Prevalence of dental caries on individual permanent tooth in patients visiting a tertiary care center

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ABSTRACT

Introduction: Dental caries is considered a major public health problem globally due to its high prevalence and significant social impact. In a developing country like Nepal, the prevalence of dental caries is increasing mainly due to a lack of awareness about dental caries. Hence, the present study was designed to assess the prevalence of dental caries on individual permanent tooth surfaces. **Methods:** This cross-sectional study was conducted in 384 patients visiting Patan Hospital, aged above 18 years where a convenience sampling technique was used for data collection. After the diagnosis of dental caries was made, each surface of caries was recorded on the proforma sheet for both maxillary and mandibular teeth. This sheet included mesial, distal, lingual/palatal, buccal/labial, incisal/occlusal surfaces. **Results:** A total of 1194 carious surfaces were recorded in 384 participants. Caries distribution was higher in maxillary arch 614(51.40%) than in mandible 580(48.60%). The majority of caries affected teeth were first molars followed by second molars. **Conclusions:** In this study, the prevalence of caries was higher in the maxillary arch than in the mandibular arch and the most affected tooth was the mandibular first molar and the least was mandibular central incisors. Similarly, more females were affected than males, and a higher proportion of caries were found in the age group between 18 to 35 years.

Keywords: Age, dental caries, gender, tooth surface.

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INTRODUCTION

Dental caries, otherwise known as tooth decay, is considered the most prevalent chronic disease globally and is a major public health problem.[1] According to the World Health Organization (WHO), dental caries is defined as the destruction of the enamel layer of the tooth by acids produced by the action of bacteria on sugar.[2] In both developed and developing countries, the prevalence of dental caries is increasing due to high consumption of sugary foods, poor oral care practices, and inadequate health service utilization.[3] It is estimated that nearly 2.4 billion or 36% of the world's population have dental caries in their permanent teeth.[2,4] Dental caries is most prevalent in Asia and Latin American countries.[1,4] In Nepal, the prevalence of dental caries is nearly 57.74% attributed to mainly socio-economic status, environmental and behavioural factors.[5,6]

Dental caries is susceptible in every age group even though it is largely preventable. If it is not treated they may get larger and affect deeper layers of teeth leading to severe toothache, infection, and tooth loss. Tooth loss creates problem with eating, chewing, smiling, and communication having a major impact on one's daily life and well-being. Furthermore, dental caries affects the concentration of patients in work and increases the financial burden of the family.[2,7] Caries pattern varies on each tooth surface, with pit and fissure (occlusal) surface caries being the most susceptible and smooth (labial and lingual) surface being the least susceptible. Different age

groups and populations have a distinct prevalence of dental caries, observation of which provides a useful descriptive measure of caries susceptibility in tooth surfaces.[8]

In Nepal, due to a lack of health education and insufficient preventive measures, there is a high prevalence of dental caries. This study aimed to assess the prevalence of dental caries on individual permanent tooth in patients visiting Patan Hospital. Similarly, this study also assessed the most affected tooth in the oral cavity with dental caries along with the most affected sex and age group. Finding the most affected tooth surface with dental caries can help in educating the patient visiting Patan hospital which overall in future provides help in early interventions to control dental caries cases. Also, research based on oral hygiene and oral diseases is rare in Nepal.

METHODS

This study was conducted on patients attending the dental department at Patan Hospital for the treatment of decayed teeth from January 2024 to April 2024. Before the study, ethical approval was obtained from the Institutional Review Committee, Patan Academy of Health Sciences (Ref. No. drs2401121834). Each patient was informed about the nature of the study and written consent was obtained from each selected patient.

According to the department's patient protocol, patients were first examined in the Department of Oral Diagnosis and Radiology. Then, according to their diagnosis the patients were referred to a related department for treatment. In the department of conservative and endodontics, the patients with dental caries was examined by a single examiner. According to WHO recommendations, the examination was performed with a mouth mirror and the explorer under a dental chair light. The examiner used standardized and routinely used WHO diagnostic criteria. Firstly, the carious tooth was identified and a diagnosis of dental caries was made when there was clear evidence of loss of tooth structure with black and brown catch on probing on the surface of the tooth. Then, each surface of caries was recorded on the proforma sheet for both maxillary and mandibular teeth by the primary investigator. If the pattern of caries experience was symmetrical between the right and left sides of the mouth for both maxillary and mandibular teeth, the right and left surfaces were combined for each tooth. The location of dental caries on the teeth surfaces was recorded as follows: mesial, distal, lingual/palatal, labial/buccal, and incisal/occlusal surfaces.

Furthermore, the age and gender of the patient were recorded for each carious tooth. In addition, the recorded ages on the sheet for each carious tooth were coded into three age groups: 1) 18 to 35, 2) 36 to 55, and 3) above 56 years of age.

The collected data were entered in Microsoft Office Excel, and analysis of the data was done using the statistical package of social sciences (SPSS) version 21.0. The prevalence of dental caries in individual tooth surfaces, frequency and percentage of caries among males and females, and age distribution of caries were calculated among the study population.

RESULTS

A total of 384 study participants were included in the study of which 146(38.42%) were males and 234(61.58%) were females. The age of the participants ranged from 18 to 86 years with a mean age of 42.38±17.45 years.

In this study, a total of 1194 carious surfaces were recorded in 384 carious teeth. Caries distribution was higher in maxillary arch 614(51.40%) than in mandibular arch 580(48.60%). Of the total, the majority were first molars 454(38%) followed by second molars 263(22%) as depicted in Table 1.

Table 1: Distribution of examined caries teeth according to arch

Tooth	Maxillary arch n(%)	Mandibular arch n(%)	Total n(%)
Central incisors	42(6.80%)	8(1.40%)	50(4.20%)
Lateral incisors	23(3.70%)	11(1.90%)	34(2.80%)
Canine	34(5.50%)	19(3.30%)	53(4.40%)
First premolars	68(11.10%)	39(6.70%)	107(9%)
Second premolars	90(14.70%)	77(13.30%)	167(14%)
First Molars	225(36.60%)	229(39.50%)	454(38%)
Second Molars	108(17.60%)	155(26.70%)	263(22%)
Third Molars	24(3.90%)	42(7.20%)	66(5.50%)
Total	614(51.40%)	580(48.60%)	1194(100%)

Table 2a shows the distribution of caries surfaces in maxillary teeth. The occlusal surface of the maxillary first molar 126(56%) had the highest caries rates followed by second molar 70(64.80%), whereas the incisal surface of canine had the least caries distribution 1(2.90%).

Table 2a: Distribution of caries surfaces in maxillary teeth

Maxillary teeth	Distal n(%)	Mesial n(%)	Labial/ Buccal n(%)	Palatal n(%)	Incisal/ Occlusal n(%)
Central incisors (n=42)	4(9.50%)	28(66.70%)	5(11.90%)	3(7.10%)	6(14.30%)
Lateral incisors (n=23)	5(21.70%)	14(60.90%)	5(21.70%)	2(8.70%)	-
Canine (n=34)	9(26.50%)	6(17.60%)	18(52.90%)	1(2.90%)	1(2.90%)

First premolars (n=68)	16(23.50%)	23(33.80%)	22(32.40%)	2(2.90%)	11(16.20%)
Second premolars (n=90)	31(34.40%)	32(35.60%)	21(23.30%)	3(3.30%)	15(16.70%)
First Molars (n=225)	28(12.40%)	74(32.90%)	11(4.90%)	15(6.70%)	126(56%)
Second Molars (n=108)	28(25.90%)	19(17.60%)	4(3.70%)	2(1.90%)	70(64.80%)
Third Molars (n=24)	1(4.20%)	3(12.50%)	1(4.20%)	-	20(83.30%)

Of the total caries surface in mandibular teeth, the majority were occlusal surface caries in the first molar 163(71.20%) followed by second molars 111(71.60%). In addition, the lingual surface of the mandibular first and second molars had the least caries distribution of 1(0.40%) followed by 1(0.60%). (Table 2b)

Table 2b: Distribution of caries surfaces in mandibular teeth

Mandibular teeth	Distal n(%)	Mesial n(%)	Labial/ Buccal n(%)	Lingual n(%)	Incisal/ Occlusal n(%)
Central incisors (n=8)	2(25%)	3(37.50%)	-	-	4(50%)
Lateral incisors (n=11)	4(36.40%)	5(45.50%)	1(9.10%)	1(9.10%)	2(18.20%)
Canine (n=19)	4(21.10%)	6(31.60%)	8(42.10%)	1(5.30%)	1(5.30%)
First premolars (n=39)	7(17.90%)	10(25.60%)	22(56.40%)	-	8(20.50%)
Second premolars (n=77)	20(26%)	15(19.50%)	27(35.10%)	-	23(29.90%)
First Molars (n=229)	35 (15.30%)	37(16.20%)	35(15.30%)	1(0.40%)	163(71.20%)
Second Molars (n=155)	27 (17.40%)	18(11.60%)	22(14.20%)	1(0.60%)	111(71.60%)
Third Molars (n=42)	-	4(9.50%)	-	-	40(95.20%)

Greater number of females (261) had caries in maxillary and mandibular first molars than male (193). A higher proportion of females 160(61.30%) had caries on the occlusal surface as compared to males 129(66.80%), in both arches of the first molars as depicted in Table 3.

Table 3: Distribution of caries surfaces according to gender

Teeth	Gender	Distal n(%)	Mesial n(%)	Labial/ Buccal n(%)	Palatal n(%)	Incisal/ Occlusal n(%)
Central incisors	Female (n=25)	3(12%)	20(80%)	2(8%)	2(8%)	2(8%)
	Male (n=25)	3(12%)	11(44%)	3(12%)	1(4%)	8(32%)
Lateral incisors	Female (n=19)	6(31.60%)	13(68.40%)	2(10.50%)	1(5.30%)	-
	Male (n=15)	3(20%)	6(40%)	4(26.70%)	2(13.30%)	2 (13.30%)
Canine	Female (n=26)	10(38.50%)	4(15.40%)	11(42.30%)	-	2(7.70%)
	Male (n=27)	3(11.10%)	8(29.60%)	15(55.60%)	2(7.40%)	-
First premolars	Female (n=60)	14(23.30%)	17(28.30%)	22(36.70%)	1(1.70%)	13(21.70%)
	Male (n=47)	9(19.10%)	16(34%)	22(46.80%)	1(2.10%)	6(12.80%)
Second premolars	Female (n=107)	33(30.80%)	33(30.80%)	29(27.10%)	3(2.80%)	22(20.60%)
	Male (n=60)	18(30%)	14(23.30%)	19(31.70%)	-	16(26.70%)
First Molars	Female (n=261)	38(14.60%)	71(27.20%)	23(8.80%)	9(3.40%)	160(61.30%)
	Male (n=193)	25(13%)	40(20.70%)	23(11.90%)	7(3.60%)	129(66.80%)
Second Molars	Female (n=171)	40(23.40%)	21(12.30%)	17(9.90%)	2(1.20%)	122(71.30%)
	Male (n=92)	15(16.30%)	16(17.40%)	9(9.80%)	1(1.10%)	59(64.10%)
Third Molars	Female (n=39)	-	4(10.30%)	1(2.60%)	-	36(92.30%)
	Male (n=27)	1(3.70%)	3(11.10%)	-	-	24(88.90%)

A higher proportion of caries was found in group 18 to 35 years (n=232) on occlusal surface 184(79.30%) of first molars and the least was found in age group ≥56 years (n=6) on occlusal surface 1(16.70%) of central incisors, as depicted in table 4.

Table 4: Distribution of caries surfaces according to age group

Teeth	Age group (in years)	Distal n(%)	Mesial n(%)	Labial/ Buccal n(%)	Palatal n(%)	Incisal/ Occlusal n(%)
Central incisors	18-35(n=30)	5(16.70%)	19(63.30%)	-	3(10%)	6(20%)
	36-55(n=14)	-	7(50%)	4(28.60%)	-	3(21.40%)
	≥56(n=6)	1(16.70%)	5(83.30%)	1(16.70%)	-	1(16.70%)
Lateral incisors	18-35(n=16)	3(18.80%)	12(75%)	4(25%)	-	-
	36-55(n=9)	4(44.40%)	4(44.40%)	-	-	2(22.20%)
	≥56(n=9)	2(22.20%)	3(33.30%)	2(22.20%)	3(33.30%)	-
	18-35(n=6)	3(50%)	2(33.30%)	1(16.70%)	-	-
Canine	36-55(n=17)	8(47.10%)	4(23.50%)	5(29.40%)	-	1(5.90%)
	≥56(n=30)	2(6.70%)	6(20%)	20(66.70%)	2(6.70%)	1(3.30%)
First premolars	18-35(n=23)	8(34.80%)	5(21.70%)	4(17.40%)	1(4.30%)	11(47.80%)
	36-55(n=40)	10(25%)	19(47.50%)	9(22.50%)	1(2.50%)	6(15%)
	≥56(n=44)	5(11.40%)	9(20.50%)	31(70.50%)	-	2(4.50%)
Second premolars	18-35(n=35)	9(25.70%)	9(25.70%)	1(2.90%)	-	22(62.90%)
	36-55(n=62)	25(40.30%)	22(35.50%)	13(21%)	-	11(17.70%)
	≥56(n=70)	17(24.30%)	16(22.90%)	34(48.60%)	3(4.30%)	5(7.10%)

	18-35(n=232)	22(9.50%)	36(15.50%)	13(5.60%)	9(3.90%)	184(79.30%)
First Molars	36-55(n=113)	18(15.90%)	46(40.70%)	10(8.80%)	4(3.50%)	58(51.30%)
	≥56(n=109)	23(21.10%)	29(26.60%)	23(21.10%)	3(2.80%)	47(43.10%)
	18-35(n=151)	19(12.60%)	11(7.30%)	15(9.90%)	2(1.30%)	122(80.80%)
Second Molars	36-55(n=67)	26(38.80%)	14(20.90%)	5(7.50%)	-	38(56.70%)
	≥56(n=45)	10(22.20%)	12(26.70%)	6(13.30%)	1(2.20%)	21(46.70%)
	18-35(n=30)	-	-	-	-	30(100)
Third Molars	36-55(n=17)	-	3(17.60%)	1(5.90%)	-	15(88.20)
	≥56(n=19)	1(5.30%)	4(21.10%)	-	-	15(78.90)

DISCUSSION

The present study was based on determining the rates and incidence of caries on individual tooth surfaces. Therefore, the patients who visited this hospital for the treatment of decayed teeth were selected. The decayed tooth surfaces were recorded along with patient-related age and sex.

The results of the present study showed that anterior teeth were least likely to be caries, while posterior teeth were most likely to be caries in both maxillary and mandibular arches as posterior teeth have grooves, pits, and fissures which can easily collect food particles. Caries were more prevalent in the maxillary arch than in the mandibular arch. This study is similar to the study reported by Mahmud et al. which showed caries distribution in the maxillary arch (53.38%) and mandibular jaw (46.62%).[9]

This study showed that mandibular molars were the most affected teeth while mandibular central incisors were least likely to be affected. This result confirmed the findings of Luan et al. who evaluated the ten-year incidence of dental caries in adult and elderly Chinese patients.[10] Similarly, in the present study, mandibular molars were slightly more significantly affected than maxillary molars. However, in the case of premolars and anterior teeth, the upper jaw was more affected than the lower jaw. This study confirmed the findings reported by Klein and Palmer. They also found that mandibular incisors and canines were least susceptible to caries attack.[11] Whereas, the study reported by Demirci et al. showed that maxillary molars (62.40%) were slightly more affected than mandibular molars (37.60%), who evaluated the four-year incidence of dental caries among Turkish people.[8]

The results of the present study showed that occlusal surface caries of the first and second molars had the highest caries rates whereas the lingual/palatal surface of first and second molars had the least caries distribution. This was supported by the study conducted by Eklund et al. which showed occlusal caries exceed all other types.[12] Similarly, a study conducted by Pradhan et al. showed the highest occlusal caries (66.04%) followed by smooth surface caries (24.42%).[13] The possible reason for more occlusal caries mostly in permanent molars may be due to complicated surface morphology as the pit and fissure show early signs of caries as soon as after eruption.[14,15] According to Hannigan et al., the most frequent site of occurrence was the occlusal surface of permanent first and second molars which was similar to this study.[16]

In this study, the mesial surface of the maxillary and mandibular first molars had more caries distribution than the distal surface of the same tooth whereas, the distal surface of maxillary and mandibular second molars had more caries distribution than the mesial surface of the same tooth. However, in the study conducted by Stenlund et al. distal surface of the first molar developed caries more often than the mesial surface of the second molar.[17] This showed that neighboring approximal tooth surfaces differed in caries susceptibility, implying that one surface may show obvious radiographic signs of caries while the neighboring surface may not show.[9] Additionally, the caries rate of an approximal tooth surface was 1.6 to 32.3 times higher if the adjacent surface was in a caries state compared to when the adjacent surface was sound.[17,18]

More caries were observed on the mesial surface than on the distal surface of the central and lateral incisor, first and second premolar, and first molar except for the mandibular second premolar, as most of the mesial surface of permanent teeth comes in direct contact with caries distal surface of primary teeth. Hence, overall caries rates in mesial surfaces were higher in maxillary teeth than in mandibular teeth. This is similar to the study conducted by Demirci et al.[8]

In this study, females had a higher incidence of caries than males which was similar to the study conducted by Mahmud et al., Lukacs et al., and Antunes et al.[9,19,20] This may be attributed to the fact that in general permanent teeth erupt earlier in women than in men, exposing to the risk of caries for a longer period. Other factors may be related to awareness, hormones, and lifestyle.[9,19] A technical report of the Federation Dentaire International also attributed the higher prevalence of caries in girls to their earlier eruption of permanent teeth.[8]

Caries were common in every age group from young to old age of the study patients. Molars were more prone to caries

than incisors, canines, and premolars in all age groups. A higher prevalence of occlusal caries in the first and second molar was found in the age group 18 to 35 years and the least was found in the age group ≥56 years. A lower proportion of occlusal caries was found in central incisors in the age group ≥56 years. Similarly, Berman et al. found that occlusal caries was a problem in the initial years after tooth eruption and that approximal caries became more prevalent in later stage.[21] Overall, this study showed that a greater number of caries were explained in the younger age group in the first and second molar and this rate decreased with increasing age. This finding is different from the study conducted by Saunders et al., which showed older adults were more prone to coronal and root caries than younger adults which may be due to a wide spectrum of oral and general health problems faced by them during later stages of life.[22] Maji et al. reported that the generally held view of caries experience being reduced with age may not result from reduced caries activity but from a reduced number of remaining teeth.[9]

This study bears some limitations like a small sample size and limited time period for studying the sample as a three-month time for examination of dental caries patients may not be sufficient. Furthermore, a multi-centric study with an extended period and larger sample size could have helped to generalize the results of this study.

CONCLUSIONS

In this study, maxillary teeth were more susceptible to dental caries. Maxillary and mandibular molars demonstrated the highest caries rates while mandibular central incisors were least likely to have caries. Occlusal surface caries were more commonly observed than proximal caries. Furthermore, approximal surfaces of incisors, canines, and premolars had higher caries rates than other sites. Gender and age did not affect the prevalence of caries on teeth sites. However, women generally had more carious teeth than men. Furthermore, carious teeth were more common among younger patients. The findings of this study can be utilized to provide oral health education and provide the timely treatment to the patients.

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AUTHORS' CONTRIBUTION

NKC designed the research, collected the data and prepared the first draft of the manuscript. AM, ST and BPS interpreted the data and contributed in preparing the final draft of the manuscript. All authors read and approved the manuscript.

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