent molars among primary school girls in Riyadh, Saudi Arabia. *Eur J Dent* 2017;11:455-60.

DOI: 10.4103/ejd.ejd_189_17

| Access this article online | |
|--|---|
| Quick Response Code:  | Website: www.eurjdent.com |

In addition to other caries preventive measures and procedures, the use of sealants is one of the strongest evidence-based preventive interventions for dental caries and recommended mainly on the posterior permanent teeth, acting by preventing the development and growth of plaque and bacteria in the grooves.^[10,11]

There is evidence in the literature regarding fissure sealants' effectiveness in caries prevention and control, for both individual and community-based interventions for children and adolescents.^[7,10]

Oral health surveys provide an idea about the population's oral health status, treatment needs, and provide baseline information to establish oral health plans as per the actual needs of their population.^[12] Effective delivery of dental services and establishing a national preventive program with sealants in a community must be based on reliable information regarding the epidemiological pattern of caries, caries risk of individuals, and caries prevalence of the country.^[7,13] School-based sealant preventive programs are highly recommended for their effectiveness.^[14,15]

In Riyadh, the capital city of Saudi Arabia, there have been no studies undertaken to determine the prevalence of dental caries in the FPMs, and it is essential to obtain baseline data regarding the condition of the FPMs so that appropriate prevention and treatment needs can be implemented. For such a sealant preventive program, some knowledge regarding the existing usage of sealants in relation to caries need to be answered, to determine the feasibility and appropriateness of this type of intervention at a national level.

The aims of this cross-sectional survey were to:

1. Investigate the prevalence of dental caries in the FPMs among 6–9-year-old primary school girls in Riyadh, Saudi Arabia
2. Determine the presence of fissure sealants on their FPMs, to report the use of fissure sealant and analyze the preventive need of fissure sealants
3. Provide a national reference foundation for the prevention strategies of caries.

MATERIALS AND METHODS

Population

This cross-sectional survey was conducted during October 2015 through May 2016 at public female primary schools in Riyadh city, Saudi Arabia. It was

carried out as a part of the annual dental preventive program targeting primary schoolchildren, organized by the Preventive Dentistry Department, Ministry of Health, Riyadh, Saudi Arabia. The program includes educational part on oral hygiene and topical fluoride application. Ethical approval was obtained from the Preventive Dentistry Committee, Ministry of Health, Riyadh, Saudi Arabia (H-01-R-009-1359).

A total of 120 public female primary schools were randomly selected using stratified random sampling from different geographic locations within Riyadh city.

The schools were officially informed, and visitation permissions and coordination with the schools were obtained from the Ministry of Education and school principals to arrange a day for data collection. Written consents were obtained from children's parents.

In this survey, 17,891 female students were examined, which included all children with obtained consent form, in the first three grades within the selected schools (first, second, and third grades). The age of schoolchildren at the first grade is 6–7, second grade is 7–8, and third grade is 8–9 years.

Before commencing the examination, a brief orientation and oral hygiene instructions to the students were carried out. Topical fluoride varnish (Clinpro™ 5% Sodium Fluoride White Varnish, 3M ESPE, St. Paul, MN, USA) was applied following examination to the children with obtained informed consent.

Oral examination

Oral examination was conducted by forty examiners (trained and calibrated female hygienists) who were divided into twenty teams. In this way, each team included two examiners; one either conducted examination or assisted in data entry in a designed data collection form.

The children were examined, in their classroom with the child sitting on a conventional, nondental classroom chair, with a disposable mouth mirror, wooden tongue blade, and a probe, when needed, under adequate natural day light, and under all infection control measures. The probe was used sparingly on doubtful surfaces. In case of any doubt, the tooth was marked sound.

For the purpose of this study, only the FPMs of the children were recorded. The examination and record consist of all FPMs with the full occlusal surface of the

crown exposed. Partially erupted or unerupted FPMs were excluded. Dental caries was assessed using the World Health Organization diagnostic criteria for oral health survey.^[12] The decayed FPMs were recorded as decayed regardless of the carious lesion stage.

The fissure sealants were recorded as present or absent. Fissure sealant's presence on the FPMs was recorded regardless the status of the sealant whether intact or partially lost. No radiographs were taken.

Statistical analysis

Inter- and intra-examiner reproducibility were assessed using weighted kappa statistics by reexamining a group of 120 children, 5 weeks after the start of the study. A very high degree of agreement was demonstrated ($\kappa > 0.80$).

All data were managed and edited using Microsoft® Excel® (Microsoft® Office 2007, Microsoft® Corp, Redmond, WA, USA). All statistical analyses were performed using Statistical Package for the Social Sciences (IBM SPSS Statistics 20.0 Armonk, NY, USA). Descriptive statistics, frequencies, and proportions were generated.

Chi-square test was used to assess the significance of differences in prevalence and proportions at tooth level. The level of statistical significance was set at $\alpha = 0.05$.

Comparisons were made between grades (first, second, and third), which reflect the age groups, and between maxillary versus mandibular FPMs.

RESULTS

In the 17,891 children examined, a total of 58,140 FPMs were recorded for carious status, presence of restoration, presence of fissure sealants, or being sound. Partially erupted and unerupted FPMs were excluded ($n = 13,424$ teeth).

The children who had at least one decayed, filled, or missing due to caries FPMs (i.e., caries prevalence) counted for 35.4% ($n = 6338$ children). In other words, 64.6% of the children ($n = 11,553$) did not have caries experience in their FPMs (i.e., caries free). Only 1.3% of the children ($n = 233$) had at least one fissure sealant applied.

At tooth level, the decayed FPMs counted for 24.6% ($n = 14,313$) of the total number of teeth examined, while only 1.0% ($n = 573$) of the FPMs had fillings. There was obvious underutilization of the fissure sealants on the FPMs, 0.8% ($n = 478$). The missing FPMs due to caries were only 38 teeth (0.07%). The remaining 24,738 FPMs (73.5%) were sound [Table 1].

The mandibular FPMs exhibited higher caries prevalence (33%) and more fissure sealants applied (1.1%), compared to the maxillary FPMs, 18.2% and 0.5%, respectively, which were statistically significant ($P < 0.01$).

The results and comparisons between the three grades/age groups are presented in Table 2. The proportion of carious FPMs increased with age of the children significantly ($P < 0.01$). This was increased from 16.1% for the first-grade students to 31.2% for the third-grade students.

On the contrary, there was no significant difference in the proportion of the presence of fissure sealants among the three different grade/age groups ($P > 0.05$).

The results showed no association between age and fissure sealants' use, as the results showed that fissure-sealed FPMs were almost constant between the different grade/age groups; 0.8%, 0.9%, and 0.8% for the first, second, and third grades, respectively. Additionally, there was no correlation between the proportion of decayed FPMs and the presence of fissure sealants [Table 2].

Table 1: Maxillary versus mandibular first permanent molars' caries and fissure sealants' prevalence

| | Number of excluded teeth (partially erupted or unerupted) | Number of teeth examined | Decayed teeth, <i>n</i> (%) | Filled teeth, <i>n</i> (%) | Missing teeth due to caries, <i>n</i> (%) | Fissure-sealed teeth, <i>n</i> (%) | Sound teeth, <i>n</i> (%) |
|------------------------------------|---|--------------------------|-----------------------------|----------------------------|---|------------------------------------|---------------------------|
| Total | 13,424 | 58,140 | 14,313 (24.6) | 573 (1.0) | 38 (0.07) | 478 (0.8) | 42,738 (73.5) |
| Maxillary | 7164 | 28,618 | 5040 (17.6) | 131 (0.5) | 18 (0.06) | 151 (0.5) | 23,278 (81.3) |
| Mandibular | 6260 | 29,522 | 9273 (31.4) | 442 (1.5) | 20 (0.07) | 327 (1.1) | 19,460 (65.9) |
| Comparison (χ^2 , <i>P</i>) | - | - | 1491.1, <0.01 | 160.9, <0.01 | 0.05, >0.05 | 59.95, <0.01 | 1775.1, <0.01 |

Table 2: Distribution and comparison of first permanent molars' caries and fissure sealants' prevalence based on age groups

| | Number of excluded teeth (partially erupted or unerupted) | Number of teeth examined, n (%) | Decayed teeth, n (%) | Filled teeth, n (%) | Missing teeth due to caries, n (%) | Fissure-sealed teeth, n (%) | Sound teeth, n (%) |
|---|---|---------------------------------|----------------------|---------------------|------------------------------------|-----------------------------|--------------------|
| Total | 13,424 | 58,140 | 14,313 (24.6) | 573 (1.0) | 38 (0.07) | 478 (0.8) | 42,738 (73.5) |
| First grade (6-7-year-olds), number of children=6183 | 9984 | 14,748 (59.6) | 2370 (16.1) | 52 (0.4) | 10 (0.07) | 112 (0.8) | 12,204 (82.8) |
| Second grade (7-8-year-olds), number of children=5848 | 2817 | 20,575 (88.0) | 4833 (23.5) | 177 (0.9) | 13 (0.06) | 181 (0.9) | 15,371 (74.7) |
| Third grade (8-9-year-olds), number of children=5860 | 623 | 22,817 (97.3) | 7110 (31.2) | 344 (1.5) | 15 (0.07) | 185 (0.8) | 15,163 (66.5) |
| Comparison (χ^2 , P) | - | - | 1121.2, <0.01 | 127.6, <0.01 | 0.03, >0.05 | 1.58, >0.05 | 1245.0, <0.01 |

It was interesting to know that 59.6% of the FPMs were erupted in the first-grade girls (6–7-year-olds), 88.0% in the second-grade girls (7–8-year-olds), and 97.3% of FPMs were erupted in the third-grade girls (8–9-year-olds).

DISCUSSION

This survey investigated the caries prevalence and the presence of fissure sealants on FPMs exclusively, among 6–9-year-old public school girls in Riyadh city, Saudi Arabia. Only the FPMs were evaluated since they are a key to the permanent dentition and have almost erupted in this age of children. Further data analyses and comparisons were conducted at tooth level instead of child level because of the exclusion of the partially erupted and unerupted FPMs.

Although several studies have been reported on the prevalence of dental caries among schoolchildren in Saudi Arabia, there has been a scarcity in data regarding the caries prevalence in addition to the use and presence of fissure sealants on FPMs specifically.

The results revealed a high proportion of identified untreated caries and a low proportion of subsequently placed restorations. Very low use of fissure sealants was noted for this population. Extraction of FPMs due to caries was very rare in this population, and this could be because of the young age of the groups involved.

Comparing our results to previous global and national studies was quite difficult because of the differences in studies' design and the age of the targeted groups, in addition to other related variables.

In this study, the children who had at least one decayed, filled, or missing due to caries FPMs (i.e., caries prevalence) counted for 35.4% ($n = 6338$ children). In other words, 64.6% of the children ($n = 11,553$) did not have caries experience in FPMs (i.e., caries free). This is considerably lower than that reported in some studies. Nationally, Al-Samadani and Ahmad^[6] reported that 67% of 9-year-old children in Jeddah, Saudi Arabia, had caries in their FPMs. In another city, Abha, in a study by Togoo *et al.*,^[5] who examined 7–10-year-old children for the caries prevalence in FPMs, it was reported that 66.4% of children had carious FPMs. Globally, a study on Moroccan children aged 6–15 years revealed that 77% of children had caries prevalence in their FPMs.^[16] In Taiwan, a study by Warren *et al.*,^[17] on first-grade schoolchildren, aged 6 years, resulted in 52% of children with caries prevalence in their FPMs. In contrast, in China, few reports had wide variation in the caries prevalence among children aged in the range of 6–15 years. In ascending order of their results, the caries prevalence particularly in the FPMs was reported in 8.7% of 7–8-year-old,^[18] 26.5% in 7–9-year-old,^[19] 47.5% in 7–9-year-old,^[20] and 72% in 7–12-year-old children.^[21] The variation in caries prevalence worldwide and the involvement of older age participants in some of the studies would be a possible explanation would be a possible explanation for the inconsistent results.

When analyzing the prevalence of fissure sealants on the FPMs, we verified in the current study that only 1.3% of the children ($n = 233$) had at least one fissure sealant applied. This result is very low and alarming of the underutilization of fissure sealants in caries prevention among children.

In the United States, during 2011–2012, it was reported that 31.4% of 6–8-year-old children had a fissure sealant.^[22] In Germany, a study among 8–12-year-old children showed that 55.6% of children had at least one fissure sealant applied.^[23] Another study on adolescents aged 12–18 years in Portugal reported that 59% of participants were with the presence of at least one fissure sealant on FPMs.^[24] In contrast, a very low fissure sealants' prevalence was noted in 12–15-year-old Greek adolescents (8%).^[13] The younger group of children in the current study would explain our low finding, although the fissure sealant is recommended to be placed as soon as the FPMs erupted.

At tooth level, the overall caries prevalence was in 25.7% of the FPMs, which indicates that 74.3% of the examined FPMs were free of caries. In particular, the caries prevalence was 16.6%, 24.5%, 32.8%, for first-grade children (6–7-year-olds), second-grade children (7–8-year-olds), and third-grade children (8–9-year-olds), respectively. Comparing these findings to other studies, there was a controversy view. A very early study by King *et al.*^[25] revealed 10% carious FPMs among 7.4-year-old children, and another recent study showed about 16% carious FPMs among 7–8-year-old children in Poland.^[26] However, the study conducted by Togoo *et al.*,^[5] in Abha, Saudi Arabia, showed a higher caries prevalence in the FPMs. In their study, the overall caries prevalence was 43.4% of the FPMs in a group of children aged 7–10 years. In particular, the prevalence was 14%, 36%, and 57% among children aged 7 years, 8 years, and 9 years, respectively.

In this survey, the caries prevalence in the mandibular FPMs was significantly higher than the caries prevalence in the maxillary FPMs. This finding is in agreement with other studies.^[5,19,27] The reason expected behind this finding is the difference in the morphology and the earlier eruption time of mandibular compared to maxillary FPMs.^[5]

The caries prevalence was statistically increased as the age increased. There is almost agreement in the literature that aging is accompanied with increase of the caries prevalence of the FPMs among children, which was similar to our findings.^[5,6,16,19,20]

Our finding that 59.6% of FPMs had erupted in girls in their first grade (6–7-year-olds) agreed approximately with a previous study which reported that 50% of FPMs had erupted by the age of 7.4 years,^[25] bearing in mind the general earlier teeth development in girls.

It was clear that the carious process in the FPMs starts as soon as they erupt and can be clinically detected within 1–2 years.^[6,28] The results emphasize the need and importance of early prevention and educational programs which should be implemented even in earlier age of the children. When considering fissure sealant application in children, it is recommended to be applied soon after tooth eruption.^[28,29]

Considering the excellent outcomes in caries reduction from other countries,^[30–33] where school-based fissure sealants programs were implemented, it is logical to recommend the introduction of the use of fissure sealants in school-based or public preventive programs in Saudi Arabia. To plan and establish a national preventive program with fissure sealants in a community, it is essential to obtain baseline data regarding the condition of the FPMs and the prevalence of fissure sealants applied on them. Additionally, the provision of fissure sealants is used as an indicator of the preventive care provided to children, on an individual or on a public health basis.^[34]

From the findings of this study, the use of fissure sealants in children was extremely low. The underutilization of the fissure sealants might be attributed to the lack of awareness of the public and that the dentists have not been convinced on the usefulness and effectiveness of sealants on caries prevention, or lack of emphasis on the use of sealants even knowing their effectiveness in caries prevention. This hypothesis is supported from the findings of other studies conducted internationally aiming to investigate the dentist's knowledge and opinion on sealant use.^[13,35,36] Further investigation of the associated factors behind the low use of fissure sealants nationally and related to parents and dentists is recommended.

CONCLUSIONS

- Caries prevalence in the FPMs was high among this cohort of young students. The prevalence of caries in the FPMs increased with age. The caries prevalence in mandibular FPMs was higher than that of maxillary FPMs
- There was very low prevalence of fissure sealants on FPMs, indicating the underutilization of fissure sealants among schoolchildren examined in this study
- School-based or national sealant programs should be promoted strongly and implemented as an effective preventive approach, complemented with oral health education. Efforts are needed to

increase the knowledge of sealants by the general public as well as to promote sealant use by dentists.

Acknowledgments

We wish to acknowledge the extensive time and effort contributed by the field examiners in the collection of the data used in this publication. We would like to thank the staff and students of the schools for participation in the project.

Financial support and sponsorship

The study was funded by the Ministry of Health, Riyadh, Saudi Arabia.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

- Al Agili DE. A systematic review of population-based dental caries studies among children in Saudi Arabia. *Saudi Dent J* 2013;25:3-11.
- Al-Ansari AA. Prevalence, severity, and secular trends of dental caries among various Saudi populations: A literature review. *Saudi J Med Med Sci* 2014;2:142-50.
- Batchelor PA, Sheiham A. Grouping of tooth surfaces by susceptibility to caries: A study in 5-16 year-old children. *BMC Oral Health* 2004;4:2.
- Beauchamp J, Caufield PW, Crall JJ, Donly K, Feigal R, Gooch B, et al. Evidence-based clinical recommendations for the use of pit-and-fissure sealants: A report of the American Dental Association Council on Scientific Affairs. *J Am Dent Assoc* 2008;139:257-68.
- Togoo R, Yaseen S, Zakirulla M. Prevalence of first permanent molar caries among 7-10 years old school going boys in Abha city, Saudi Arabia. *J Int Oral Health* 2011;3:29-34.
- Al-Samadani KH, Ahmad MS. Prevalence of first permanent molar caries in and its relationship to the dental knowledge of 9-12-year olds from Jeddah, Kingdom of Saudi Arabia. *ISRN Dent* 2012;2012:391068.
- Ahovuo-Saloranta A, Forss H, Walsh T, Hiiri A, Nordblad A, Mäkelä M, et al. Sealants for preventing dental decay in the permanent teeth. *Cochrane Database Syst Rev* 2013;3:CD001830.
- Ahovuo-Saloranta A, Forss H, Hiiri A, Nordblad A, Mäkelä M. Pit and fissure sealants versus fluoride varnishes for preventing dental decay in the permanent teeth of children and adolescents. *Cochrane Database Syst Rev* 2016;1:CD003067.
- Vanka S, Vanka A. Caries prevention: A global strategy. *Eur J Dent* 2013;7:266.
- Hou J, Gu Y, Zhu L, Hu Y, Sun M, Xue H. Systemic review of the prevention of pit and fissure caries of permanent molars by resin sealants in children in China. *J Investig Clin Dent* 2017;8:1-7.
- Wright JT, Tampi MP, Graham H, Estrich C, Crall JJ, Fontana M, et al. Sealants for preventing and arresting pit-and-fissure occlusal caries in primary and permanent molars. *Pediatr Dent* 2016;38:282-308.
- World Health Organization. *Oral Health Surveys: Basic Methods*. 5th ed. Geneva, Switzerland: WHO Publications; 2013.
- Oulis CJ, Berdouses ED, Mamai-Homata E, Polychronopoulou A. Prevalence of sealants in relation to dental caries on the permanent molars of 12 and 15-year-old Greek adolescents. A national pathfinder survey. *BMC Public Health* 2011;11:100.
- Truman BI, Gooch BF, Sulemana I, Gift HC, Horowitz AM, Evans CA, et al. Reviews of evidence on interventions to prevent dental caries, oral and pharyngeal cancers, and sports-related craniofacial injuries. *Am J Prev Med* 2002;23:21-54.
- Dulgergil CT, Ercan E, Colak H. Evaluation of school-based prevention program in turkey: Results of a 24-month study. *Eur J Dent* 2016;10:245-9.
- Zouaidi K, Chala S, Ameziane R, Chhoul H. First permanent molar caries: A case study of Moroccan children between 6 and 15 year-old. *Odontostomatol Trop* 2012;35:5-10.
- Warren JJ, Hand JS, Yao JH. First-molar caries experience among Taiwanese first-grade children. *ASDC J Dent Child* 1997;64:425-8.
- Wang JD, Chen X, Frencken J, Du MQ, Chen Z. Dental caries and first permanent molar pit and fissure morphology in 7- to 8-year-old children in Wuhan, China. *Int J Oral Sci* 2012;4:157-60.
- Riziwaguli A, Asiya Y, Liu Y, Yang R, Zou J. Caries prevalence of the first permanent molar among 7-9 years old Uyghur children in Urumqi, Xinjiang Autonomous Region. *Shanghai Kou Qiang Yi Xue* 2013;22:559-61.
- Xue Y, Lin W, Jie L, Qing D. Caries status of the first permanent molar among 7- to 9-year-old children in Tangshan city and their correlation. *Hua Xi Kou Qiang Yi Xue Za Zhi* 2015;33:54-7.
- Su HR, Xu PC, Qian WH. Investigation of the first permanent molar caries in primary school students in Xuhui district of Shanghai municipality. *Shanghai Kou Qiang Yi Xue* 2012;21:329-32.
- Dye BA, Thornton-Evans G, Li X, Iafolla TJ. Dental caries and sealant prevalence in children and adolescents in the United States, 2011-2012. *NCHS Data Brief* 2015;191:1-8.
- Kühnisch J, Berger S, Goddon I, Senkel H, Pitts N, Heinrich-Weltzien R, et al. Occlusal caries detection in permanent molars according to WHO basic methods, ICDAS II and laser fluorescence measurements. *Community Dent Oral Epidemiol* 2008;36:475-84.
- Veiga NJ, Pereira CM, Ferreira PC, Correia JJ. Prevalence of dental caries and fissure sealants in a Portuguese sample of adolescents. *PLoS One* 2015;10:e0121299.
- King NM, Shaw L, Murray JJ. Caries susceptibility of permanent first and second molars in children aged 5-15 years. *Community Dent Oral Epidemiol* 1980;8:151-8.
- Baginska J, Rodakowska E, Milewski R, Kierklo A. Dental caries in primary and permanent molars in 7-8-year-old schoolchildren evaluated with Caries Assessment Spectrum and Treatment (CAST) index. *BMC Oral Health* 2014;14:74.
- Srinivasan D, Louis CJ. Evaluation of caries in deciduous second molar and adjacent permanent molar in mixed dentition. *J Pharm Bioallied Sci* 2015;7:S572-5.
- Hata H, Igari K, Kanou N, Kamiyama K. Evaluation of preventive dental care for first permanent molars in children. *Shoni Shikagaku Zasshi* 1990;28:928-36.
- Borges BC, de Souza Borges J, Braz R, Montes MA, de Assunção Pinheiro IV. Arrest of non-cavitated dentinal occlusal caries by sealing pits and fissures: A 36-month, randomised controlled clinical trial. *Int Dent J* 2012;62:251-5.
- Gooch BF, Griffin SO, Gray SK, Kohn WG, Rozier RG, Siegal M, et al. Preventing dental caries through school-based sealant programs: Updated recommendations and reviews of evidence. *J Am Dent Assoc* 2009;140:1356-65.
- Wendt LK, Koch G, Birkhed D. Long-term evaluation of a fissure sealing programme in public dental service clinics in Sweden. *Swed Dent J* 2001;25:61-5.
- Parnell CA, O'Farrell M, Howell F, Hegarty M. Evaluation of a community fissure sealant programme in County Meath, Ireland. *Community Dent Health* 2003;20:146-52.
- Whelton H. Overview of the impact of changing global patterns of dental caries experience on caries clinical trials. *J Dent Res* 2004;83:C29-34.
- Amarasena N, Ha DH, Amarasena N, Ha DH. Fissure Sealant Use Among Children Attending School Dental Services: The Child Dental Health Survey, Australia 2008. Canberra, Australia: AIHW; 2012.
- Michalaki M, Sifakaki M, Oulis CJ, Lygidakis NA. Attitudes, knowledge and utilization of fissure sealants among Greek dentists: A national survey. *Eur Arch Paediatr Dent* 2010;11:287-93.
- San Martín L, Castaño A, Bravo M, Tavares M, Niederman R, Ogunbodede EO, et al. Dental sealant knowledge, opinion, values and practice of Spanish dentists. *BMC Oral Health* 2013;13:12.