Comparative study of risk indicators associated with tooth loss among adult population in urban and rural areas of Muradnagar, Ghaziabad, Uttar Pradesh, India

Deepa Tomar[1], Ipseeta Menon[1], Avnish Singh[2], Upasana Tyagi[1], Deepak Passi[3], Jyoti Goyal[1]

[1]Department of Public Health Dentistry, I.T.S. Centre for Dental Studies and Research, Muradnagar, Ghaziabad, Uttar Pradesh, [2]Department of Public Health Dentistry, Seema Dental College and Hospital, Rishikesh, Uttarakhand, [3]Department of Dentistry, Subdivisional Hospital, Bundu, Ranchi, Jharkhand, India

Abstract

Background: Oral health objectives prescribed by World Health Organization for the year 2020 have expressed that there ought to be an expansion in the quantity of people with functional dentitions (at least 21 common teeth) at ages of 35–44 and 65–74 years. **Aim:** The aim of this study is to examine the prevalence of tooth loss and to evaluate and compare the risk indicators associated with tooth loss among adult population in urban and rural areas of Muradnagar, Ghaziabad. **Materials and Methods:** A cross-sectional study was led among 1200 adults aged 35–74 years in urban and rural areas of Muradnagar, India. Information was assembled by an interview followed by clinical examination (number of missing teeth). Demographic and socioeconomic factors and self-perceived oral health were the independent variables assessed. One-way analysis of variance, post-hoc test (Bonferroni), Chi-square test, Student's *t*-test, and logistic regression analysis were used for statistical analysis. **Results:** Low educational status, no dental check-ups, low frequency of brushing, older age, and smoking habit were independent risk factors for tooth loss. The odds of tooth loss in older adults and illiterates were higher; the odds for tooth loss among those who expressed their desire for replacement of missing teeth were 1.3 times lower than their counterparts. **Conclusion:** The experiences gained up showed that tooth loss was very pervasive in Muradnagar populace and the critical hazard indicators identified were age, education, socioeconomic status, and cigarette smoking.

Keywords: Edentulous, elderly, Ghaziabad, oral health knowledge, risk indicator, tooth loss

Introduction

Tooth loss is the aftereffect of complex connection of variables, of which the clinical state of the tooth like caries, periodontal ailment, or injury may just be the activating components, instead of the one single purpose behind the loss of teeth.[1] It is said to fluctuate by age, sex, race, education, pay, and geographic district. Tooth loss impedes the personal satisfaction, regularly generously, and influences the prosperity of the individual.

Tooth loss diminishes masticatory work, limits sustenance, influences phonation, and causes an esthetic detriment that may finish in mental aggravation.[2] These arrangements of results in the daily schedule of individuals' lives add to a decrease in the quality of life. The essential markers of tooth loss are dental caries and periodontal disease.[3] However, different elements are likewise identified with this result, for example, increased age, low financial status, and trouble to access the dentistry administrations.[4] Most of these reviews were comparative as they examined the measure of tooth loss, the purposes for extraction, and the dissemination of tooth loss as indicated by age, sexual orientation, and tooth type.[5]

Address for correspondence: Dr. Deepak Passi, Department of Dentistry, Subdivisional Hospital, Bundu, Ranchi, Jharkhand, India.
E-mail: drdeepakpassi@gmail.com

Access this article online

Quick Response Code:

Website:
www.jfmpc.com

DOI:
10.4103/jfmpc.jfmpc_409_18

Tooth loss is an imperative oral medical issue among Indian individuals that demonstrates the propensity to expanded seriousness as time passes.[6,7] In this manner, the recognizable proof of tooth loss chance markers in specialists is a vital general well-being measure. Notwithstanding clinical causes, different components have been related with tooth loss, for example, the dental administration utilized, time since the last visit to the dental specialist, purpose behind looking for treatment, and way of life, statistic, and financial factors.[8]

The most reliable discoveries tending to the issue recommend age, sex, financial status, social qualities toward oral well-being, and other organic and conduct factors as affecting tooth loss. Achievement is estimated by the declining rates of edentulous and an expansion in the quantity of retained teeth.[9] The loss of teeth happens regularly because of traumas or caries movement and takes much less time because of genetic formative imperfections, for example, tooth abnormality or hypodontia. Poor oral cleanliness, tobacco smoking, and high alcoholic utilization are thought to be synergistic hazard factors. As it were, their counteractive action and control rely upon a man's way of life and behavior.[10] Studies have demonstrated that subjects of low salary and education will probably be edentulous than their partners. The connection between sort of living space (urban and rustic territories) and tooth extraction reasons are exceptional intrigue.[11]

From the literature review it was found that no studies have been done in past on Muradnagar adults regarding risk indicators tooth loss. Subsequently, an endeavor has been made to investigate chance components related with tooth loss among the number of inhabitants in Muradnagar square, Ghaziabad, India.

Materials and Methods

The survey was conducted on 1200 residents of Muradnagar block aged 35–74 years (600 were males and 600 were females). The investigation was done in both urban and rural zones. Individuals who gave the consent were incorporated into the investigation. *Ethical clearance from the institutional ethical committee*: Data collection proforma was divided into two parts; first part was used to obtain information about variables like regarding the subject's personal details, sociodemographic characteristics, oral hygiene practices, habits oral health knowledge, availability and utilization of dental services and self-perceived oral health, and need for treatment. The second part contains indices like Community Periodontal Index and Dentition Status (2013). Questionnaire validity was checked by Cronbach's alpha and the value of alpha for this study is 0.83.

A multistage sampling was done. To obtain complete representation of the sample, Muradnagar block was divided into urban and rural areas. The urban and rural areas were further divided into gram-panchayat (rural) and nagar parishad (urban area), respectively, according to administrative division of Muradnagar block. The gram-panchayat was further divided into the villages. In rural part, total number of gram-panchayats is 45

and total number of villages is 61; the urban area constitutes a total of 25 wards. The ward for the urban area and the villages for the rural area were taken as the sampling unit. To obtain the required sample size, 15 gram-panchayats were randomly selected in rural area, from where 15 villages were further randomly selected for survey. In the urban area, all 15 wards were selected for the survey to obtain the required sample size. From each division, 600 individuals were selected (600 urban and 600 rural) in urban areas, 300 males and 300 females, and the same criteria were followed for rural areas.

Subjects falling within the stipulated age range, who agreed to participate in the research and were cooperative, were included. Physically and mentally challenged subjects, with supernumerary teeth not having the cognitive ability to answer the questionnaire, and subjects who have not given consent were excluded from study.

Descriptive statistical analysis was carried out in the present study. SPSS software version 20 was used. The variables were assessed for normality using the Kolmogorov–Smirnov test. Chi-square test, Student's *t*-test, and one-way analysis of variance with Bonferroni post-hoc test were used to assess bivariate relationships. Multivariate analysis was used to assess the relative importance of independent variables and to identify the main variables influencing tooth loss. All the risk indicators were dichotomized and employed as independent variables in multiple logistic regression estimating values of odds ratio or/and the respective 95% confidence interval (CI). Goodness of fit was assessed by means of Hosmer and Lemenshow test. Statistical significance was set at $P \leq 0.05$.

Results

The study sample comprises 1200 subjects aged 35–74 years with equal numbers belonging to urban and rural area. Table 1 shows that 515 (42.9%) did not have any loss of teeth, 64 (5.3%) had completely edentulous, and 621 (51.8%) had partially edentulous, in which 306 (51%) were partially edentulous and 265 (44.2%) had no tooth loss from urban population. In rural population, 315 (52.5%) had partially edentulous and 35 (5.8%) had completely edentulous arches [Table 1].

In Graph 1, mean tooth loss experience was increased with the rise in age. Mean tooth loss age group, lowest seen in 35–44 years age group, was 1.4 ± 3.1 in rural population as compared to

Mean	35-44	45-54	55-64	65-75
Urban	1	2.6	5.2	10.7
Rural	1.4	2.6	5.6	12
Overall	1.2	2.6	5.4	11.5
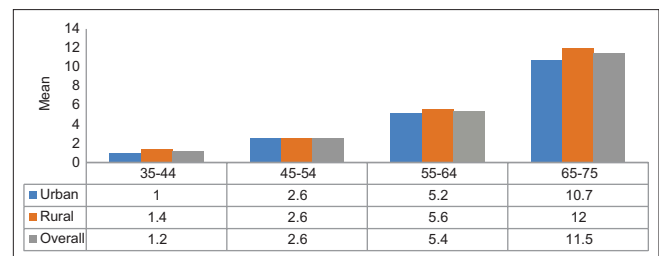
Graph 1: Distribution of mean tooth loss in relation to age group and place of residence among study population

Table 1: Prevalence of tooth loss according to place of residence and gender						
Place of residence	Gender	No tooth loss	Completely edentulous	Partially edentulous	Chi-square	P
Urban	Male	121 (40.3)	16 (5.3%)	163 (54.4%)	3.6138	0.164
	Female	144 (48%)	13 (4.3%)	143 (47.7%)		
	Total	265 (44.2%)	29 (4.8%)	306 (51%)		
Rural	Male	110 (36.7%)	20 (6.7%)	170 (56.6%)	6.298	0.04
	Female	140 (46.7%)	15 (5%)	145 (48.3%)		
	Total	250 (41.7%)	35 (5.8%)	315 (52.5%)		
Overall	Male	231 (38.5%)	36 (6%)	333 (55.5%)	9.71	0.001*
	Female	284 (47.3%)	28 (4.7%)	288 (48%)		
	Total	515 (42.9%)	64 (5.3%)	621 (51.8%)		

Chi-square test. *$P \leq 0.05$ is statistically significant

1 ± 2 in urban population. Male mean tooth loss was 3.9 ± 7 and 3.2 ± 6.5 was in female of urban population [Table 2].

Mean tooth loss experience shows statistically highly significant difference according to marital status and place of residence. Tooth loss experience decreases as education level increases. Tooth loss experience increases as level of socioeconomic status increases [Table 3].

About 921 (76.7%) of overall population used toothbrush with paste for cleaning of teeth as compared to 110 (9.2%) of population who used fingers and other materials [Graph 2].

Overall, maximum number of 663 (55.2%) used smoked form of tobacco, whereas 198 (16.5%) used chewing form. In rural population, 554 (90.7%) had smoking habit and 135 (22.5%) had tobacco chewing habit. In urban population, it reduced to 119 (19.8%) who had smoking habit, whereas only 63 (10.5%) of population had chewing habit [Graph 3].
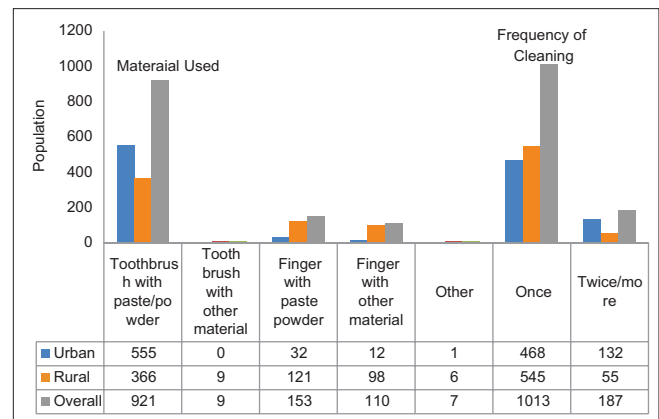
Table 4 represents tooth loss in relation to the oral health knowledge and attitude among the study population. Overall, 756 (63%) of population believed that loss of teeth is normal with increasing age. Maximum is observed in rural population. In a similar table, attitude of population showed that 687 (57.2%) desired to get replacement of their missing teeth. In urban population, 364 (60.7%) desired to get replacement of missing teeth, whereas 236 (39.3%) did not have the desire to get it. In rural population, 323 (53.8%) desired its replacement, but 277 (46.2%) did not want it. Overall, 579 (48.2%) of population utilized the service. Total and rural category results showed statistically highly significant difference ($P = 0.001$), but rural group showed not statistically significant difference ($P = 0.01$).

Dental facilities, which were considered, were none, government hospital, private clinics and dental college. Overall, 527 (43.9%) did not utilize any dental facilities. Extraction of teeth was a major cause for dental visit by subjects (nearly 41%). Overall, 396 (33%) did not go for treatment due to financial reasons. In urban population, 345 (57.5%) did not go for treatment due to financial reason (financial), whereas 6 (1%) did not have any dentist nearby. In rural population, 328 (54.7%) did not utilize

Table 2: Distribution of mean tooth loss in relation to age group and gender with place of residence among study population					
	Urban		Rural		Overall	
	Mean±SD	P	Mean±SD	P	Mean±SD	P
Age (years)						
35-44	1±2	0.001*	1.4±3.1	0.001*	1.2±2.6	0.001*
45-54	2.6±5.1	F=49.27	2.6±5	F=63.13	2.6±5	F=117.4
55-64	5.2±7.9		5.6±7.9		5.4±7.9	
65-75	10.7±11.3		12±10.8		11.5±10.9	
Gender						
Male	3.9±7	0.05	5.5±8.2	0.05	4.7±7.7	0.01*
Female	3.2±6.5	t=1.27	3.9±7.2	t=2.54	3.6±6.9	t=2.61

Student's *t*-test and one-way analysis of variance with Bonferroni post-hoc test. *$P \leq 0.05$ is statistically significant

	Toothbrush with paste/powder	Tooth brush with other material	Finger with paste powder	Finger with other material	Other	Once	Twice/more
Urban	555	0	32	12	1	468	132
Rural	366	9	121	98	6	545	55
Overall	921	9	153	110	7	1013	187

Graph 2: Distribution of oral hygiene practices among population according to place of distribution

dental facilities as no dentists were available nearby, whereas 51 (8.5%) had financial reasons. Nearly 56% of study subjects self-perceived no problem in oral health, 489 perceived that they need treatment, and 711 thought they do not need any treatment [Table 5].

The odds of tooth loss in adults aged over 55 years were nearly 1.1 times higher than those for adults aged less than 55 years. Married adults showed about 82% odds than unmarried subjects. The odds were 1.1 times higher in illiterates than literates. In people with monthly income of less than Rs. 10,000, the odds
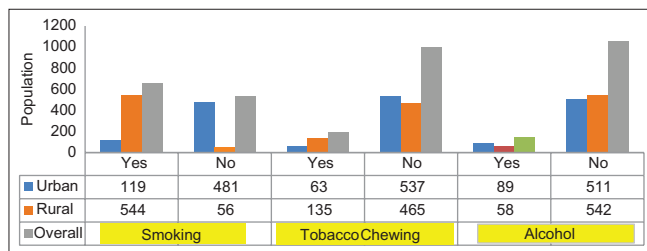
Table 3: Prevalence of tooth loss respect to marital status, educational status, and socioeconomic status among study population

	Urban		Rural		Overall	
	n (%)	P	n (%)	P	n (%)	P
Marital status						
Married	548 (91.3%)	0.001*	554 (92.3%)	0.001*	102 (91.8%)	0.001*
Unmarried	25 (4.2%)	F=8.704	11 (1.9%)	F=26.09	36 (3%)	F=36.49
Widow/Widower	27 (4.5%)		35 (5.8%)		62 (5.2%)	
Educational status						
Illiterate	60 (10.0%)	0.001*	200 (33.3%)	0.001*	260 (21.7%)	0.001*
Primary school certificate	126 (21.0%)	F=11.95	195 (32.5%)	F=3.64	321 (26.7%)	F=15.3
Middle school certificate	5 (0.8%)		29 (4.8%)		34 (2.8%)	
High school certificate	191 (31.9%)		135 (22.5%)		326 (27.2%)	
Intermediate/Post-high-school diploma	50 (8.3%)		10 (1.7)		60 (5.0%)	
Graduation and above	150 (25.0%)		27 (4.5%)		177 (14.8%)	
Professor/Honors	18 (3.0%)		4 (0.7%)		22 (1.8%)	
Socioeconomic status						
I	243 (40.5%)	0.05*	31 (5.2%)	0.05*	274 (22.8%)	0.001*
II	136 (22.7%)	F=3.08	69 (11.5%)	F=2.49	205 (17.1%)	F=7.12
III	114 (19%)		86 (14.3%)		200 (16.7%)	
IV	64 (10.7%)		154 (25.7%)		218 (18.2%)	
V	43 (7.1%)		260 (43.3%)		303 (25.2%)	

Student's *t*-test and one-way analysis of variance with Bonferroni post-hoc test. *$P \leq 0.05$ is statistically significant

Table 4: Tooth loss in relation to oral health knowledge and attitude among the study population

	Urban		Rural		Overall	
	n (%)	P	n (%)	P	n (%)	P
Belief that losing teeth is normal with increasing age						
Yes	359 (59.8%)	0.04	397 (66.2%)	0.01	756 (63%)	0.001
No	84 (14%)	t=3.62	93 (15.5%)	t=6.13	177 (14.8%)	t=8.80
Did not respond	157 (27%)		110 (18.3%)		267 (22.2%)	
Utilization of dental services						
Yes	350 (58.3%)	0.001	229 (38.2%)	0.01	579 (48.2%)	0.001
No	250 (41.7%)	t=5.74	371 (61.8%)	t=4.42	621 (51.8%)	t=6.27
Desire for replacement of missing teeth						
Yes	364 (60.7%)	0.001	323 (53.8%)	0.21	687 (57.2%)	0.001
No	236 (39.3%)	t=4.83	277 (46.2%)	t=1.27	513 (42.8%)	t=3.36

	Yes	No	Yes	No	Yes	No
Urban	119	481	63	537	89	511
Rural	544	56	135	465	58	542
Overall	Smoking		Tobacco Chewing		Alcohol	

Graph 3: Distribution of tobacco practice among population according to place of residence

were nearly double than the higher income group. Similarly, 87% odds were observed in smokers than nonsmokers. Variance in the number of missing teeth was also ascertained among the adults utilizing dental care services (OR = 0.964). Finally, the odds for tooth loss among those who expressed their desire for replacement of missing teeth were 1.3 times lower than their counterparts [Table 6].

Table 7 reveals the relationship between clinical indicators with tooth loss which was not found to be significant.

Discussion

The demography of the industrialized world has changed extensively in ongoing decades with a quickly expanding number of elderly people. One of which is tooth loss among elderly populace. The connection between oral health and tooth maintenance is complex.[12]

The rate of edentulous is evaluated at 30% for African-Americans, American-Indians, or Alaska Natives for this age group, 26% for Caucasians, and 24% for Hispanic. Complete edentulism is an international problem, particularly in the 65 years and older age groups; the conditions do not appear to be concentrated in developing countries, as Ireland (48.3%), Malaysia (56.6%), the Netherlands (65.4%), and Iceland (71.5%) report some of the highest levels.[13]

Table 5: Distribution of subjects' responses regarding utilization of dental services

	Urban	Rural	Overall	Chi-square test	*P*
Dental facilities					
None	1 (0.2%)	526 (87.7%)	527 (43.9%)	954	0.001
Govt. hospital	9 (1.5%)	11 (1.8%)	21 (1.75%)		
Private clinic	94 (15.6%)	6 (1%)	99 (8.25%)		
Dental college	387 (64.5%)	56 (9.3%)	443 (36.9%)		
More than one dental treatment facility	109 (18.2%)	1 (0.2%)	110 (9.2%)		
Reason for utilization					
Consultation	26 (4.4%)	5 (0.8%)	31 (2.6%)	238.8	0.001
Filling	62 (10.3%)	18 (3%)	80 (6.7%)		
Extraction	248 (41.3%)	438 (73%)	686 (57.2%)		
Gum problem	34 (5.7%)	8 (1.4%)	42 (3.5%)		
Cleaning	138 (23%)	5 (0.8%)	143 (11.9%)		
Tooth replacement	69 (11.5%)	106 (17.6%)	175 (14.6%)		
Combination of above	23 (3.8%)	20 (3.4%)	43 (3.5%)		
Reason for nonutilization					
No dentist nearby	6 (1%)	328 (54.7%)	334 (27.8%)	238.8	0.001
Fear of pain	82 (13.7%)	2 (0.3%)	84 (7%)		
Economic reasons	345 (57.5%)	51 (8.5%)	396 (33%)		
Transportation problems	53 (8.8%)	15 (2.5%)	68 (5.7%)		
Other priorities	61 (10.2%)	0	61 (5.1%)		
Feeling that they do not have any problem	35 (5.8%)	199 (33.2%)	234 (19.5%)		
Combination of above	18 (3%)	5 (0.8%)	23 (1.9%)		
Self-perceived oral health					
No problem	298 (49.7%)	378 (63%)	676 (56.3%)	32.2	0.001
Tooth decay and pain	102 (17%)	104 (17.3%)	206 (17.2%)		
Gum problem	108 (18%)	72 (12%)	180 (15%)		
Others	92 (15.3%)	46 (7.7%)	138 (11.5%)		
Self-perceived need of treatment					
Treatment needed	309	180	489	56.549	<0.001
Treatment not needed	291	420	711		

Table 6: Estimates of multiple logistic regressions for variables affecting tooth loss

Variables	Category	Odds ratio	95% Confidence interval
Place of residence	Urban	0.741	0.414-1.598
	Rural		
Age (years)	>55	1.106*	0.924-1.536
	≤55		
Gender	Male	1.033	0.843-1.445
	Female		
Marital status	Married	0.825*	0.60-1.408
	Unmarried		
Education	Illiterate	1.121*	0.818-1.535
	Literate		
Socioeconomic status	≤10,000	1.769*	1.347-2.612
	>10,000		
Smoking	No	0.868*	0.614-1.365
	Yes		
Frequency of cleaning teeth	≥2	0.852*	0.633-1.347
	<2		
Utilization of dental services	Yes	0.964*	0.507-1.898
	No		
Desire for tooth replacement	Yes	1.259	1.13-1.789
	No		

*Indicates statistical significance at *P*<0.05

The mean number of missing teeth was lower in correlation with investigation done by Reddy *et al.*[14] in Davangere Taluk, Karnataka, India. Similar discoveries were accounted in consideration led by Deepthi *et al.*[15] and Al Shammari *et al.*[16] In the present investigation, mean tooth loss age group was 35–44 years, similar to the studies in Sri Lanka[17] and China.[18] The present investigation revealed that 55% of the elderly (65–74 years) were completely edentulous. This is less when compared with the investigations conducted in China[18] and Sudan.[19] Tooth loss and age are specifically related in this study; yet, it is lower than that found in the National Oral Health Survey of India.[20]

Greater tooth loss among the more elderly age group might be because of the combined impact of dental maladies and absence of oral social insurance measure. It might reflect numerous things that well-established individuals may have encountered in their past, for example, high prevalence and rate of oral diseases. The attitude of the rural people is generally such that they elect to have their symptomatic teeth extracted rather than conserving those.[11]

The level of education related to tooth loss is also significant. This outcome broadens the finding of past inquiries about the

Table 7: Relationship between clinical indicators with tooth loss

	Clinical indicator [% (*n*)]	Odds ratio	*P*
Urban	CPI ≥1 [67 (402)]	1.125	0.53
	CPI=0 [33 (198)]		
Rural	CPI ≥1 [73.25 (441)]	1.211	0.597
	CPI=0 [26.75 (159)]		

CPI: Community periodontal index

recording that lower education level is related to higher number of missing teeth.[16,21] In the present investigation, females had fewer missing teeth than males. This could be because females in urban area had a better access to treatment and were more aware of their appearance. Warren *et al.* found that individuals, particularly females, living in urban populace (52%) were to the least extent liable to be edentulous than country populace (48%).[22] Although comparable perception was found in other studies, a couple of studies have demonstrated female prevalence and furthermore no distinction in tooth loss.[13,14]

Higher social class individuals demonstrated less predominance of tooth loss which was comparatively revealed in different investigations additionally.[1,20] Specifically, people of lower social classes tend to put almost no incentive of oral health. They give next to zero significance for conservation of their teeth for the whole lifetime and lean toward extraction over restoration. The beneficial outcome of cleaning the teeth with tooth brush twice a day bringing about more noteworthy tooth maintenance is steady with the consequences of different examinations.[23]

On contrasting the urban and rural individuals, tooth loss was observed to be essentially higher among smokers of rural territory. This may be because of the way the individuals in urban zone smoke cigarettes, which are moderately less destructive contrasted with beedis generally smoked by the rural individuals. This perception is in concurrence with aftereffects of some other studies.[7,9] A conceivable clarification may be that the health convictions of the people are affected by a scope of components like essential and auxiliary socialization which generally directs the human practices and qualities. Similar findings were seen in Hong Kong, the United Kingdom, and China.[24] The low level of utilization of dental services suggests that people tend to overestimate their dental health and underestimate their need for care, and those who underestimate their own dental care need to utilize the services less frequently.[16]

Thus, the mean number of missing teeth among dental service users was higher than their counterpart, which affirms that most dental treatments intend to mitigate the results of dental infections, instead of keeping the beginning or course of the ailment itself. This finding is in concurrence with the results received in previous researches,[24] however different from various studies which have affirmed that nonusers of dental services had more prominent number of missing teeth.[6,7]

The maturing populace is expanding – one out of nine people worldwide are of 60 years and above, and it is anticipated that by 2050, this will increase to one out of five individuals in developing countries.[25]

These results emphasize the importance of good oral health habits, such as frequent tooth brushing, routine dental check-ups, and no smoking, and indicate that more appropriate and compulsory education regarding oral health is needed to lessen the education level-derived differences in oral health.[26,27] Although dental caries and periodontal maladies are the fundamental explanations behind tooth loss, other adjusting variables, for example, social convictions, financial attributes, access to dental consideration, eating regimens, dental trauma conduct qualities, and dental professional's theory of treatment, may impact the dental conduct.

Conclusion

The discoveries of this study give a knowledge into the prevalence of tooth loss which was seen to be higher among rural than urban population in Muradnagar district, Ghaziabad. The related sociodemographic hazard indicators in charge of expanded tooth loss included age, unskilled people, and low financial status groups. This epidemiological information affirms the requirement for network-based oral health advancement and disease-prevention programs designed to reduce the risk for tooth loss in these comparative populaces.

Financial support and sponsorship

Conflicts of interest

There are no conflicts of interest.

References

1. Jaleel BF, Nagarajappa R, Mohapatra AK, Ramesh G. Risk indicators associated with tooth loss among Indian adults. Oral Health Dent Manag 2014;13:170-8.

2. Trulsson U, Engstrand P, Berggren U, Nannmark U, Brånemark P-I. Edentulousness and oral rehabilitation: Experiences from the patients' perspective. Eur J Oral Sci 2002;110:417-24.

3. Roumanas ED The social solution-denture esthetics, phonetics, and function. J Prosthodont 2009;18:112-5.

4. Susin C, Haas AN, Opermann RV, Albandar JM. Tooth loss in a young population from south Brazil. J Pub Health Dent 2006;66:110-5.

5. Preethanath RS. Reasons for tooth extraction in urban and rural populations of Saudi Arabia. Pakistan Oral Dent J 2010;30:199-204.

6. Slade GD, Gansky SA, Spencer AJ. Two-year incidence of tooth loss among South Australians aged 60+ years. Community Dent Oral Epidemiol 1997;25:429-37.

7. Locker D, Ford J, Leake JL. Incidence of and risk factors for tooth loss in a population of older Canadians. J Dent Res 1996;75:783-9.

8. Batista MJ, Rihs LB, Sousa MD. Risk indicators for tooth loss in adult workers. Braz Oral Res 2012;26:390-6.

9. Corraini P, Baelum V, Pannuti CM, Pustiglioni AN, Romito GA, Pustiglioni FE. Tooth loss prevalence and risk indicators in an isolated population of Brazil. Acta Odontol Scand 2009;67:297-303.

10. Gerritsen AE, Allen PF, Witter DJ, Bronkhorst EM, Creugers NHJ. Tooth loss and oral health-related quality of life: A systematic review and meta-analysis. Health Qual Life Outcomes 2010;8:126.

11. Batista MJ, Gonçalves JR, Hilgert JB, Hugo FN, de Sousa MD. Tooth loss in adult workers according different indicators in a hierarchical approach. J Adv Oral Res 2014;5:28-35.

12. Henriksen BM, Axell T, Laake G. Geographic differences in tooth loss and denture wearing individuals among the elderly in Norway. Community Dent Oral Epidemiol 2003;31:403-11.

13. Felton D. Edentulism and commorbid factors. J Prosthodontics 2009;18:88-96.

14. Reddy PS, Reddy ASK, Jain AR, Pradeep R. Tooth loss prevalence and risk indicators in an isolated population of Kadapa, South India. Am J Public Health Res 2014;2:221-5.

15. Deepthi A, Chandrasekhar Reddy V, Sudhir KM, Krishna Kumar RV, Srinivasulu S, Srinivas N. An epidemiological data of oral health status and treatment needs of rural population of Nellore district, Andhra Pradesh, India. J Indian Assoc Public Health Dent 2016;14:281-6.

16. Ekanayaka A. Tooth mortality in plantation workers and residents in Sri Lanka. Community Dent Oral Epidemiol 1984;12:128-35.

17. Al-Shammari KF, Al-Ansari JM, Al-Melh MA, Al-Khabbaz AK. Reasons for tooth extraction in Kuwait. Med Princ Pract 2006;15:417-22.

18. Wen-Min L, Baelum V, Xia C, Fejersko O. Tooth mortality and prosthetic treatment patterns in urban and rural Chinese aged 20-28 years. Community Dent Oral Epidemiol 1989;17:221-6.

19. Atieh MA. Tooth loss among Saudi adolescents: Social and behavioural risk factors. Int Dent J 2008;58:103-8.

20. Khalifa N, Allen PF, Abu-bakr NH, Abdel ME Factors associated with tooth loss and prosthodontic status among Sudanese adults. J Oral Sci 2012;54:303-12.

21. Kida IA, Astrøm AN, Strand GV, Masalu JR. Clinical and socio-behavioral correlates of tooth loss: A study of older adults in Tanzania. BMC Oral Health 2006;6:5.

22. Warren JJ, Watkins CA, Cowen HJ, Hand JS, Levy SM, Kuthy RA. Tooth loss in the very old: 13-15-year incidence among elderly Iowans. Community Dent Oral Epidemiol 2002;30:29-37.

23. Rao SR, Thanikachalam S, Sathiyasekaran BW, Vamsi L, Balaji TM, Jagannathan R. Prevalence and risk indicators for attachment loss in an urban population of South India. Oral Health Dent Manag 2014;13:60-4.

24. Tin-Oo MM, Saddki N, Hassan N. Factors influencing patient satisfaction with dental appearance and treatments they desire to improve aesthetics. BMC Oral Health 2011;11:6.

25. Medina-Solís CE, Pontigo-Loyola AP, Pérez-Campos E, Hernández-Cruz P, Ávila-Burgos L, Kowolik MJ, *et al.* Association between edentulism and angina pectoris in Mexican adults 35 years of age and older: A multivariate analysis of a population-based survey. J Periodontol 2014;85:406-16.

26. Ishikawa S, Konta T, Susa S, Kitabatake K, Ishizawa K, Togashi H, *et al.* Risk factors for tooth loss in community-dwelling Japanese aged 40 years and older: The Yamagata (Takahata) study. Clin Oral Investig 2018. doi: 10.1007/s00784-018-2604-x.

27. Nilsson H, Berglund JS, Renvert S. Periodontitis, tooth loss and cognitive functions among older adults. Clin Oral Investig 2017;22:2103-9.