

The Bilateral Occurrence of Dental Caries Among 12-13 and 15-19 Year Old School Children

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Abstract

The purpose of the study was to determine the bilateral occurrence of dental caries in 12-13 year old and 15-19 year old Saudi school children. There were 673 children (324 boys and 349 girls) in the 12-13 year old group and 734 children (399 boys and 335 girls) in the 15-19 year old group with mean ages of 13.1 (SD 0.7) years and 16.4 (SD 1.2) years, respectively. All children were examined for dental caries using the World Health Organization (WHO) criteria for the diagnosis of dental caries. There were no significant differences between the caries prevalence of right and left sides for most teeth at the significance level of 0.05. Among 12-13 year old children, maxillary first molars (86.5%), mandibular central incisors (86.2%), and mandibular first molars (86.0%) showed very high ($p < .01$) caries bilaterality. Among the 15-19 year old children, mandibular first molars (91.6%), maxillary first molars (87.9%), and mandibular second molars (79.9%) showed very high ($p < .01$) caries bilaterality. The conditional probability for bilateral occurrence of caries was highest in first molars followed by second molars and central incisors. The bilateral caries occurrence and conditional probability for bilateral caries occurrence were significantly higher ($p < .05$) in 15-19 year old children as compared to 12-13 year old children. It was concluded caries bilaterality and the conditional probability for bilateral caries occurrence was high in the study population.

Keywords: Dental caries, bilateral occurrence, school children

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Introduction

Dental caries is one of the most highly prevalent diseases in children. Hence, the prevention and treatment of dental caries remains an important responsibility of the dental profession. Several studies have reported high dental caries prevalence in Saudi school children¹⁻⁴ which warrants a well-organized approach towards prevention and diagnosis of dental caries in these children.



Information about caries patterns in a population assists in the prevention and diagnosis of dental caries. A bilaterally symmetrical pattern in the occurrence of dental caries has been reported previously by several researchers around the world. Brekhus (1928)⁵ reported a bilateral pattern of tooth loss due to dental caries in America. Knutson and Klein (1938)⁶ noticed that the occurrence of dental caries in their study population of elementary school children was bilaterally equal. Halikis (1965)⁷ also reported the bilaterality of dental caries in the primary and permanent dentition of Australian children. More recently, Wei et al. (1993)⁸ reported a similar phenomenon in Hong Kong preschool children.

In Saudi Arabia, Nainar and Wyne (1998)⁹ have reported similar bilateral caries prevalence in a selected sample of preschool children. Wyne (2000)¹⁰ also reported the phenomenon of caries bilaterality in a random sample of preschool children. However, there have been no reports about the bilateral symmetry in the distribution of dental caries in permanent dentition of Saudi school children.

All the studies cited above on the bilateral symmetry of dental caries occurrence have based their results upon the similar prevalence of caries on both sides of the mouth. Similar

caries prevalence on both sides of the mouth may not indicate the true bilateral occurrence of dental caries. The purpose of the present study was, therefore, to determine the true bilateral occurrence of dental caries in permanent dentition of Saudi school children aged 12-13 years and 15-19 years.

Subjects and Methods

The information about the total population of 12-13 and 15-19 year old school children in Central Province was obtained from the Saudi Ministry of Education.¹¹ The sample size was determined utilizing the "sample size formula for estimating the mean".¹² A recent study has shown only 2.3% of the study population lives in areas with optimum water fluoride level.¹³ A large majority (85.3%) live in areas with low water fluoride levels, while 12.5% live in high water fluoride areas. The zones with similar water fluoride concentrations were identified utilizing a map prepared by the water analysis study.¹³ The list of these zones served as the sampling frame for the study. Municipalities were randomly selected in each zone to represent the population in each of these zones. One or more primary and intermediate schools (both for boys and girls) were then selected depending on the sample size requirements. All the children were Saudi nationals and permanent residents of the selected areas.

All selected children were examined for dental caries by field examiners utilizing the World Health Organization (WHO) criteria for the diagnosis of dental caries.¹⁴ The field examiners were trained and calibrated with a senior faculty from King Saud University College of Dentistry. The data were entered into a computer using FOXPRO software and a data file was generated. The data were then analyzed



$P(A/B) = P(A \text{ and } B)/P(B)$

e.g., $P(26/16) = P(26 \text{ and } 16)/P(16)$
 i.e., Probability of caries on 26 given that 16 has caries, is equal to probability of caries in 26 and 16 divided by probability of caries in 16.

Figure 1. Conditional Probability Formula.

utilizing Statistical Package of Social Sciences (SPSS). The McNemar’s test¹⁵ for paired samples was used to establish any significant difference in caries prevalence between the right and left side of the teeth. The data were further analyzed to determine actual bilateral caries occurrence by counting cases with caries on both sides of the mouth. A one-tail Z test was used to test the bilaterality levels beyond chance ($p < 0.5$). The Z test comparing two proportions was utilized to determine any significant difference in bilateral caries occurrence between the two age groups. The same test was also used to determine any significant difference in conditional bilateral caries occurrence between the two age groups. Intra- and inter-examiner agreement was determined using Kappa statistics. An excellent degree of agreement (above 0.9) was demonstrated between the reference examiner and the field examiners. The intra-examiner agreement of all the field examiners was also excellent (above 0.9). The conditional probability formula (Figure 1) was used to determine the probability of the occurrence of caries on the left side with the presence of caries on the right side as a given condition.

Results

A total of 1,407 children (723 boys and 684 girls) were examined for dental caries with the mean age of 14.8 (SD 1.9) years. There were 673 children (324 boys and 349 girls) in the 12-13 year old group and 734 children (399 boys and 335 girls) in the 15-19 year old group with the mean age of 13.1 (SD 0.7) years and 16.4 (SD 1.2) years, respectively. The overall caries prevalence was 90.7%, with 90.5% of 12-13 year olds and 90.9% of 15-19 year olds having dental caries. There was no significant difference in the bilateral occurrence of dental caries in relation to gender and water fluoride levels, so combined data are presented.

The prevalence of caries was similar in both sides of the mouth in maxillary and mandibular teeth (Table 1 and 2). The combined data also showed similar caries prevalence in both sides of the mouth (Table 3).

There were no statistically significant differences between caries prevalence of both the right and left sides of the mouth for most teeth (with few

Table 1. Tooth specific caries prevalence in 12-13 year olds.

Tooth Type	Maxillary			Mandibular		
	Right (%)	Left (%)	Total (%)	Right (%)	Left (%)	Total (%)
Central incisor	6.4	6.5	6.45	1.0	1.3	1.2
Lateral incisor	7.7	8.2	8.0	1.2	1.2	1.2
Canine	2.4	2.1	2.3	0.6	0.5	0.55
First premolar	15.6	16.5	16.1	5.2	5.9	5.6
Second premolar	13.8	14.6	14.2	13.4	15.8	14.7
First molar	64.2	63.9	64.1	72.1	74.9	73.5
Second molar	11.1	12.9	12.1	21.0	23.5	22.3

Table 2. Tooth specific caries prevalence in 15-19 year-olds.

Tooth Type	Maxillary			Mandibular		
	Right (%)	Left (%)	Total (%)	Right (%)	Left (%)	Total (%)
Central incisor	9.5	10.6	10.1	1.2	1.0	1.1
Lateral incisor	9.3*	11.9*	10.0	1.1	0.7	0.9
Canine	4.8	4.2	4.5	0.8	0.7	0.8
First premolar	26.0*	22.2*	24.1	9.4	11.7	10.7
Second premolar	24.7	24.4	24.6	22.8	22.6	22.7
First molar	70.6	69.3	70.0	75.7	77.2	76.5
Second molar	44.7	48.2	46.5	57.8	57.9	57.9

* significantly different (p<.05)

Table 3. Tooth specific caries prevalence in total sample.

Tooth Type	Maxillary			Mandibular		
	Right (%)	Left (%)	Total (%)	Right (%)	Left (%)	Total (%)
Central incisor	8.0	8.7	8.4	1.1	1.1	1.1
Lateral incisor	8.5	10.1	9.4	1.1	0.9	1.0
Canine	3.6	3.2	3.4	0.7	0.4	0.6
First premolar	21.0	19.5	20.3	7.4	9.0	8.3
Second premolar	19.5	19.7	19.6	18.3	19.3	18.8
First molar	67.5	66.7	67.1	74.0	76.1	75.1
Second molar	28.6*	31.3*	30.0	40.2	41.4	40.8

* significantly different (p<.05)

exceptions) at the significance level of 0.05 (Table 1 – 3). Actual bilateral caries occurrence in the two age groups and combined results are given in Table 4.

The proportions of bilateral caries occurrence, or bilaterality, in caries positive cases for various teeth are presented in Table 5. In 12-13 year old children, maxillary first molars (86.5%), mandibular central incisors (86.2%), mandibular first molars (86.0%), and mandibular lateral

incisors (83.3%) showed very high caries bilaterality. Caries were significantly bilateral (p < .05) in all the teeth except in canines and premolars. Among the 15-19 year old children, mandibular first molars (91.6%), maxillary first molars (89.8%), and mandibular second molars (79.9%) showed very high caries bilaterality. Caries were significantly bilateral (p<0.05) in all the teeth except canines and mandibular first premolars. The combined data also showed significant (P<.05) bilateral caries occurrence for

Table 4. Tooth-specific bilateral occurrence of caries.

Tooth Type	12-13-year-olds		15-19-year-olds		Combined sample	
	Max. (%)	Mand. (%)	Max. (%)	Mand. (%)	Max. (%)	Mand. (%)
Central incisor	3.9	1.0	6.4	0.7	5.2	0.9
Lateral incisor	4.3	1.0	5.7	0.5	5.0	0.8
Canine	0.7	0.0	2.3	0.3	1.6	0.1
First premolar	8.0	1.9	15.1	5.4	11.7	3.8
Second premolar	6.8	7.4	14.6	13.2	10.9	10.4
First molar	55.4	63.2	62.4	70.0	59.1	66.7
Second molar	7.0	14.3	34.5	46.2	21.3	30.9

Max.: Maxillary, Mand.: Mandibular

Table 5. Proportion of bilateral caries in various teeth.

Tooth Type	12-13-year-olds		15-19-year-olds		Combined sample	
	Max. (%)	Mand. (%)	Max. (%)	Mand. (%)	Max. (%)	Mand. (%)
Central incisor	60.4	86.2	63.6	63.1	62.2	81.8
Lateral incisor	53.8	83.3	56.9	53.2	53.36	79.2
Canine	31.0*	0.0*	51.0*	40.0*	47.0*	17.2*
First premolar	49.8*	34.1*	62.3	50.6*	57.7	38.6*
Second premolar	47.9*	50.4*	59.5	58.1	55.6	55.3
First molar	86.5	86.0	89.8	91.6	87.9	88.9
Second molar	58.0	64.1	74.2	79.9	70.9	75.7

Max.: Maxillary, Mand.: Mandibular * Not-significant (p > 0.05)

Table 6. Tooth-specific conditional probability for bilateral occurrence.

Tooth Type	12-13-year-olds		15-19-year-olds		Combined sample	
	Max.* (%)	Mand.* (%)	Max.* (%)	Mand.* (%)	Max.* (%)	Mand.* (%)
Central incisor	61.0	100	67.0	58.0	65.0	82.0
Lateral incisor	56.0	83.0	61.0	45.0	59.0	73.0
Canine	29.0	0.0	48.0	38.0	44.0	14.0
First premolar	51.0	37.0	58.0	57.0	56.0	51.0
Second premolar	49.0	55.0	59.0	58.0	56.0	57.0
First molar	86.0	88.0	88.0	92.0	88.0	90.0
Second molar	63.0	68.0	77.0	80.0	74.0	77.0

Max.: Maxillary, Mand.: Mandibular * Not-significant ($p > 0.05$)

all the teeth except canines and mandibular first premolars. The caries bilaterality was lowest in canines in all groups. The bilateral caries occurrence and caries bilaterality were generally higher in 15-19 year old children as compared to 12-13 year old children. The Z test comparing two proportions showed a significant ($p < .05$) difference between the two age groups.

Table 6 illustrates the conditional probability for bilateral caries (the probability of caries on the left side tooth given the right side tooth is carious) for all the teeth. The combined data showed there was a higher than 50% probability of the left side tooth being carious given the right side tooth was carious for all the teeth except the canines. The conditional probability for bilateral caries occurrence was highest in first molars followed by second molars and central incisors. The conditional probability for bilateral caries occurrence was also generally higher in 15-19 year olds as compared to 12-13 year olds, and the Z test comparing two proportions showed significant ($p < .05$) difference between the two age groups.

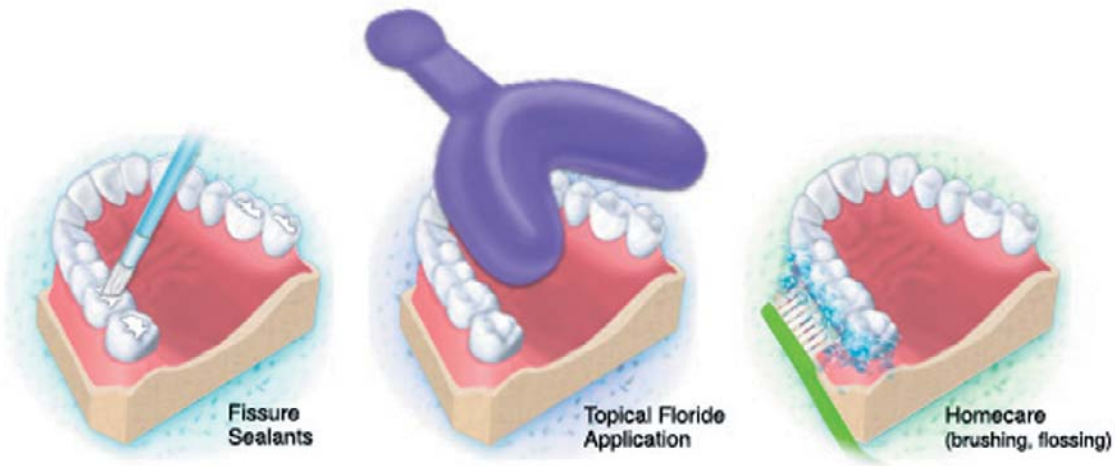
Discussion

Caries prevalence was similar in both the right and left side of the mouth in various teeth, which is in agreement with several previous studies.^{6,7} A similar caries prevalence on both sides of the

mouth indicates a high bilateral occurrence of caries. In the present study caries prevalence in both right and left mandibular second molars in 15-19 year old children was 57.8% and 57.9%, respectively; this appears to indicate a near 100% bilateral caries occurrence. However, further analysis of data found that about 80.0% of these children had actual bilateral caries occurrence, i.e., caries on both right and left mandibular second molars at the same time; the other 20% had a carious mandibular second molar only on one side of the mouth.

The proportion of bilateral caries occurrence or caries bilaterality was also calculated to highlight the magnitude of bilateral caries occurrence among various teeth. Some teeth with low caries prevalence could have a high caries occurrence bilaterality. For example; the combined mandibular central incisors showed a very low caries prevalence (1.1%) and bilateral caries occurrence (0.9%). However, the proportion of bilateral occurrence or caries bilaterality ($0.9 \times 100/1.1 = 81.8$) indicated that among the children with carious mandibular central incisors, four out of every five children had caries in both right and left mandibular central incisors at the same time.

Caries bilaterality was highest in first molars. First permanent molars are one of the most important teeth in the mouth and, therefore, need special



attention during routine dental examinations. A high bilateral occurrence demands careful prevention strategies including fissure sealants, topical fluoride applications, and meticulous home care. A study in Riyadh preschool children showed similar results in primary teeth, where the bilateral occurrence of caries was also very high especially in first and second primary molars and incisors.¹⁰

The conditional probability for the bilateral occurrence of caries was generally high especially in first molars followed by second molars and central incisors. The high conditional probability of caries has diagnostic and preventive implications. The presence of caries on one side would warrant a careful clinical and radiographic examination to rule out caries on the contralateral side. If the contralateral tooth is sound, additional preventive efforts would be required in the form of fissure sealants, topical fluoride applications, and meticulous home care. The phenomenon of caries bilaterality may also be utilized in dental public health, e.g., in future large caries surveys.

The caries status and treatment needs can be assessed by the dental examination of only one side of the mouth, resulting in quite accurate overall information while saving considerable time and precious resources. Considering the results of this study in permanent teeth and the previous two studies in primary teeth^{9,10}, this conclusion can be extended to both primary and permanent teeth in children of all age groups.

The caries bilaterality and conditional probability of bilateral caries occurrence were higher in older children as compared to younger children. This was expected; as age increases and cariogenic factors continue to exist, more and more contralateral teeth become carious. Although, the caries prevalence was similar on both sides of the mouth and there was no significant difference in the conditional probability for bilateral caries occurrence based on the side chosen as test side, the right side was chosen as the test side in the present study. This was because of the traditional use of the right side as a test side in research. In addition, routine dental examination



usually begins at the right side. There was no difference in bilateral caries occurrence in relation to water fluoride level. This finding was expected as the great majority of the study population lives in low fluoride areas.¹³ Moreover, the effect of fluoride would be similar on both sides of the mouth. The low caries rate bilaterality in canines and premolars as compared with molars and incisors could be related to factors such as morphology, tooth brushing effects, and low caries prevalence in these teeth. However, further investigation is required in this area. There is also a need to study the phenomenon of bilateral caries occurrence in terms of tooth surfaces. Nevertheless, the present study has provided useful information about bilateral occurrence of dental caries in a high caries population whose majority lives in low fluoride areas. It is hoped that the information would assist in effective diagnosis and prevention of dental caries.

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Conclusions

1. The prevalence of caries was similar in both sides of the mouth in maxillary and mandibular teeth in the study population.
2. Bilateral caries occurrence was highest in first molars followed by second molars and central incisors. The bilateral caries occurrence was lowest in canines.
3. The conditional probability for bilateral occurrence of caries was high especially in first molars, second molars, and central incisors.
4. The caries bilaterality and conditional probability for bilateral caries occurrence were higher in older children as compared to younger children.

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