EGS Mumghamba
FM Fabian

Tooth loss among habitual chewing-stick and plastic toothbrush users in the adult population of Mtwara, rural Tanzania[1]

Authors' affiliations:
Mumghamba EGS, Fabian FM, Department of Restorative Dentistry, School of Dentistry, Muhimbili University College of Health Sciences (MUCHS), Dar-es-Salaam, Tanzania

Correspondence to:
Dr EGS Mumghamba
Department of Restorative Dentistry, School of Dentistry, Muhimbili University College of Health Sciences (MUCHS)
P.O. Box 65014, Dar-es-Salaam
Tanzania
Tel.: +255 741 422 245
Fax: +255 222 150 465
E-mail: emumghamba@muchs.ac.tz, emumghamba@excite.com

[1]The abstract of this work was delivered as 'Oral Presentation' in the First Joint Congress of the East and Southern Africa and Kuwaiti Divisions; West African and Jordanian Sections of the International Association for Dental Research (IADR), 26–28 August 2004, Nairobi, Kenya.

Dates:
Accepted 10 January 2005

To cite this article:
Int J Dent Hygiene **3**, 2005: 64–69
Mumghamba EGS, Fabian FM:
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Abstract: *Objectives:* The aim of this study was to determine the extent and type of tooth loss in relation to habitual chewing-stick (CS) and plastic toothbrush (PT) users in adults. *Methods:* A cross-sectional descriptive study was conducted in Mtwara's rural population aged ≥40 years. A total of 206 randomly selected study participants – males (55.8%) and females (44.2%) – were interviewed on oral hygiene practices using a structured questionnaire, and a clinical examination performed for assessment of tooth loss. *Results:* Of the total, 93.2% were partially edentulous, 2.4% completely edentulous and those with no tooth loss 4.4%. The total number of missing teeth were 1728 (mean, 8.38 ± 7.9), and the causes were caries (74.9%), mutilation (4.8%) and others including periodontal and trauma (20.3%). There was no significant difference in the mean number of tooth loss between the upper and lower jaw, and between males and females. However, the mean number of missing teeth in the lower jaw was higher in females than in males ($P = 0.04$), and on lower left than lower right jaw ($P = 0.008$). Lower molars, especially first molars, were the teeth lost most often. Tooth-cleaning devices included PT (51.5%), CS (25.7%), both type (BT; 17.0%) and unspecified (5.8%). The differences in the mean number of missing teeth were higher in CS than habitual PT users ($P = 0.024$) and in BT ($P = 0.029$). Tooth loss was also higher among those who brushed once when compared with those who brushed two times or more per day ($P = 0.046$). *Conclusion:* Tooth loss was significantly higher in CS than PT habitual users and affected mostly the lower molars and especially the first molar. However, for economical reasons,

effective use of CS should be promoted for enhanced tooth retention.

Key words: chewing-stick; epidemiology; manual plastic toothbrush; rural; Tanzania; tooth loss

Introduction

Most of the oral health services in Tanzania are inclined to relieving dental pain and the treatment most offered is tooth extraction as part of emergency oral health care (1). From a survey in Ilala district, Dar-es-Salaam, Tanzania, it has been reported that the 'missing' component was higher when compared with other components in the Decayed Missing Filled Teeth, DMFT (2). However, other available data from Tanzania showed that about 10% of the DMFT was composed of the 'missing' component and that the level of edentulousness was 0.2% for those at the age of 35–44 years, whereas for those aged ≥55 years it was 0.6% (1). The main cause of tooth loss in Tanzania is dental caries for those <40 years of age and periodontal diseases for those at aged ≥40 years (3). Predisposing factors for dental caries and periodontal diseases are multifactorial and include microbial plaque (4, 5). Microbial plaque accumulation among other things is very much dependent on oral hygiene practices, the nature of tooth-cleaning devices and the methods of their application (4). Tooth-cleaning devices commonly used in Tanzania are plastic toothbrush (PT) (68%) and chewing-stick (CS) (32%), while dental floss is very rarely used (6, 7). It is believed that CS have been widely used under different names in many societies in Africa, South America, the Middle East and Asia for instance; miswak, siwak or arak in Middle East, miswaki, in Tanzania and that the modern day 'toothbrush was unknown even in Europe until about 300 years ago' (8).

The use of CS in children under proper instructions has been reported to be as effective as PT (9). However, other researchers have shown PT to be more efficacious than the CS particularly in individuals who had severe plaque deposits, and that CS was as effective as the toothbrush in patients with moderate plaque deposits (10). In traditional, unsupervised tooth cleaning using CS and PT, no significant difference were found in children as well as in adults (7, 11). The plants used as CS in Tanzania include *Salvadora persica* (7), *Acacia senegal*, *Eriosema psoraleoides*, *Ocimum suave*, *Opillia celtidifolia*, *Xerophyta suave-olens* (12), *Euclea divinorum* and *Rhus natalensis* (13). Among the advantages of using a CS is that the barks of various plants have been shown to have a wide range of anti-microbial activity to cariogenic and other oral bacteria (12, 14). The use of *S. persica*, in particular, has been found to reduce the amount of *Actinobacillus actinomycetemcomitans*, one of the important periodontal pathogens in the subgingival plaque (15).

Habitual use of CS has been reported to be a risk factor for gingivitis in Tanzania (16). Use of CS has also been associated with a higher prevalence of gingivitis when compared with PT (17, 18). Given the fact that gingivitis may progress to periodontitis, the habitual use of CS may indirectly predispose the user to a higher risk of tooth loss in later years at old age. However, the relationship between tooth-cleaning devices and tooth loss in Tanzania is not known. Therefore, the aim of this study was to determine the extent and type of tooth loss in relation to the type of tooth-cleaning device: CS and PT habitual users among adults aged ≥40 years.

Study participants and methods

This was a cross-sectional descriptive study, that was conducted in Mtwara-Rural district in Mtwara region, a remote area on the south-east coast part of Tanzania. Mtwara region was sampled for convenience, as there were other studies on oral health being conducted at the same time (19–21). Administratively, the region is divided into districts, then to wards, and wards into villages. From the 2002 Tanzania population and housing census report, Mtwara region and Mtwara-Rural district had 1 128 523 and 204 770 inhabitants, respectively, whereby the population strata aged ≥40 years was about 23% (22). A simple random sampling by the ballot technique was used to select one out of five districts. Thereafter, a multistage simple random sampling technique was conducted from ward to village levels, whereby five villages were picked up to form the study sites. The adult population aged ≥40 years was therefore considered for the study. The distribution of study participants by age groups and gender is shown in Table 1. Of the 206 study participants who were randomly selected, males were 55.8% and females 44.2% with a mean age of 55.24 ± 11.87 years. The difference in age groups and gender of the participants were not statistically significant.

Table 1. **Distribution of study participants by gender and age groups**

Age group (years)	Gender of the participants		
	Male *n* (%)	Female *n* (%)	Total *n* (%)
40–44	19 (16.5)	20 (22.0)	39 (18.9)
45–54	38 (33.0)	30 (33.0)	68 (33.0)
55–64	28 (24.3)	26 (28.6)	54 (26.2)
65+	30 (26.1)	15 (16.5)	45 (21.8)
All	115 (55.8)	91 (44.2)	206 (100.0)

The difference in age distribution between males and females was not statistically significant.

The study participants were interviewed using a structured questionnaire on their level of education, oral hygiene practices, exposure to oral health education (OHE) and distance to the nearest oral health service facility. Clinical examination was performed in a well-ventilated room with plenty of natural light for tooth-loss assessment with a mouth mirror and the Community Periodontal Index (CPI) probe (23). The inclusion/exclusion criteria were age and personal consent. All adults in the sample population were interviewed for age and those found to be <40 years at the time of the interview were excluded from the study. However, emergency treatment including tooth extraction and referral was provided as per demand to all those who turned up for the interview. The Muhimbili University College of Health Sciences (MUCHS) Research and Publication Committee approved the protocol of this study, and ethical clearance was obtained from the Ethical Committee at MUCHS. Informed consent was obtained from the study participants before commencement of the interview and clinical examination.

The data were entered into a personal computer and analysed using the Statistical Package for Social Sciences (SPSS) 10.0 for Windows. Initial analyses included generation of frequencies for all variables and later on recoding was done for generation of age groups, type of teeth extracted, type of jaw (upper/maxillary teeth or lower/mandibular teeth) and grouped number of missing teeth. Further analyses for categorical data included the proportion of missing as well as sound teeth and for the teeth that were indicated for extraction, cross-tabulations were generated for age groups and gender of the participants, whereby chi-square test was used. Moreover, comparison of mean value for the number of teeth that were sound, missing or indicated for extraction was performed by age groups and gender of the participants, whereby Student's *t*-test was used to test the differences. Significance level was taken at a level of *P*-value <0.05.

Results

Nine of 206 (4.4%) study participants had complete dentition, while 192 (93.2%) were partially dentate and five (2.4%) were completely edentulous. The tooth brushing frequency practised by study participants was once per day (35.4%), two to three times per day (56.8%) and 5.3% were not specific regarding the frequency of brushing. Types of tooth-cleaning devices used were PT, 106 (51.5%), CS, 53 (25.7%), a combination of PT and CS (BT), 35 (17.0%) and other unspecified means of tooth cleaning, 12 (5.8%). Habitual CS users had significantly higher mean age (59.9 ± 11.7 years) than PT users (53.1 ± 12.1 years; $P = 0.001$) and users of BT (53.3 ± 10.2; $P = 0.008$). Those who did not specify the type of tooth-cleaning device used were also of higher mean age (59.6 ± 8.3 years).

The mean number of missing teeth by age group and gender of the participants is presented in Table 2. The mean number of tooth loss was 8.4 ± 7.9 and the difference between males (7.85 ± 8.02) and females (9.07 ± 7.77) was not statistically significant. However, the mean number of missing teeth in the lower jaw was higher in females (5.15 ± 3.91) than in males (4.05 ± 3.85), ($P = 0.04$). Moreover, the missing mandibular teeth in the left side were higher in females (2.60 ± 2.08) than in males (1.88 ± 1.80), ($P = 0.008$). For molars, there was higher mean number of missing mandibular teeth (2.99 ± 1.99) than the maxillary teeth (1.98 ± 1.94), but in other tooth-types there was slightly higher mean number of tooth loss from the maxillary than the mandibular jaw (Table 3). After grouping the number of missing teeth (MT) into different categories, about 60% of the study participants had lost between one and eight teeth, whereby the majority were those with one to four missing teeth (Table 4). However, there was no significant difference in the tooth loss between age groups and between males and females. As shown in Table 5, the mean number of teeth lost was significantly higher in CS (12.04 ± 8.35) than in PT habitual users (8.73 ± 7.00, $P = 0.015$) and BT

Table 2. **Mean number of missing teeth by age group and gender of the study participants**

Age group (years)	Mean no. of missing teeth		
	Male ($n = 115$)	Female ($n = 91$)	Total ($n = 206$)
40–44	2.47 (1.84)	4.60 (4.03)	3.56 (3.30)
45–54	4.47 (3.85)	5.77 (4.01)	5.04 (3.94)
55–64	10.36 (9.11)	13.69 (9.07)	11.96 (9.16)
65+	13.20 (9.23)	13.60 (8.53)	13.33 (8.90)
ALL	7.85 (8.02)	9.07 (7.77)	8.39 (7.92)

Values are mean (SD).

Table 3. **Mean number of missing teeth by jaw and tooth type**

	Mean number of missing or lost teeth for the studied participants ($n = 206$)					
	Maxillary teeth		Mandibular teeth		All teeth	
Tooth type	Mean (SD)	*n*	Mean (SD)	*n*	Mean (SD)	*n*
Molars	1.98 (1.94)	408	2.99 (1.99)	616	4.97 (3.44)	1024
Premolars	0.75 (1.25)	155	0.67 (1.08)	139	1.43 (2.09)	294
Canine	0.23 (0.55)	48	0.17 (0.51)	35	0.40 (0.97)	83
Incisors	0.88 (1.38)	182	0.70 (1.31)	145	1.59 (2.38)	327
All	3.85 (4.44)	793	4.54 (3.91)	935	8.39 (7.92)	1728

Table 4. **Grouped number of missing teeth by gender of the study participants**

No. of missing teeth	Proportion of the study participants with specified number of missing teeth by gender		
	Male	Female	Total
0	6 (5.2)	3 (3.3)	9 (4.4)
1–4	49 (42.6)	26 (28.6)	75 (36.4)
5–8	25 (21.7)	25 (27.5)	50 (24.3)
9–12	11 (9.6)	18 (19.8)	29 (14.1)
13–16	8 (7.0)	7 (7.7)	15 (7.3)
17–24	8 (7.0)	6 (6.6)	14 (6.8)
25–32	8 (7.0)	6 (6.6)	14 (6.8)

The number of missing teeth in males when compared with females was not statistically significant.
Values are given as *n* (%).

(8.20 ± 6.46, $P = 0.046$), respectively. The group that had 'unspecified-means' of tooth cleaning apart from tooth brushing had significantly higher mean number of tooth loss than in the CS, PT habitual-users or BT ($P \leq 0.002$; Table 5).

Regarding frequency of tooth brushing, 73 (35.4%) brushed once per day, 117 (56.8%) two to three times per day 11 (5.3%) had unspecified frequency and five (2.4%) participants did not brush, because they were completely edentulous. In this study population, it was found that tooth loss was higher among those who brushed once (8.97 ± 7.84) when compared with those brushing two times or more per day (6.83 ± 6.71, $P = 0.046$). The mean number of missing teeth (7.71 ± 7.18) was significantly lower ($P < 0.001$) among participants who brushed at least before breakfast than those who reported not to brush before breakfast (19.33 ± 11.15). Moreover, those (36.9%) who brushed their teeth before going to bed had a lower mean number of tooth loss (6.25 ± 6.25) than the 63.1% who did not brush (9.64 ± 8.52, $P < 0.001$).

A total of 99 (48.5%) of the study participants were living >5 km from the rural dispensary. The mean number of missing teeth among those living >5 km from the rural dispensary (10.81 ± 9.27) was significantly higher ($P < 0.001$) than those living within 5 km (6.11 ± 5.57). The study participants who were literate, i.e. with primary education or higher (43.1%) had significantly lower mean number of missing teeth (5.58 ± 6.28) than the illiterate (53.9%) with 10.79 ± 8.39 mean number of missing teeth ($P < 0.001$). However, the difference in the mean number of missing teeth (6.35 ± 7.88) between those who had some exposure to OHE (19.4%) when compared with the mean number (8.88 ± 7.87) of those who had never had any access to OHE (80.6%) was not statistically significant.

The number of teeth that were indicated for extraction ranged from one to 18 (mean, 2.44 ± 2.84). Moreover, females had a significantly ($P = 0.032$) higher mean number of teeth indicated for extraction (2.91 ± 2.74) than males (2.06 ± 2.88). However, the difference in proportion of study participants between females (46.9%) and males (53.1%) who had one tooth or more indicated for extraction was not statistically significant. The mean number of teeth indicated for extraction was significantly higher ($P = 0.036$) in the CS habitual users

Table 5. **Mean number of tooth loss in relation to type of tooth-cleaning device used**

Type of tooth-cleaning device	*n*	Mean	SD	Significance (two-tailed)	Mean difference	95% Confidence Interval	
						Lower	Upper
Chewing stick	53	12.04	8.35	0.015	3.31	0.66	5.96
Plastic toothbrush	106	8.73	7.00				
Chewing stick	53	12.04	8.35	0.046	3.84	0.69	6.99
Both types of toothbrushes	35	8.20	6.46				
Chewing stick	53	12.04	8.35	0.002	−9.13	−14.74	−3.52
Other means	12	21.17	10.55				
Plastic toothbrush	106	8.73	7.00	0.695	0.53	−2.12	3.17
Both types of toothbrushes	35	8.20	6.46				
Plastic toothbrush	106	8.73	7.00	0.002	−12.44	−19.23	−5.65
Other means	12	21.17	10.55				
Both types of toothbrushes	35	8.20	6.46	0.001	−12.97	−19.91	−6.03
Others mean	12	21.17	10.55				

Table 6. **Mean number of sound teeth by age group and gender of the participants**

Age group (years)	Mean no. of sound teeth		
	Male ($n = 115$)	Female ($n = 91$)	All ($n = 206$)
40–44	27.37 (3.15)	24.95 (5.46)	26.13 (4.60)
45–54	26.05 (4.40)	23.73 (5.00)	25.03 (4.78)
55–64	18.93 (9.15)	14.88 (8.01)	16.98 (8.78)
65+	17.40 (8.98)	15.07 (7.98)	16.62 (8.64)
All	22.28 (8.14)	20.04 (7.98)	21.29 (8.13)

Values are given as mean (SD).

(2.96 ± 3.10) than in the PT users (2.03 ± 2.35) (95% CI 0.06–1.81). The mean number of sound teeth (not indicated for extraction) in different age groups and gender is shown in Table 6. Although not statistically significant, the mean number of sound teeth was slightly higher in males (22.28 ± 8.14) than in females (21.29 ± 8.13).

Discussion

The pattern of missing teeth in this adult population generally was that, molars were missing more than (>) incisors, incisors > premolars > canines a finding that is different from what was reported by Kikwilu, whereby most of the teeth lost were molars > premolars > incisors > canines (2). The possible explanation for this was that our study included adults aged ≥40 years while the latter study had included children and young adults. Although tooth-cleaning devices such as CS and PT are not directly associated with tooth loss, it is agreed that these devices have limited effect in pits, fissures and interproximal areas in human dentition (4), thus predisposing the affected teeth to occlusal (pits/fissure) dental caries, and periodontal diseases; ultimately these diseases may lead to some tooth loss. The significant difference between CS and PT habitual users in the number of teeth lost in the upper jaw suggests, among other things, that CS is less effective when compared with PT in cleaning the upper teeth. However, given the fact that CS in the rural area is readily available and affordable by most of the economically deprived community, we recommend oral hygiene instruction on proper use of CS for effective cleaning, in line with The Year 2000 Consensus Report on Oral Hygiene by the World Health Organization and as it has been advocated for other developing countries as well (24, 25). In Tanzania, oral health services are basically aimed at relieving dental pain through tooth extractions, as resources for restorative care are scarce (1). Moreover, there is no organized regular periodontal therapy in Tanzania and hence teeth affected by severe periodontal disease end up being extracted (3, 20). Given the life expectancy of a normal Tanzanian being 44.5 years (26), it appears that most of the adult population in Mtwara would die with a good number of natural dentition (about 25–26 teeth) and this is in agreement with what has been reported in other populations in Tanzania (27).

The level of edentulousness among adults (≥40 years) in this study population was higher than what has been reported in some other populations in Tanzania (1, 28). Moreover, the mean number of missing teeth in the older age group of ≥65 years in this study population was lower than what has been reported from Tanga and Dar-es-Salaam populations in Tanzania (28). Among other things, the occurrence of risk factors for tooth loss, age group of the study participants, and poor accessibility and limited oral health services in the current study may partly account for the differences observed. Rampant tooth extraction should be prevented for aesthetic reasons, speech and effective mastication. However, under the 'shortened dental arch (SDA)' concept, it has been pointed out that the most important factor is the amount of functional, occluding pairs of teeth, with occlusal stability rather than the mere number of teeth present (29).

There are some limitations that are worth commenting on in this study. First, Mtwara region was sampled for convenience because this was part of another study and therefore the results cannot be generalized for the whole Tanzanian population. However, generalization for the Mtwara region is permissible. Secondly, the effect of tooth cleaning devices on tooth loss is not a direct, linear relationship and therefore some factors such as plaque accumulation assessment, which was scored at a sextant rather than tooth-surface level might have confounded the interpretation of the results. Thirdly, other limiting factors were that the effectiveness of these tooth-cleaning devices in relation to methods of tooth brushing, for proper and effective tooth brushing practice was not recorded. Fourthly, the use of self-reported information on oral hygiene practices without observational studies might have affected the results as it appears that nobody would like to report that he/she is not brushing his/her teeth, although all of them were found to have plaque, calculus and gingival bleeding in most of the sextants in the mouth (21). Fifthly, it might be difficult for the study participants to report retrospectively and accurately which teeth were lost because of caries, periodontal disease, trauma, tooth-mutilation or any combination of these situations. Sixthly, as PT were not assessed and as this is a rural poor community, it is possible that for those who were using PT, they could be using old defective brushes with worn-out or bent bristles, which are not effective in cleaning.

Finally, the dietary habits of the study participants such as consumption of sugary food products which are associated with dental caries, the major cause of tooth loss in Tanzania, were not studied.

It is concluded that, tooth loss in adult population aged ≥40 years in this rural population of southern Tanzania was substantial, affecting the lower molars and most especially the first molar and that tooth loss was significantly higher in the CS than in the PT habitual users. Despite these results and in view that most Tanzanians are economically deprived, proper and effective use of CS in adults if promoted could improve oral health and therefore enhance tooth retention.

Acknowledgement

The Muhimbili University College of Health Sciences (MUCHS) of the University of Dar-es-Salaam (UDSM), Tanzania, funded this study.

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