

Root Caries Prevalence and Associated Socio-Behavioral and Clinical Factors Among Elderly Patients Attending Selected Public Dental Clinics in Dar Es Salaam, Tanzania

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Abstract

Background: Root caries is an emerging dental health problem for elderly mostly because of increased life expectancy and improvement in oral health care, leading to higher retention of teeth, and hence increased number of exposed root surfaces susceptible to caries.

Objective: To determine the prevalence of root caries and associated sociodemographic, behavioral and clinical factors among elderly patients who attended dental clinics in selected public hospital in Dar es Salaam, Tanzania.

Methods: Elderly patients 60 years and above were interviewed to obtain socio demographic and behavioral factors. This was followed by clinical examination to assess teeth with root caries, gingival recession and oral hygiene of the patients.

Findings: The study involved 348 elderly with mean age of 76 SD \pm 6.2 years. Prevalence of root caries was 42.2% (n=147) and the mean root caries index was 6.77%, SD 9.6 (0.00 – 43.24). Multiple logistic regression analysis revealed that; older age (OR 1.8, CI 1.13 – 2.87), having higher level of education (OR 1.77, CI 1.1 – 2.93) and poor oral hygiene (OR 4.03, CI 2.3 – 6.98), significantly associated with having root caries. Across all the types of teeth, maxillary teeth were mostly affected by root caries than mandibular teeth.

Conclusion: The current study reveals high prevalence of root caries among the examined elderly patients. Socio-demographic as well as clinical factors contributed significantly to having root caries. Appropriate oral hygiene measures and prevention of gingival recession is recommended when providing oral health care for the elderly in Dar es Salaam.

Keywords: Elderly; Gingival recession; Older adults; Root caries; Root caries index; Tanzania

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Received Date: 01-24-2021

Published Date: 10-02-2021

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Background

Globally, an increase in the number of elderly populations is reported, even in low income countries and it is estimated that the elderly will mainly be living in this region [1]. This increase in life expectancy observed in many parts of the world has been attributable to the improvement in health care and preventive measures [1,2]. Similarly, improvement in oral health care has been reported, leading to a change in pattern of oral disease among this group of population, following provision of specialized dental care, growing dental awareness and the widespread use of fluoride containing tooth pastes, with preference to tooth retention [2,3].

Root caries is a multi-factorial condition that causes demineralization of root surface of teeth as a result of interaction between tooth, cariogenic bacteria, suitable carbohydrate and time [4]. The disease is considered the most common cause for tooth loss in the elderly after periodontitis, occurring when root surface is exposed to the oral environment for instance, due to gingival recession and mechanical injury [5]. It has been reported that up to 10–20% of root caries lesions occur sub-gingivally, thus portraying certain deferring clinical characteristics [6]. Symptoms such as pain or discomfort are not commonly associated with root caries and may therefore be noticed when in advanced stage [7].

Prevalence of root caries varies in between countries possibly due to variation in diagnostic criteria, differences geographical areas and age groups assessed [8,9]. Root caries is usually diagnosed while examining the teeth for other problems, primarily on traditional visual-tactile methods, and

later on confirmed with radiographs [7]. Recent systematic review and meta-analysis reveal mean prevalence of root caries among adults to range from 3.69% - 96.4%, with a pooled prevalence of 41.5% [9]. Majority of these studies were conducted in the middle- and high-income countries with very few from the African continent [9]. The scarcity of studies from Africa should be an impetus for gauging the magnitude of the problem of root caries for appropriate implementation strategies in this region.

A number of factors have been reported that contribute to the occurrence of root caries: sociodemographic factors including age, sex education and patient income; behavioral factors like tooth brushing frequency/ technique and smoking, as well as clinical factors [2,10,11]. The elderly also may suffer from systemic conditions that can result in decreased quantity and altered quality of saliva owing to disease itself or medication use [12]. On the same note, some chronic diseases contribute to limited efficiency to practice oral hygiene due to impaired functions such as cognitive deficits or manual dexterity [8].

With high retention of natural teeth, elderly patients are at risk of having complicated prostheses; and abutment teeth are likely to be affected by periodontal disease, gingival recession and root caries because they tend to be inadequately cleaned [13]. The later might pose a challenge to dental practitioners, especially in low income counties, due to limited resources both for specialized care; equipment and infrastructure [14]. In Tanzania the previous population survey (2012) showed the percentage of older people 65 years and above to have

increased compared to the previous survey of 2002 [15–17]. Before the conduction of this study, there was no retrievable data in Tanzania to that addresses the prevalence of root caries among the elderly and factors associated thereof, hence the conduction of this study. This study therefore set out to determine the prevalence of root caries, clinical characteristics and associated socio-demographic, behavioral and oral health factors, among elderly patients who attended selected public dental clinics in Dar es Salaam, Tanzania.

Materials and Methods

This was a hospital based cross-sectional study conducted in dental clinics of three hospitals in Dar es Salaam city namely: Kinondoni, Amana and Temeke Regional Referral Hospitals and; two dental clinics in Muhimbili National hospital (MNH) and Muhimbili University of Health and Allied Sciences (MUHAS). All elderly patients aged 60 years and above who attended for treatment at the selected dental clinics during the period of data collection (August 2017 to April 2018) were recruited into the study. Those who were edentulous, hearing or speech impairment that could affect the interview, mentally unstable and oral conditions such as tumors that could preclude oral examination were excluded. Furthermore, elderly patients aged 60 years and above attending the five selected dental clinics were conveniently recruited to participate in the study.

Data was collected from consented elderly participants using a structured pre-tested questionnaire by trained and calibrated research assistants. The interview schedule included questions on socio-demographic

details in terms of age, sex and level of education. Questions on behavioral characteristics in terms tooth brushing frequency, tobacco use, alcohol consumption, sugary diet and dental visiting behavior in the past one year. Also included in the questionnaire were questions on patient history of experiencing dry mouth, having systemic conditions and use of systemic medications. Following the interview clinical examination was conducted by one author (LT), on a dental chair with an overhead light; and the findings were recorded in a clinical examination form by an assistant. Root caries was assessed and scored as 0=no root caries, 1= discolored and no cavitation on the CEJ, 2= discoloration and cavitation on root surface. These were dichotomized into: 0=no root caries and 1=root caries (a combination of score 1 and 2). Furthermore, gingival recession was scored in actual millimeters (mm) according to Smith [18] whereby score 0=1–3mm, 1= 4–5mm and 2= ≥ 6mm. For analysis gingival recession was dichotomized into: 0=no gingival recession, while 1=Yes gingival recession included score 1 and 2. Root caries index a percentage of root surfaces for each study participant which are at risk of developing root caries for the next 24 months was scored based on the formula by Kartz [19] i.e. $RCI = \frac{(R-D) + (R-F)}{(R-D) + (R-F) + R-N} \times 100$, whereby, 0=R-N (recession with sound root surface); 1=R-D (recession with decayed root) and 2= R-F (recession with filled root surface). Oral hygiene was assessed by calculating the Mucosal Plaque Score (MPS) by Henriksen et al., [20]. Plaque score of 1=was recorded when no easy visible plaque was seen; score 2=small amount of visible plaque; score 3

=moderate amount of visible plaque and score 4 =abundant amount of confluent plaque was observed. For the Mucosal score: score 1= normal appearance of gingival and mucosa; score 2=mild inflammation; score 3=moderate inflammation and score 4=severe inflammation was observed. The Mucosal Plaque Score (MPS) was the sum of Plaque score and Mucosal, whereby: score range of 2 - 4 denoted good oral hygiene; score 5 - 6 denoted fair oral hygiene while score of 7 - 8 denotes poor oral hygiene. For statistical analysis, the variable was dichotomized in score 0=including those with good oral hygiene; and score 1=including those with poor and fair oral hygiene.

The collected data was analyzed using IBM SPSS Statistics for Windows, version 24.0 Armonk, NY: IBM Corp. The univariate analysis was used for frequency computations to calculate the prevalence and the clinical characteristics of root caries. Bivariate analysis for computing associations between the dependent and independent variables using the chi-square test, whereby, a p- value of less than 0.05 was considered statistically significant. Logistic regression analysis was used to determine the strength of associations between root caries and the different

demographic, behavioral and clinical variables.

Ethical clearance was obtained from the Research and Publications Committee of the Muhimbili University of Health and Allied Sciences (MUHAS). Permission to conduct the study was sought from the MUHAS Dental School, MNH authorities and the three hospitals (Kinondoni, Amana and Temeke Regional Referral Hospital in Dar es Salaam city.

Results

A total of 348 elderly patients aged 60 years and above attending the dental clinics in MUHAS and MNH; and three Dar es Salaam regional referral hospitals were interviewed and clinically examined. The mean age of participants was 76 years \pm 6.2 SD, ranging from 60 to 92 years and the female to male ratio of 1:0.7. The prevalence of root caries was 42.2% (n=147) and the mean Root Caries Index (RCI) was 6.77%, SD 9.6 (0.00 - 43.24). None of the examined teeth had filled root surfaces (R-F). As stipulated in Table 1, majority of the elderly patients belonged to age group 60 - 69 years (69.8%, n=243), female (58.6%, n=204), those who reported to have secondary education and above (74.1 %, n=258).

Table 1: Distribution of elderly patients' prevalence of root caries according to the socio-demographic details (frequency and chi-square statistics).

Socio-demography	Frequency % (n)	Root caries -Yes %(n)	p-value
Age: 60-69 years	69.8 (243)	37.9 (92)	0.008**
70+ years	30.2 (105)	52.9 (55)	
Sex: Female	58.6 (204)	39.7 (81)	0.152
Male	41.4 (144)	45.8 (66)	
Education: Low (None/1 ^o)	25.9 (90)	32.2 (29)	0.017*
High (\geq 2 ^o school)	74.1 (258)	45.7 (118)	
* p<0.05, **p<0.01			

Table 1 shows that advanced age of 70 years and above and higher level of education were statistically significant associated with having root caries (p-value of 0.008 and 0.017, respectively). Sex did not show statistically significant association with root caries (p-value=0.152).

Table 2 shows that, majority of the participants reported that they do not eat sugary diet (73.6%, n=256), and neither smoke (92.5%, n=322) nor consume alcohol

(76.7%, n=267). Similarly, only sixteen participants visited to a dentist in past one-year (4.6%), and 64.1% (n= 223) report to brush their teeth at least twice a day. As stipulated in table 2, Chi-square statistics on behavioral factors in terms of; consumption of sugary foods (p=0.185), tobacco smoking (p=0.074), alcohol use (p=0.469), dental visiting behavior (p=0.120) as well as toothbrushing (p=0.201) showed no statistically significant association with having root caries.

Table 2: Distribution of elderly patients' prevalence of root caries according to behavioral factors (frequency and chi-square statistics set at p<0.05).

Behavioral factors	Frequency % (n)	Root caries -Yes %(n)	p-value
Sugary diet: No	73.6 (256)	40.6 (104)	0.185 ^{ns}
Yes	26.4 (92)	46.7 (43)	
Tobacco smoking: No	92.5 (322)	41.0 (132)	0.074 ^{ns}
Yes	7.5 (26)	57.7 (15)	
Alcohol use: No	76.7 (267)	41.9 (112)	0.469 ^{ns}
Yes	23.3 (81)	43.2 (35)	
Visit to dentist: None:	95.4 (332)	43.1 (143)	0.120 ^{ns}
At least once	4.6 (16)	25.0 (4)	
Tooth brushing: once a day/none	35.9 (125)	45.6 (57)	0.201 ^{ns}
Twice or more	64.1 (223)	40.4 (90)	
^{ns} not statistically significant			

Clinical factors, as shown in table 3, reveal that majority of the elderly reported to have systemic diseases (75.3%, n= 262) and currently use systemic medication (73.9%, n=257). Moreover, majority of the examined elderly participants exhibited poor oral hygiene (71.8%, n=250) and gingival recession (98%, n=341). Fewer number of participants reported to have dry mouth (12.4%, n=43) and in possession of a dental prosthesis (7.2%, n=25). Cross tabulations to assess the association

between root caries and the clinical variables revealed that having systemic disease (p=0.419), use of systemic medication (p=0.409), having a prosthetic appliance of any type (p=0.207) and complaint of dry mouth showed no statistically significant association with having root caries. Patients assessment of oral hygiene (MPS) (p=0.000) and gingival recession (p=0.021) showed statistically significant relationship with having root caries.

Table 3: Distribution of elderly patients' prevalence of root caries according to clinical factors (frequency and chi-square statistics).

Clinical factors	Frequency % (n)	Root caries -Yes %(n)	p-value
Systemic disease: No	24.7 (86)	40.7 (35)	0.419
Yes	75.3 (262)	42.7 (112)	
Systemic medication: No	26.1 (91)	40.7 (37)	0.409
Yes	73.9 (257)	42.8 (110)	
Mucosal Plaque score: Fair	28.2 (98)	20.4 (20)	0.000**
Poor	71.8 (250)	50.8 (127)	
Gingival recession: No	2 (7)	0 (0)	0.021*
Yes	98 (341)	43.1 (147)	
Prosthesis: No	92.8 (323)	41.5 (134)	0.207
Yes	7.2 (25)	52.0 (13)	
Dry mouth: No	87.6 (305)	41.6 (127)	0.328
Yes	12.4 (43)	46.5 (20)	

* p < 0.05, ** p < 0.01

Multiple logistic regression analysis of the different sociodemographic, behavioral and clinical characteristics was conducted to the variables that were statistically significantly associated with root caries on bivariate analysis. As seen on table 4, older age (OR 1.8, CI 1.13 – 2.87), and having higher level of education (OR 1.77, CI 1.1 – 2.93) were at higher odds of having root

caries than their counter parts, younger age group and low level of education, respectively. Also, according to table 4, participants who were clinically observed to have poor oral hygiene (OR 4.03, CI 2.3 – 6.98) were more likely to have root caries than those with good oral hygiene, while none of patients without gingival recession had root caries (Table 3).

Table 4: Socio-demographic and clinical factors associated with root caries. Chi-square, odds ratio (OR) and 95% confidence interval (CI).

Variables	Root caries % (n)	OR (CI)	p-value
Socio-demography			
Age: 60-69 years	37.9 (92)	1	
70+ years	52.9 (55)	1.81 (1.13 – 2.87)	0.012*
Education: Low (None/1 ^o)	32.2 (29)	1	
High (≥ 2 ^o school)	45.7 (118)	1.77 (1.1 – 2.93)	0.026*
Clinical			
Mucosal Plaque score: Fair	20.4 (20)	1	
Poor	50.8 (127)	4.03 (2.3 – 6.98)	0.000**

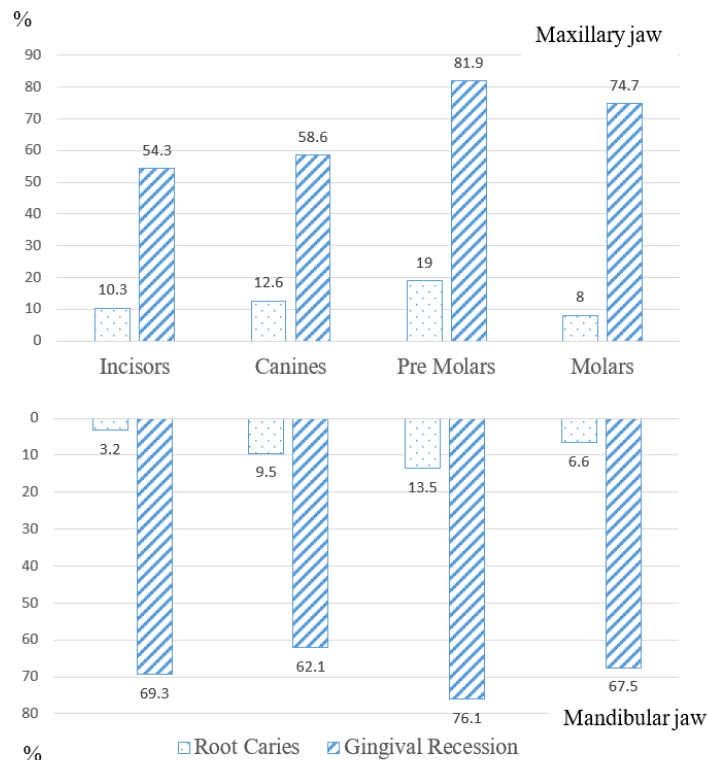
Figure 1 shows the distribution of the different types of teeth that were affected by gingival recession and root caries. The teeth most affected by gingival recession

were maxillary premolars (81.9%, n=285) followed by the mandibula premolars (76.1%, n=265), while the least affected were the maxillary Incisor teeth (54.3%,

n=189). Further to this, across all types of teeth, root caries was observed mostly on maxillary than mandibular teeth. Highest percentage of teeth affected by root caries were maxillary premolar teeth (19%, n=66)

followed by the mandibular premolars (13.5%, n=47) with the least affected teeth being the mandibular incisors (3.2%, n=11) (Figure 1).

Figure 1: Percentage distribution of maxillary and mandibular teeth with root caries and gingival recession



Discussion

In view of the strong indications that the elderly population is increasing in Tanzania similar to the trend worldwide, it is inevitable that dental problems associated with the elderly and future demand for dental services will also increase for this section of the society. This study which was carried out in selected dental clinics in Dar es Salaam utilized hospital-based data. This may somehow limit the generalization of the results for the whole of Tanzania. However, the

findings have yielded much-needed baseline data on root caries in the country which was not previously available. The prevalence of root caries among the elderly participants found in this study (42.2%) shows a fairly large percentage of the elderly in the city of Dar es Salaam to have root caries which need to be treated. This finding was similar to studies conducted among elderly in India [11], Japan [21] and China but lower than what was reported among elderly in Sri Lanka [22] and Mexico [23]. Considerably lower prevalence than the current findings was reported from

studies conducted in Turkey [24], Chiang Mai-Thailand [25] and Brazil [26]. The differences observed in the prevalence of root caries among the different elderly populations could be attributed to actual variations in geographical location, characteristics of participants studied, study designs or indices used to assess root caries [9]. In the present study, the lack of filled component (R-F) in root surface lesion upholds previous reports among Tanzanian population that the 'F' component of the Decayed Missing and Filled Teeth (DMFT) as negligible, recommending more effort to be put in place to increase dental visiting behaviors for restorative care [27,28]. The root caries index (RCI) of the elderly Tanzanians was similar to what was reported by Marino and colleagues, among Chilean older adults [29]. However, the results of the present analysis on RCI were higher than the report of Irish elderly [2] and lower than the Chinese elderly [10].

In this study root caries was most prevalent in the age group 70 years and above, indicating that the elderly become more vulnerable to root caries as they age. Similar results were reported in previous community as well as hospital based studies [11,25,30]. The authors cited decline in oral health that is common with old age, for instance, poor oral hygiene, increase in gingival recession as the main reason rather than the aging process per se [3]. The findings in this study on lack of significant difference between males and females corroborates with previous findings by Udoye and colleagues [30]. These results though, were in disagreement with a study by Nicolau and colleagues [25] and Watanabe's [31] findings, which reported male and female predominance,

respectively. The lack of association between sex and root caries occurrence might indicate the need for further investigations to Tanzanian general population. Level of education in this study was used as a proxy for social class among the elderly patients. The results that the Tanzanian elderly with higher level of education were at higher odds of having root caries was unexpected, since having higher education was expected to correlate with higher levels of awareness on prevention of oral disease and hence less disease burden [10]. In previous studies among Tanzanian elderly in urban and rural Tanzania low levels of knowledge on causes and prevention of dental caries and periodontal disease were reported [32]. This entails that, oral health related education and promotion programs targeting elderly are recommended.

About a quarter of the participants reported to consume sugary items (26.4%) and alcohol (23.3%); with about 7.5% of them reported the use of tobacco of different forms. None of these behavioral factors significantly associated with root caries (Table 2), unlike previous reports [11,33]. The lack of association of root caries and consumption of sugary foods is similar to what has been reported before among Danish adults [34]. In the same study by Christensen and co-workers, alcohol consumption lacked positive association with active root caries [34]. There may be a number of possible reasons for these results including: method of collecting information which was based patient recall, study population majority of whom have systemic disease or use systemic medication hence might have lifestyle that differ from main population. Contrary to what has been reported previously tobacco

use did not show association with development of root caries among elderly examined here [11,34]. The current study being hospital based might have involved participants with similar behavioral characteristics that might have concealed the association. It is therefore advocated to conduct community-based studies that consider the type and amount of sugary foods, alcohol and tobacco, among elderly in Tanzania in order to confirm this lack association of the different behavioral variables on root caries prevalence. The habit of not attending to dental clinics has been reported previously, to be associated with having root caries [24,30]. In this study, only 16 elderly (4.6%) reported to have attended dental clinic in the past year. Taking into consideration that root caries does not instill symptoms and the fact that attendance to dental clinics among most Tanzanians is said to be symptom driven, signifies a higher burden of root caries than what is reported in the current study [35]. Root caries is mostly diagnosed during regular dental checkup, the habit that is lacking among the elderly examined in this study. This entails more emphasis should be put to encourage elderly to attend dental clinics for early diagnosis of root caries and treatment. Proper tooth brushing aiming at reducing plaque formation is effective in preventing root caries. In the current study, majority of the elderly (64.9%) reported to brush their teeth at least twice a day and this variable was not statistically significantly associated with root caries. Information on tooth brushing behavior relied on participants' report, hence the participants might have overstated their brushing behavior, hence might have affected the association. This is because high number of elderly patients

were observed with poor oral hygiene (71.8%) (Table 3) despite the high prevalence of reported tooth brushing, also reported in previous studies among Tanzanian older adults [35]. Another possibility could be poor technique of tooth brushing performed by the elderly which was not inquired in this study, hence limiting explanation of current outcomes.

Majority of the elderly reported to either have or use medication for, systemic disease/conditions, which might make them at a greater risk for oral diseases/conditions. Studies have revealed association between use of systemic medications with development of root caries. Most systemic medications and diseases are responsible for reduced salivary flow, reduced salivary cleansing effects and hence caries development especially root caries [12]. This association of systemic disease, systemic medication and xerostomia as independent variables with root caries was not observed among the elderly in this study, warranting further investigations. This study revealed a high prevalence of poor oral hygiene (Table 3) among the elderly patients, slightly higher than what has been reported among Tanzanian elderly before [35,36]. Poor oral hygiene was statistically associated with having root caries among elderly in this study, similar to what has been reported by Hayes et al., [2] and other researchers [37] which underpins the role of plaque in development of root caries among the elderly. As expected, in the current study, elderly patients with gingival recession were significantly at higher odds of having root caries, since recession is considered a prerequisite for development of root caries hence a possible reason for the association [25]. According to Figure 1, the distribution

of root caries prevalence consistently followed a similar pattern as gingival recession revealing a close resemblance with that of gingival recession in most teeth examined.

In the current study, very few elderly patients were in possession of a dental prosthetic appliance of any type, similar to what has been reported previously among Tanzanian adults [38]. The presence of tooth restoration or a dental prosthetic appliance has been linked to increased susceptibility to caries development [3,33,34]. Though the prevalence of root caries among the participants with dental prosthetic appliance was in the expected direction, the association was not statistically significant (Table 3). With expected increasing awareness on different dental treatment options and demand for restorative treatment (including dental prosthetic appliances), efforts to improve oral hygiene measures and care for restorations and prosthesis should be reinforced. Regarding the specific types of teeth affected by root caries, lower incisor teeth have been observed before to be least susceptible to root caries as in the current report [31]. Similar to the current finding, premolar teeth were reported to be more affected teeth by a study in Chile [29] unlike other studies that reported molars being the most commonly affected teeth

[8,24]. This is in conformity with the findings of previous studies which indicated that it could be due to the comparatively low frequency of extraction of premolar teeth compared to molar teeth [29].

Conclusion

It was evident from this study that the prevalence of root caries among the elderly patients attending public dental clinics in Dar es Salaam, Tanzania, was high. Increasing age, higher level of education, gingival recession and poor oral hygiene were factors which contribute to the prevalence of root caries. In order to preserve elderly dentition throughout their life, oral health promotion and disease prevention strategies should be reinforced, in order to reduce plaque accumulation, occurrence of gingival recession and consequently root caries, as well as encouraging dental visiting behaviors for routine checkup for early detection of root caries.

Conflict of interest

Authors declare no conflict of interest. This work is dedicated to the memory of our dear mentor and colleague, late Prof. Bakari Salim Lembariti, who passed away suddenly on 20th December, 2020.

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