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First Permanent Molar Caries and its Association with Carious Lesions in Other Permanent Teeth

ABSTRACT

Introduction: Dental caries is most prevalent in first permanent molars and it is bilaterally distributed in permanent maxillary and mandibular molars. It is assumed that dental caries in first permanent molar is related to caries in other permanent teeth possibly due to its infectious and transmissible nature. However, there is limited data about a relationship between caries in first permanent molar and other permanent teeth.

Aim: To assess the association between dental caries in first permanent molar and other permanent teeth in school children.

Materials and Methods: This cross-sectional study was conducted on male intermediate school children (12-15 years) in Dammam, Saudi Arabia in 2016. A sample of 1250 children was randomly selected. Data collection involved clinical examination of caries using the World Health Organisation (WHO) criteria and a pilot-tested questionnaire. Training and calibration of examiners were conducted (κ >0.6). Statistical analyses involved descriptive statistics, univariate and multivariate logistic and linear regressions using SPSS software.

Results: Of 1250 children invited, 1109 participated with a response rate of 88.7%. The first permanent molars had the highest percentage of dental caries among all permanent teeth (50.4%) with a mean of 1.08 carious molars. This was followed by second permanent molars (prevalence^4.7%, mean number of decayed molars=0.25). The canines had the lowest prevalence of dental caries (1.8%) and the mean number of carious canines was 0.02. Logistic regression showed that caries in first permanent molars were significantly associated with higher odds of caries in incisors (OR=4.87), second molars (OR=4.26) and premolars (OR=3.57). It was found that a unit increase in the number of carious first molars was associated with a significant increase in the number of carious incisors, premolars and second molars.

Conclusion: The study found associations between caries in first permanent molar with caries in other permanent teeth. School-based oral health promotion programs should start early to target young school children when first permanent molars start to erupt.

INTRODUCTION

According to World Health Organisation, dental caries is the most prevalent disease globally and affects 60-90% of school children in most industrialised nations [1]. It remains the most wide spread oral disease and one of the most unmet dental care needs in Saudi Arabia [2]. The distribution of caries varies greatly among different individual teeth and tooth surfaces with occlusal surfaces being affected more commonly than interproximal surfaces and smooth surfaces [3-5]. Molars are more predisposed to carious attack than incisors, canines and premolar teeth [6]. Even the reduction in caries experience was more pronounced in occlusal surfaces than approximal surfaces in populations that observed an overall decline in caries [7].

Anatomical features and post-eruptive enamel maturation differ among different teeth, which determine their susceptibility to caries [8]. Pits and supplementary grooves are common in mandibular and maxillary molars which promote retention of food debris and subsequent carious attack [9]. Bhardwaj VK reported the lowest caries prevalence (0.5%) in central incisors while the highest prevalence (51%) in first molars in Indian children [10]. A higher prevalence of untreated caries was observed in second permanent molars than first permanent molars [11]. Understanding the aetiology of caries in individual teeth can help in developing appropriate preventive strategies that strategically target those teeth at risk [8].

Research shows that several factors namely parental socio-economic status, sweet snacks, oral hygiene, dental care seeking behaviours and use of fluorides influence dental caries experience [8,9,11]. Understanding caries patterns is important particularly among adolescents as several environmental and behavioural factors are associated with caries and occurrence of dental caries can be prevented effectively by modifying oral health beliefs during adolescence. In addition, researchers emphasised the need to investigate the factors associated with relative caries susceptibility of different teeth [6]. However, epidemiological data are limited about the effects of different socio-behavioural factors on caries in individual teeth.

Different caries patterns have been studied in the literature. For example, caries on the distal surface of deciduous teeth have been associated with caries on the proximal surface of first permanent molars [12-14]. Similarly, Wyne AH examined the bilateral distribution of dental caries and observed the highest occurrence of caries bilaterally in maxillary and mandibular molars and mandibular central incisors in Saudi adolescents [15]. There is a high prevalence of caries in first permanent molar teeth in children in Saudi Arabia [16,17]. Caries is an infectious disease and bulk of caries experience is located in first permanent molars [16]. The question arises if there is any relationship between caries in first permanent first molar and caries in other permanent teeth. The literature has not adequately discussed the associations between caries in first permanent molar with caries in individual permanent teeth. The aim of the present study was to assess caries risk in these teeth relative to the first permanent molar. First permanent molars are first teeth to erupt and they are mostly affected with caries [10,16]. It is possible that high prevalence of caries in first permanent molars can influence the caries process in other permanent teeth and can predict carious attack in these teeth. Therefore, an association of caries in first permanent molar with other permanent teeth can be

important for prevention programs in children. It is hoped that the study findings will help health policy makers develop oral health promotion programs for younger school children so that caries can be prevented in first molars and subsequently in other teeth in children and adolescents.

MATERIALS AND METHODS

The present cross-sectional study was conducted in intermediate schools in Dammam and Khobar, Eastern Province, Saudi Arabia in February-April 2016. The target group was male students (12-15 years of age). Ethical approval was obtained from the Institutional Review Board (IRB-2015-02-187) at the Imam Abdulrahman Bin Faisal University, Dammam. The current report was part of an ongoing study that aimed to describe the oral health status of intermediate schools' male students. The students were included in the study if they were attending public schools in Khobar or Dammam, their parents or legal guardian consented in writing for their participation, the student himself agreed to be clinically examined, had no health problems and has not been on medication for the last six months. The students who did not return the written informed consent of their parents/legal guardians were excluded from the study. In addition, female students were excluded since the male examiners could not be allowed into females' schools in conformance to social norms in the country.

Sample size of the original study was calculated using the following assumptions; alpha error=5%, study power=85%, estimated caries prevalence=70% [2] and null percent=66%. The minimum required sample size to assess caries prevalence was calculated (http://www.stat.ubc.ca/~rollin/stats/ssize/b1 .html) to be 1207. The sample size was increased to 1,250 to avoid a drop because of non-response. The Directorate of Education in the province was approached to select public schools in the two cities for subjects' recruitment. The authorities selected three schools which were thus non-statistically selected. All students in these three intermediate schools were asked to join the study.

Data collection included a clinical examination and a questionnaire. Caries was diagnosed based on the World Health Organisation (WHO) criteria [18], using disposable examination mirrors under daylight conditions in the schools. Three examiners had three sessions to train on the diagnostic criteria followed by a calibration session. The examiners had an acceptable agreement with an experienced gold standard examiner (κ >0.6). An experienced faculty member of dental public health division served as the gold standard examiner during the process of calibration. Plaque was assessed using the Plaque Index by Löe H [19].

A specially designed questionnaire was developed and was assessed for face and content validity by two independent assessors. The questionnaire was then pilot tested among 30 teenagers whose data were not included in the analysis. Minor modifications were made to minimise ambiguity and enhance clarity of the questionnaire. The self-administered questionnaires were filled by the students. The examiners were there to facilitate data collection by answering any question that the students had in the study.

STATISTICAL ANALYSIS

Data were imported to SPSS, version 20.0 (Armonk, NY: IBM Corp) and analysed at 0.05 significance level. The main independent variable was caries in the first permanent molar (presence and mean number with caries). Covariates included in the study were; parents' education, home ownership, oral health practices and Plaque Index. Descriptive statistics were calculated. Univariate and multivariate logistic regression were used to assess caries presence in different teeth in relation to the presence of caries in the first permanent molars. Linear (univariate and multivariate) regression was used to assess the association between the number of these various teeth with caries and the number of first permanent molars with caries).

RESULTS

[Table/Fig-1] presents the distribution of socio-economic factors and oral health practices of the study participants. Fifty percent of the students had both parents' university educated and 53.9% of the parents owned their homes. Most of the students reported using fluoridated toothpaste (60.4%). However, only 25.2% reported having regular visits to the dentist. Seventy-six percent of the students indicated that they frequently used sugary snacks. The mean Plaque Index in the study sample was 1.4 with a standard deviation of 0.9.

Variables	Frequency (%)
Both parents' university educated Yes	561 (50.6)
No	548 (49.4)
Home ownership Rented	503(46.1)
Owned	589 (53.9)
Using fluoridated toothpaste Yes	664 (60.4)
No	436 (39.6)
Regular visits to the dentist during the last one year Yes	279 (25.2)
No	830 (74.8)
Not using sugary snacks daily Yes	247 (24.1)
No	777 (75.9)
Plaque index	Mean (SD) 1.4 (0.9)

Distribution of socio-economic factors oral health practices in study participants.

The overall prevalence of tooth decay was 57.2% while the mean number of decayed teeth was 1.63 (SD±1.99). [Table/Fig-2] presents the percentage and mean number of carious teeth in the study participants. The first permanent molars had the highest percentage of decay among all teeth (50.4%) with a mean of 1.08 carious molars. The second most affected teeth were the second permanent molars (prevalence^ 4.7%, mean number of decayed molars=0.25). The mean number of carious canines was 0.02 with a prevalence of 1.8%, which were the least affected among all teeth.

Percentage of teeth with caries mean number of carious teeth in male teenagers, Khobar and Dammam, 2016.

Different factors were associated with the presence of caries in other permanent teeth [Table/Fig-3]. None of the studied factors (both parents being university educated, living in owned houses, using fluoridated toothpaste, regular dental visits, not using sugary snacks and Plaque Index) were associated with the presence of caries in canines, premolars or second molars. Increased plaque accumulation was associated with higher odds of caries in incisors (OR=1.92) whereas using fluoridated toothpaste was associated with lower odds of caries in first molars (OR=0.47).

Adjusting for the effect of all other variables, significantly higher odds of

	OR (95% C.I.)				
	Incisors	Canines	Premolars	First molars	Second molars
Both parents university educated	1.34(0.34, 5.25)	0(0,-)	0.44(0.12, 1.60)	0.88(0.45, 1.72)	1.58(0.68, 3.66)
Living in owned home	0.91 (0.32, 2.59)	0(0,-)	1.07(0.42,2.70)	0.60(0.33, 1.08)	1.19 0.56, 2.53)
Using fluoridated toothpaste	1.08(0.37, 3.13)	0(0,-)	1.08(0.42,2.77)	0.47 (0.25, 0.86)*	0.98(0.45, 2.16)
Regular visits to the dentist	1.07 (0.27, 4.22)	0(0,-)	0.87 (0.28, 2.66)	1.33(0.66, 2.69)	0.87(0.35, 2.18)
Not using sugary snacks	1.70(0.46, 6.29)	63.32 (0,-)	0.97 (0.35, 2.66)	0.58(0.31, 1.09)	0.80(0.34, 1.91)
Plaque Index	1.92 (1.09, 3.38)*	0.9 (0.28,2.86)	1.06(0.65, 1.72)	0.78(0.57, 1.08)	0.70(0.47, 1.05)

Factors associated with caries presence different types of permanent teeth in male middle school students in Saudi Arabia.
Logistic regression adjusted for the effect of both parents being university educated, living in an owned house, using fluoridated toothpaste, regular visits to the dentist, not using sugary snacks and Plaque Index
*: Statistically significant at p<0.05, OR: Odds ratio, CI: Confidence interval

caries in incisors, premolars and second molars were associated with caries in first molars (OR=4.87, 3.57 and 4.26, respectively [Table/Fig-4]. No significant association was observed between the presence of caries in the first molars and in canines (OR=0.99). Adjusting for the effect of all other variables, a unit increase in the number of

Teeth	Odds ratio (95% CI)
Incisors	4.87 (1.04, 22.87)*
Canines	0.99(0.05, 19.18)
Premolars	3.57 (1.13, 11.35)*
Second molar	4.26 (1.60, 11.31)*

Presence of caries in different permanent teeth in relation to caries presence in the first permanent molars in participants.
Logistic regression adjusted for the effect of both parents being university educated, living in an owned house, using fluoridated toothpaste, regular visits to the dentist, not using sugary snacks and Plaque Index
*: Statistically significant at p<0.05

Teeth	Regression coefficient (95% CI)
Incisors	0.09(0.02,0.16)*
Canines	0.01 (-0.003,0.03)
Premolars	0.07(0.02,0.11)*
Second molar	0.12(0.05,0.20)*

Association between number of various permanent teeth with caries and number of carious first permanent molars in study participants.
Linear regression adjusted for the effect of both parents being university educated, living in owned houses, using fluoridated toothpaste, regular visits to the dentist, not using sugary snacks and Plaque Index.
Statistically significant at p<0.05

carious first molars was associated with a significant increase in the number of carious incisors, premolars and second molars (regression coefficients=0.09, 0.07 and 0.12, respectively) [Table/Fig-5].

DISCUSSION

Our study demonstrated that caries in first permanent molar is significantly associated with increased risk of caries in second molar, premolars and incisors. Similarly, significant associations between caries in first permanent molar and caries in other permanent teeth were also shown in multivariate linear regression analyses. The highest prevalence of caries in first and second permanent molars was observed in our sample of children. The highest percentage of caries found in first permanent molars followed by second permanent molars in the present study is in accordance with the results shown by other studies [6,10,15,17,20]. In Saudi Arabia, 86% of children (12-year-old) in Riyadh and 75.5% of children aged 9-12 years in Jeddah had caries in their first permanent molars [15,17]. Brazilian children were shown to have 87% of first permanent molar affected with caries [21]. First permanent molars were the most commonly affected with caries in Indian children [10]. Warnakulasuriya S observed similar caries trends in Sri-Lankan children [20]. In Taiwan, 48% of children were caries free in first permanent molars [22]. Macek MD et al., also reported greater caries susceptibility in permanent molars than other permanent teeth [6]. On the other hand, Desai VC et al., found that second permanent molars had greater untreated decay than first permanent molars [11]. King NM et al., observed that 10% of first permanent molars and 45% of second permanent molars became carious within one year of their eruption and 92% of first and 68% of second permanent molars were decayed and filled and missing due to caries by the age of 15 years [23].

Caries susceptibility of first permanent molar can be related to early eruption, age, anatomical features, large crown size, and its posterior location in the mouth [15,21]. There are reports of a relationship between caries in second primary molar and first permanent molar. A recent study found strong correlation between caries in second primary mandibular molar and first permanent mandibular molars in 7-9-year-old children in United Arab Emirates [24]. Leroy R et al., reported the influence of caries in deciduous molars on cavity formation in first permanent molars and the effect was more pronounced in case of second deciduous molar [12]. In addition, reduced susceptibility to caries in first permanent molar was observed when there were sound adjacent primary molars [25].

A previous research in Brazil found that children with caries in other teeth had 1.9 times higher odds of caries in first permanent teeth [26]. Likewise, the present study found a statistically significant relationship between caries in first permanent molars and caries in other permanent teeth. Although caries distribution in permanent central incisors, premolars and second molars was low, however, higher odds of caries in central incisors, premolars and second molars were associated with the presence of caries in first permanent molars. Second permanent molars were 4.28 times more likely to have caries if there was caries in first permanent molars. Similarly, the number of carious second permanent molars increased with an increase in the number of carious first permanent molars (regression coefficients. 12). Premolars caries was also significantly related to caries in first permanent molars (regression coefficients. 07).

There could be several reasons for an association between caries in first permanent molars and caries in second permanent molars which include similar occlusal morphological features (fissures and pits) and difficult access for proper tooth brushing. These factors can result in the accumulation of food debris in occlusal surfaces and can increase the risk of caries [8]. Caries initiation and progression within and between teeth could be attributed to the presence of dental plaque. It was shown that first permanent molars with visible plaque were 3.9 times more likely to have caries than those without plaque [26]. Similarly, teeth with abundant plaque were 14.5 times more susceptible to caries than those with hardly detectable plaque [27].

Dental caries is an infectious and transmissible oral condition and it is possible that caries in first permanent molar in addition to its proximity can initiate caries development in second permanent molar and premolars [28]. The accumulation of dental plaque and infectious nature of caries can contribute to the existence of an association between caries in first permanent molar and other permanent teeth. In addition, dietary and oral hygiene habits can also play a role in caries experience in different teeth [12]. Our study findings highlight the significance of preventing caries in

first permanent molars and its impact on reducing the occurrence of caries in other permanent teeth by improving oral hygiene behaviours in children. It is known that 42% of tooth extraction occurs because of first permanent molar caries which is higher than for other teeth [29].

The findings of the present study can help dental practitioners better evaluate caries risk in first permanent molars and other individual permanent teeth in children in addition to evaluating the influence of socio-behavioural factors on caries. It is also hoped that health policy-makers will benefit from the results of the present study and will develop caries preventive programs for children with high risk of caries in first permanent molars in Dammam.

LIMITATION

There are certain limitations of the study, which are the inclusion of male participants from fewer schools, and exclusion of female children. These factors can compromise the generalisability of the study findings. In addition, a cross-sectional study design precludes investigating cause and affect relationship between socio-behavioural effects and dental caries in different teeth. Under and over-reporting of responses can be seen in cross-sectional studies involving the administration of a questionnaire. Socio-economic status is a complex phenomenon and is usually determined by income, education, and occupation [24]. However; the present study focused more on education. The statistically significant relationship between oral hygiene and dental caries were assessed using Plaque Index. Moreover, a longitudinal study design should be employed in future research to investigate the presence of caries in first permanent molars and its effect on other permanent teeth particularly second permanent molars.

CONCLUSION

Based on the data analyses of the present study, it is concluded that first permanent molars had greatest caries prevalence followed by second permanent molars. Statistically significant associations were found between caries in first permanent molars and caries in other permanent teeth particularly central incisors, premolars, and second molars. Dental caries develops soon after the eruption of permanent first molars and can transmit to other permanent teeth; therefore, school-based oral health promotion programs should address younger children so that high prevalence of caries can be controlled in adolescents with early prevention. Oral health education should be raised in the community through oral health campaigns. Adequate access to public preventive and restorative dental programs and services should be ensured for all the children.

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