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Prevalence of Root Caries Among 65-75 Year Olds of Khordha District, Odisha: A Cross Sectional Study

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Abstract

This study assessed the prevalence of root caries and its risk factors in the elderly population of Khordha district, Odisha, India. Further, microbiological profiling was done for the same patients. The Khordha district was divided into four zones, and municipal clusters were selected randomly from each zone. Residents aged 65-75 years and who provided consent were included in the study, except those with physical disabilities and terminal illnesses. A pilot study on 25 subjects who met the inclusion criteria and the sample size was calculated to be 373 based on the formula N = Za2 {p (1-p)}/L2 x D.E. and rounded off to 380. The majority (70%) of the study population comprised males residing in urban areas having a minimum of middle school education. Most of them cleaned their teeth at least once daily. Tobacco use was prevalent in the population, with 37.3% smokers and 87.4% chewing tobacco, significantly more in males. The overall prevalence of root caries was 20.8%, with 16.3% in males and 4.5% in females, respectively. The mean RCI score for males in the study population was 8.09 ± 14.8, while that for females was significantly lower at 5.89 ± 8.23 ($p<0.001$). Gingival recession was observed in 6.74 ± 10.96. Streptococcus mutans was the major causative organism, irrespective of gender. This study found the prevalence of root caries to be 20.8% and influenced by gender, smoking, chewing tobacco, and consumption of alcohol. Hence, focusing on these factors would be a prudent way to tackle root caries.

Keywords: Root caries, Tobacco use, Oral hygiene, Prevalence, Microbiological profiling.

Introduction

Dental caries is a microbial disease caused by the interaction of a susceptible tooth with caries, causing bacteria and fermentable carbohydrates. Fermentation of the carbohydrates by the bacteria results in a drop in salivary pH that leads to the dissolution of inorganic components of the tooth. Apart from this primary mechanism of caries causation, environmental and endogenous factors such as the salivary flow and composition of tooth structure can hinder or propagate the process. Hence, the development of a caries lesion is a complicated process involving the interaction of multiple factors that are everchanging, resulting in fluctuations in the occurrence and severity of the disease process. This mandates periodic population-based investigations to assess risk factors and indicators of dental caries (1, 2).

In the 20th century, they identified dental caries as an endemic disease, the most common cause of pain in the oral cavity, and tooth loss. However, the last few decades saw an alteration in the disease pattern with a reduction in caries prevalence in children and adults. There has been a gradual reduction in tooth loss in adults, which implies more tooth surfaces at risk of caries (3-5). Recent years have seen an advancement in treatment options, resulting in more people retaining their natural teeth. However, increasing the retained teeth increases the risk (6). Especially root surfaces exposed with advancing age and onset of periodontal disease (3-5).

Root caries are similar to dental caries as they are multifactorial and are caused by a complex interaction of various factors that can be categorized under four behavioural domains: systemic health factors, socio-demographic factors and intraoral factors (1, 2). Root caries is a soft, irregular progressive lesion found anywhere on the root surface that has lost connective tissue attachment and is exposed to the oral environment (7). It is caries that occur on the

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exposed cementum and dentine that is covered with oral biofilm. It generally occurs on roots exposed to the gingival recession caused by periodontal disease, mechanical injury due to improper brushing, or old age. The surface of the root is very reactive in the oral environment. Because of its lower mineral content, it is more susceptible to abrasion by tooth brushing or removed by scaling and root planing. Thus making it more susceptible to the drop in pH (8). Due to improved life expectancy in developing countries, the population aged over 65 years is increasing, and in turn, those without tooth loss are also growing. In 1992, 67% of those over 60 years old were found to have dentate in a study conducted in Southern England, in contrast to a cohort from 1962, where only 15% were dentate (9). An Indian study found the prevalence of root caries to be 41.9% and influenced by smoking, tobacco chewing, and mouth dryness (7). However, baseline data on root caries in India is scarce, especially in eastern India. Hence, the current study assessed the prevalence of root caries, its risk factors, and microbiological profiles in the elderly population of Khordha district, Odisha, India.

Material and Methods

Study population

The present study was undertaken among the urban population of the Khordha district of Odisha, India. A multistage cluster sampling was used. The Khordha district was divided into north, south, east, and west zones, and then municipal clusters were selected randomly from each zone. Dental camps were organized in these municipalities. Residents of the Khorda district aged 65-75 years and who provided consent were included in the study. Those with physical disabilities and terminal illnesses were excluded. A pilot study on 25 subjects who met the inclusion criteria and the sample size was calculated to be 373 based on the formula $N = Z_a^2 \{p (1-p)\}/L^2$ x D.E. and rounded off to 380.

Data collection

Data was collected through a specially designed proforma comprising information on socio-demographic variables, oral hygiene habits, sugar exposure, and tobacco use (form, type, frequency and duration). ADA type III clinical Examination using a plain mouth mirror and Community Periodontal Index (CPI) probe was employed to assess root caries. Root caries on exposed root surfaces were identified according to criteria by Banting et al., (10). Root caries were calculated according to Katz (11). using RCI = {(R-D) +(R-F)} / {(R-D) + (R-F) + (R-N)} X 100 where R-D is a gingival recession with decay on the root surface; R-F is a gingival recession with filling on the root surface; R-N is a gingival recession with sound root surface. Only those lesions on the CEJ or apical were considered root caries. The presence or absence of gingival recession was also recorded.

The examiner was trained and calibrated in the criteria for identifying root caries. Intra-examiner variability was assessed using kappa statistics (0.8), the validity of the proforma was tested during the pilot study, and necessary modifications were made. Written and informed consent was obtained from the participants, and ethical clearance was obtained from the institutional ethical committee. The inclusion and exclusion criteria (Table 1) were strictly followed to maintain the proper representation of the chosen population group.

Table 1: Inclusion And Exclusion Criteria

Inclusion Criteria	Exclusion criteria
• Subjects aged 65-74 years • Subjects living in Faridabad for the last ten years • Subjects present on the day of the Examination • Subjects who were willing to participate	• Physically challenged and mentally compromised elderly people and those with cognitive impairment were excluded. • Elderly people with terminal illness were excluded.

Microbiological profiling of patients with root caries

A paper point was inserted into the canal and held there for 3–5 min to obtain a sample of microorganisms. This paper point was then immediately transferred to the sterile agar plates. These agar plates were taken to the laboratory for further processing. Blood agar plates and Mitis Salivarius-bacitracin media were used to enumerate the bacteria from the saliva samples collected from the patients. The plates were incubated overnight at 37°C for 24 h. The colonies formed after incubation were subjected to routine microbiological tests to identify the bacteria (12).

Data analysis

The data collected was entered into an Excel sheet (M.S. Excel) and analyzed using SPSS version 21 at the end of the day. (IBM Inc.) Descriptive statistics included calculating percentages, frequencies and standard deviation. Shapiro Wilk test was used to check normality. Mann-Whitney U test and Kruskal-Wallis test were used for inferential statistics. The Chi-square test was used to compare categorical variables. The probability value was set at ≤ 0.05.

Results

The present study was conducted among the adult population of Khordha district to assess the prevalence of root caries among 65-75-year-olds. The majority (70%) of the study population comprised males residing in urban areas having a minimum of middle school education (Table 2). Most of them cleaned their teeth using toothbrushes and dentifrice at least once daily (Table 3). Tobacco use was prevalent in the population, with 37.3% smokers and 87.4% chewing tobacco, significantly more in males. (Table 4).

The overall prevalence of root caries was 20.8%, with 16.3% in males and 4.5% in females, respectively (Table 5). The mean RCI score for males in the study population was 8.09 ± 14.8, while that for females was significantly lower at 5.89 ± 8.23 ($p<0.001$). Gingival recession was observed in 6.74 ± 10.96 (Table 6).

The mean number of teeth affected with root caries was significantly associated with the presence or absence of tobacco habit and alcohol consumption. (p-value = 0.004, 0.003, and 0.021). The root caries were significantly associated with smoking, chewing tobacco, and alcohol use (Table 7).

The microbiological profiling showed that *Streptococcus mutans* was a significant causative organism for root caries, irrespective of gender. *S. mutans* was followed by *Lactobacillus spp*, *Streptococcus sorbinus, Staphylococcus aureus, Enterococcus spp, Streptococcus mitis, Streptococcus oralis,* and *Bifidobacterium sp* (Figure 1).

Table 2: Socio-demographic variables of the study population

Variables		N	Percentage
Sex	Male	264	69.5
	Female	116	30.5
	Total	380	100
Education	Professionals or Honours	24	6.3
	Graduate or postgraduate	40	10.5
	Intermediate	9	2.4
	High school	142	37.4
	Middle school	142	37.4
	Primary school	21	5.5
	Illiterate	2	0.5
	Total	380	100
Location	Rural	151	39.7
	Urban	229	60.3
	Total	380	100

Table 3: Oral hygiene habits of the study population

Variables		Male n (%)	Female n (%)	Total n (%)
Habit of brushing	Yes	257 (67.6)	112 (29.5)	369 (97.1)
	No	7 (1.8)	4 (1.1)	11 (2.9)
	p-value = 0.268 Not significant using Chi-square			
Oral hygiene aids	Toothbrush	221 (58.1)	100 (26.3)	321 (84.4)
	Neem	38 (10)	15 (3.9)	53 (13.9)
	Finger	1 (0.3)	1 (0.3)	2 (0.6)
	Others	4 (1.1)	0	4 (1.1)
	p-value = 0.513 Not significant using Chi-square			
Cleaning agent	Charcoal	6 (1.6)	3 (0.8)	9 (2.4)
	Toothpaste	198 (52.1)	95 (25)	293 (77.1)
	Tooth powder	60 (15.8)	18 (4.7)	78 (20.5)
	p-value = 0.128 Not significant using Chi-square			
Frequency of cleaning teeth	Once	188 (49.5)	83 (21.8)	271 (71.3)
	Twice	68 (17.8)	33 (8.7)	101 (26.5)
	Thrice	5 (1.3)	1 (0.3)	6 (1.6)
	More	1 (0.3)	1 (0.3)	2 (0.6)
	p-value = 0.644 Not significant using Chi-square			

Table 4: Tobacco habits and alcohol use of the study population

Variables		Male n (%)	Female n (%)	Total n (%)
Habit of smoking	Never	120 (31.6)	108 (28.4)	228(60)
	Ever	9 (2.4)	1 (0.3)	10(2.7)
	Current	135 (35.5)	07 (1.8)	142(37.3)
	p value < 0.0001*. Highly significant using Chi-square			
The habit of chewing tobacco	Never	35(9.2)	06(1.5)	41(10.8)
	Ever	3(0.75)	4(1.05)	7 (1.8)
	Current	226(59.5)	106(27.9)	332(87.4)
	p-value < 0.0001* Highly significant using Chi-square			
Use of alcohol	Never	224(59)	112(29.4)	336 (88.4)
	Ever	6(1.5)	2(0.6)	8 (2.1)
	Current	34(8.9)	2(0.6)	36 (9.5)
	p-value < 0.003* Highly significant using Chi-square			
Dental Visit	Yes	96	38	134 (35.3)
	No	168	78	246 (64.7)
	p-value 0.289 Not significant using Chi-square			

Table 5: Prevalence of root caries

Root caries	Male n (%)	Female n (%)	Total n (%)
Present	62 (16.3)	17 (4.5)	79 (20.8)
Absent	202 (53.1)	99 (26.1)	301 (79.2)
p-value 0.032*. Statistically significant using Chi-square			

Table 6: Mean RCI score, the mean number of teeth, and mean several units with recession

Gender	n	Mean RCI (S.D.)	The mean number of teeth (S.D.)	The mean number of teeth with gingival recession(S.D.)
Male	96	8.0937 (14.84842)	26.75 (3.621)	15.60 (12.513)
Female	37	5.8954 (8.23552)	27.86 (1.449)	1.69 (5.421)
Total	133	7.4821 (13.34731)	27.45 (2.522)	6.74 (10.963)
		p value < 0.001*. Highly significant using Chi-square		

Table 7: Comparison of the mean number of teeth with root caries with variables

Variables		Number of subjects	The mean number of teeth with root caries	Standard Deviation	p-value
Dental Visit	Yes	134	0.41	1.035	0.338
	No	246	0.51	1.163	Chi-square test
Brushing habit	Yes	369	0.47	1.123	0.627
	No	11	0.55	1.036	Chi-square test
Habit of smoking	Never	228	0.36	1.035	0.004*
	Ever	10	0.30	0.483	Kruskal Walli's
	Current	142	0.70	1.263	Post hoc pairwise comparison, 3>1,2
The habit of chewing tobacco	Never	41	0.43	1.099	0.003*
	Ever	7	0.0	0.0	Kruskal Walli's
	Current	332	0.85	1.256	Post hoc pairwise comparison, 3>1>2
Alcohol use	Never	336	0.45	1.094	0.021*
	Ever	8	0.0	0.0	Kruskal Walli's
	Current	36	0.86	1.376	Post hoc pairwise comparison, 3>1>2

*Significant; p-value <0.05

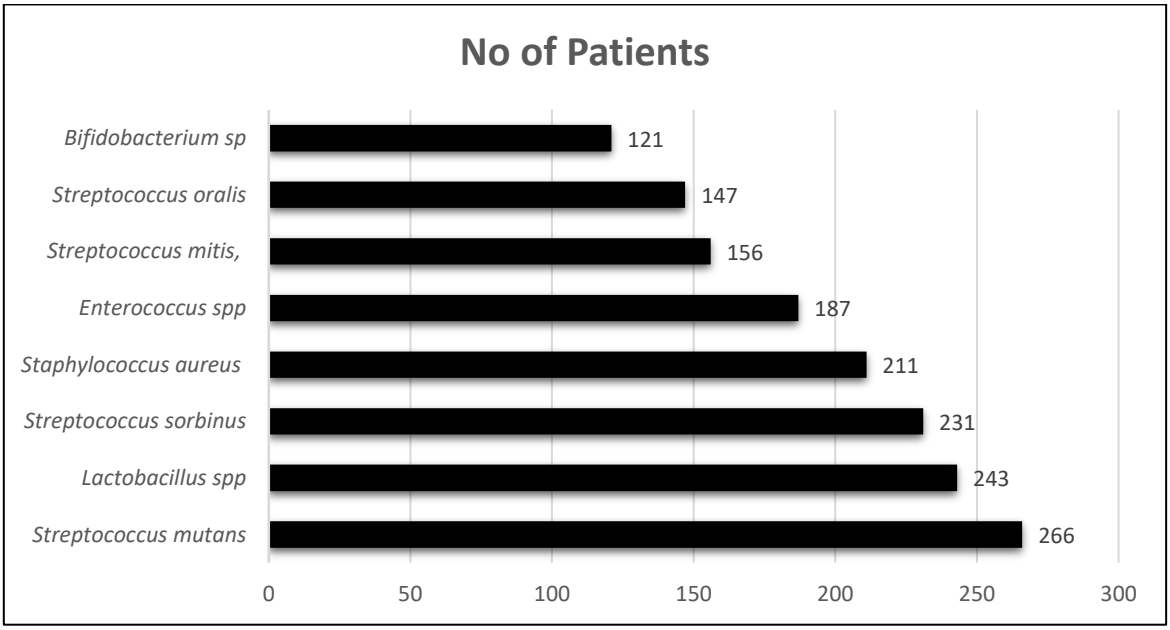

Figure 1: Details of bacteria causing dental caries isolated from saliva samples isolated from study participants.

Discussion

An increase in the proportion of the elderly population in the last 20 years has increased the clinical problem of root caries (13, 14). Diagnosis and management also pose a challenge Since these lesions often occur on subgingival proximal surfaces. Attaining competent isolation and restoration of root caries is clinically time-consuming. Hence, identifying factors causing these lesions and preventing root caries would be prudent to tackle this mounting concern. Further, the COVID-19 pandemic may have been an essential factor, particularly for elderly people, which may have affected the study outcome (15).

Several risk factors contribute to root caries development in the elderly population. One is poor oral hygiene, where inadequate brushing and flossing can lead to plaque accumulation, which contains bacteria that produce acids responsible for tooth decay. Secondly, dry mouth (xerostomia), where elderly individuals experience reduced saliva production, is crucial in neutralizing acids and preventing tooth decay (16, 17). Medications, certain medical conditions, and ageing can also cause a dry mouth. Thirdly, an imbalanced diet with high sugar and carbohydrate intake can contribute to developing dental caries. Diets rich in sugary snacks and beverages provide a favourable environment for bacteria to thrive and produce acids that erode tooth enamel (16, 17).

Further, ageing can weaken the immune system, making elderly individuals more susceptible to oral infections, including those caused by cariogenic (cavity-causing) bacteria. Moreover, certain medical conditions, such as diabetes, can increase the risk of dental caries in the elderly. Diabetes can affect the body's ability to regulate blood sugar, which may contribute to oral health problems. Additionally, physical limitations affecting an individual's ability to perform oral hygiene practices can contribute to developing dental caries. For example, arthritis may make it difficult for someone to brush and floss effectively (16, 17). For some elderly individuals, access to dental care may be a challenge. Regular dental check-ups and cleanings are essential for preventing and detecting dental issues early.

Furthermore, previous dental work, such as dental restorations, fillings, or crowns, can sometimes deteriorate, creating areas where bacteria accumulate and contribute to caries. Likewise, reduced exposure to fluoride, whether through drinking water, toothpaste, or other sources, may increase the risk of dental caries. Fluoride is known for its protective effects on tooth enamel (16, 17).

The present study was conducted among the elderly aged 65 -75 in the Khordha district to assess the prevalence of root caries and identify the associated factors. The majority of the study population were males residing in urban localities. The overall prevalence of root caries was 20.8%, with a mean RCI score of 7.4 ± 13.3. This was comparable to that of a study undertaken by Moreno *et al.,* (18) but was lesser than the findings of other studies (7,17-20). This lower prevalence in the current study population could be attributed to the reduced number of teeth with the gingival recession, which was 6.74 ± 10.96. Gingival recession is one of the important predisposing factors for root caries (19, 20).

The prevalence of root caries was comparatively lesser in females, with only 4.5% affected, similar to a study by Kumara Raja B *et al.,* (21) but in contrast with the studies conducted by Bharateesh *et al.,* and Watanabe (7,19). Women commonly are likely to engage in better self-care and oral hygiene. They are also more inclined to use preventive services and comply better with treatment regimens. This could be the reason for women being less affected by root caries. However, this gender gap could be used to target health behaviours and effectively improve oral health.

Toothbrushing is fundamental yet considered an essential marker of maintaining good oral hygiene and is considered the most reliable means of controlling plaque, provided toothbrushing is performed daily and competently. Oral hygiene habits were acceptable in the study population, with 97.1% practising acceptable oral hygiene methods. This was similar to the findings of a study conducted by Moreno *et al.,* (18) and Kumara Raja B *et al.,* (21) but differed from the conclusions of Imazato S et al., (20). However, this was not significantly associated with the occurrence of root caries.

Smoking was seen in 37.3% of the study participants, influencing the prevalence of root caries ($p < 0.0001$), with mean RCI being 0.85 among current tobacco chewers. It was found to

be significantly higher than non-users or tobacco users. These findings follow the studies conducted by Bharateesh *et al.,,* Moreno *et al.,,* Kumara Raja B *et al.,,* and Md Sofiqul Islam *et al.,* (7, 18, 21, 22). Khordha district belongs to the eastern state of Odisha in India, where smokeless chewable tobacco is prevalent, with 42.9% of the population using chewable tobacco. The present study found that 87.4% of the study subjects use some form of smokeless tobacco, and the mean RCI was significantly associated with tobacco habit. Similar reports were done by studies conducted by Bharateesh *et al.,,* Moreno et al.,, and Tomar and Winn (7, 18, 23).

The use of tobacco in both smoked and smokeless forms has been associated with a change in the normal commensal microflora of the oral cavity with the increased growth of *Streptococcus mutans, Streptococcus sanguis* and *Lactobacillus casei*. Smoking also increases caries susceptibility by a reduction in the buffering capacity of saliva, hence lowering salivary pH. Studies have reported increased collagenase activity that was observed adjacent to the area of tobacco quid placement that, together with specific microorganisms, destroyed the organic matrix of cementum. Chewable tobacco products also contain high quantities of sweeteners and sugars, increasing the chances of developing caries (23, 25). In the present study, the majority, i.e. 88.4% of the subjects, never consumed alcohol, whereas 9.5% were current alcohol consumers. The mean RCI (0.86) was the highest among subjects who were current alcohol users. These results corroborate the study conducted by Moreno *et al.,* (18).

In the study, Chen *et al.,* 2023 found *S.mutans* as the primary organism causing root caries in elderly patients, along with organisms like *S. sorbinus* and *Bifidobacterium* sp (25). These results were similar to those found in our study. In another Indian study, in comparison to the middle-aged group, older persons had a higher prevalence of both anaerobic bacteria (*Actinomyces* spp.) and aerobic Gram-positive cocci (*S. mutans, Lactobacillus*) in root carious lesions. Hence, it is evident that *S. mutans* is the primary organism responsible for root caries in all genders and ages (26).

The present study observed that subjects who had visited a dentist were less likely (mean RCI-0.41) to have root caries than those who did not (mean RCI-0.51), though significant associations could not be found. Visiting a dentist for preventive services, especially among older adults, is still a relatively new concept in India. Even when they visit the dentist occasionally, it is most likely for curative treatment rather than preventive services. However, since this is a cross-sectional study, the results could be inconclusive. Further longitudinal studies exploring the relationship between root caries and dental care utilization could be conducted.

Conclusion

The current study found the prevalence of root caries to be 20.8% in elderly people and influenced by gender, the habit of smoking, chewing tobacco, and consumption of alcohol. Also, age is a significant factor that plays a vital role in the deteriorating immune system, leading to root caries in elderly people. Public health strategies are necessary to revive the fight against caries and promote the prevention of future oral disease despite disagreements over the cause of the rise in caries. There are many different risk factors linked to the development of caries. The progression of future caries can be halted, and everyone's oral health can be improved by raising awareness of and promoting fluoridation of water, fluoride applications, emphasis on brushing teeth properly with a fluoride dentifrice, flossing, a healthy diet, and routine dental office visits. Hence, focusing on these factors would be a prudent way to tackle root caries. However, further studies should be planned to measure other factors influencing root caries among these population groups.

Abbreviations

Nil

Author's contribution

SCB and DS designed and conceptualized the study. SCB and RPD conducted the study and collected data. SCB SKS and BS analysed the data collected. RPD, DS, and SR drafted and finalized the manuscript. All authors critically reviewed the manuscript.

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Conflicts of interests

Nil

Ethical aprroval

This study was conducted after the approval of the Institute Ethical Committee, IMS & Sum Hospital, Bhubaneswar, Odisha Reference No DMR/IMS.SH/SOA/180316.

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