

# Oral Hygiene Status of Chewing Stick Users in a Rural Kenyan Community

Hideki Fukuda<sup>1</sup>, Toshiyuki Saito<sup>1</sup>, Eunice Kihara<sup>1</sup>, Cyril Ogada<sup>1</sup>, Evelyn G. Wagaiyu<sup>3</sup>, Yoshihiko Hayashi<sup>2</sup>

<sup>1</sup>Department of Oral Health, Nagasaki University Graduate School of Biomedical Sciences, Nagasaki, Japan. <sup>2</sup>Department of Cariology, Nagasaki University Graduate School of Biomedical Sciences, Nagasaki, Japan. <sup>3</sup>University of Nairobi School of Dental Sciences, Nairobi, Kenya.

## Abstract

**Objective:** We evaluated oral hygiene status in chewing-stick users compared with tooth-brush users, using multiple logistic regression analyses.

**Methods:** An oral health examination was conducted in November 2011 in Mbita district, Kenya. In total 124, 97 adults underwent an oral health examination and participated in a questionnaire survey. Kenyan dentists examined dental caries and evaluated periodontal status and the presence of dental plaque. Tooth-brushing tools that participants used on a daily basis were categorized as a “tooth brush” or a “chewing stick.”

**Results:** The frequency of tooth brushing was significantly higher among the tooth brush users than the chewing stick users. The adjusted odds ratio of those who had heavy dental plaque was 3.53 (95% CI: 1.1-10.89.9) in chewing stick users compared with tooth brush users.

**Conclusions:** Chewing stick users had a poor oral hygiene status rather than tooth brushing users. To improve oral hygiene status in chewing stick users, appropriate oral health education for rural Kenyan communities should be developed.

*Key words: Chewing stick, Oral hygiene status, Tooth-brushing instruction*

## Introduction

The practice of using chewing sticks as traditional tooth brushes is common in many parts of Asia, Africa, and the Middle East [1,2]. They are readily available and inexpensive. The efficiency of dental plaque removal with chewing sticks has been shown to be at least at the same level as that of conventional tooth brushes [3-7]. It has been noted that chewing stick users have a healthy gingival and periodontal status compared with tooth brush users [3,5,6,8,9]. The extract from chewing sticks has been shown to have anti-bacterial effects in vitro [10-12]. These extracts reduce bacterial levels in human subgingival pockets [13,14] and saliva [15]. For these reasons, chewing sticks are recommended as appropriate tooth-cleaning tools, especially in developing countries.

The proportions of chewing stick users have been found to vary among genders, age groups, educational levels, and residential areas [6,16]. Oral hygiene status in chewing stick users is influenced by these individual factors. We hypothesize that to our knowledge, the oral hygiene status of chewing stick users differs according to individual characteristics and tooth-brushing behaviors have not been determined.

The first objective of this study was to investigate the relationship between demographic factors and oral health behavior in chewing stick users in a rural Kenyan community. The second was to evaluate the oral hygiene status of chewing stick users compared with toothbrush users by means of multiple logistic regression analyses.

## Methods

### Research field

An oral health examination was conducted in November 2011 in Mbita district, Kenya. This is a rural area, situated in western Kenya. The nearest dental clinic is located in the town of Homa-Bay, about 50 km from Mbita center.

### Participants

Participants in this study were relatives of school children aged 12 years, attending two primary schools (U primary school and K primary school). These two primary schools were selected by the superintendent of educational affairs of Mbita district. The numbers of school children aged 12 years at U primary school and K primary school were 86 and 64, respectively. We asked all the school children to invite at least two members of their family for an oral examination. All were given invitation letters to take to their relatives. In total, 97 adults at U primary school and 27 at K primary school participated in the questionnaire survey. Of them 97 participants underwent oral health examinations.

### Oral examination

Oral examinations were conducted by two Kenyan dentists who are members of the faculty of University of Nairobi School of Dental Sciences (UONSDS). Dental caries was judged and classified according to WHO standards [17]. The presence of dental plaque was evaluated according to the following four categories: “none” (no visible plaque), “less than 1/3,” “1/3-2/3,” and “2/3 or more” on the labial side of anterior teeth. This index was used for school children aged 12 years at the same primary schools on the other day. The index is used widely in Japanese school dental examination. Periodontal status was evaluated with community periodontal index (CPI) measured at designated teeth on sextant of the mouse [17]. Calibration of the two dentists who carried out the examination was conducted by a senior member of the team (YH) before beginning the oral examination.

The oral examination was carried out in a class room, next to the windows, in each primary school. The participants’ oral health status was examined using a head light to visualize the oral cavity and disposable mirrors and dental probes. While conducting the oral examination, any individual found to be

in need of dental treatment was given a referral letter to the nearest dental clinic and/or a prescription for painkillers, depending on the symptoms.

**Questionnaire survey**

An original questionnaire was developed in English in consultation with staff from Nagasaki University Institute of Tropical Medicine (NUITM) and UONSDS. The questionnaire was modified according to advice received from the local community health workers (LCHWs) in Mbita district. LCHWs were employed to assist in both the administration of the questionnaire and conducting group oral health education after the examination.

Tooth-brushing tools that participants used on a daily basis were recorded by responding as follows: “plastic tooth brush”, “inter-dental brush”, “dental floss”, “chewing stick”, “ash and charcoal”, “sand, salt, or soap”, and “others”. If participants responded by saying that they used a tooth brush and other items, they were categorized as “tooth brush”. If they used only chewing sticks, they were categorized as “chewing stick”. although it was unconfirmed that they never use tooth brush before.

**Statistical methods**

The chi-squared test was used for equality of proportion. The adjusted odds ratio for “1/3 and more” dental plaque on the tooth surface in chewing-stick users versus tooth brush users was calculated using multiple logistic analyses, adjusting for gender, age groups, experience of receiving tooth-brushing instruction (TBI), and frequency of tooth brushing. Statistical significance was set at  $p < 0.05$ . All statistical tests were conducted using the SPSS software (ver. 20.0; IBM SPSS).

**Ethical considerations**

This study was approved by the Kenyatta National Hospital Ethics & Research Committee (P328/9/2010) on December 8, 2010. All participants provided written consent after an explanation of the oral health examination.

**Results**

**Characteristics of participants according to the tooth-brushing tool used**

The percentage of those who used chewing sticks did not differ significantly according to gender. Older participants were more likely to use chewing sticks; however, this trend was not statistically significant. Over 70% of tooth brush users received TBI, but only 32% of chewing-stick users did. The frequency of tooth brushing was significantly higher among tooth brush users than among chewing stick users (*Table 1*).

**Relationship between dental plaque and tooth-brushing behaviors**

Of plastic tooth brush users, 21% had no visible dental plaque. In contrast, only 7% of chewing stick users had no visible dental plaque. The percentage of participants with a high volume of dental plaque (1/3 and more) was 18% for plastic tooth brush users and 45% for chewing stick users; this difference was statistically significant. Other individual characteristics and tooth-brushing behavior did not relate to dental plaque (*Tables 2 and 3*).

After adjusting for gender, age group, experience of receiving TBI, and frequency of tooth brushing, the odds ratio to was 3 (95% CI: 1.1-9) this was statistically significant. No factor other than the tooth-brushing tool used showed a statistically significant relationship with heavy dental plaque.

**Dental plaque and oral health status**

Percentage of participants with CPI code4 (deep periodontal pockets with 6 millimeters or more) increased with volume of dental plaque significantly. Percentage of participant with 5 decayed teeth and more, however, did not have a significant tendency with volume of dental plaque (*Table 4*).

**Discussion**

We found that the percentage of those who had not received

*Table 1. Tools for tooth-brushing by characteristics and tooth-brushing behavior (\*chi-square test).*

Characteristics		Toothbrush	Chewing stick	P value*
Sex	Male	13 (37.1%)	22 (62.9%)	0.96
	Female	22 (36.7%)	38 (63.3%)	
Age group	less than 30	14 (42.4%)	19 (57.6%)	0.37
	30-44	13 (40.6%)	19 (59.4%)	
	45 and more	8 (26.7%)	22 (73.3%)	
Experience of receiving TBI	Yes	8 (72.7%)	3 (27.3%)	<0.01
	No	26 (31.7%)	56 (68.3%)	
Frequency of brushing	Once/day and less	17 (28.3%)	43 (71.7%)	0.02
	2 times/day and less	18 (51.4%)	17 (48.6%)	

*Table 2. Dental plaque by characteristics and tooth-brushing behavior (linear by linear association test).*

		Dental Plaque			P value*
		none	less than 1/3	1/3 and more	
Tool for tooth brushing	Tooth brush	7 (20.6%)	21 (61.8%)	6 (17.6%)	0.003
	Stick	4 (6.7%)	29 (48.3%)	27 (45%)	
Sex	Male	4 (11.4%)	15 (42.9%)	16 (45.7%)	0.247
	Female	7 (11.7%)	35 (58.3%)	18 (30%)	
Age group	less than 30	4 (12.1%)	18 (54.5%)	11 (33.3%)	0.501
	30-44	4 (12.9%)	17 (54.8%)	10 (32.3%)	
	45 and more	3 (9.7%)	15 (48.4%)	13 (41.9%)	
Experience of receiving TBI	Yes	1 (9.1%)	8 (72.7%)	2 (18.2%)	0.428
	No	10 (12.2%)	41 (50%)	31 (37.8%)	
Frequency of brushing	Once/day and less	7 (11.5%)	31 (50.8%)	23 (37.7%)	0.684
	2 times/day and less	4 (11.8%)	19 (55.9%)	11 (32.4%)	

**Table 3.** Adjusted odds ratio related with dental plaque (\*Adjusted for all independent value).

		Odds ratio*	(95% IC)	P value
Tool for tooth brushing	Tooth brush	1		
	Chewing Stick	3.31	(1.11-9.87)	0.031
Sex	Male	1		
	Female	0.42	(0.16-1.11)	0.079
Age group	less than 30	1		
	30-44	1.05	(0.33-3.36)	0.93
	45 and more	1.25	(0.4-3.92)	0.707
Experience of receiving TBI	Yes	1		
	No	2.43	(0.42-14.18)	0.322
Frequency of brushing	Once/day and less	1		
	2 times/day and less	1.1	(0.39-3.07)	0.861

**Table 4.** Highest CPI codes and number of decayed teeth by dental plaque (\*Linear by linear association test).

Dental plaque	Highest CPI code			P value*	Number of decayed teeth			P value*
	Code 0-2	Code 3	Code 4		0	01-Apr	5 and more	
None	4 (36.4%)	5 (45.5%)	2 (18.2%)	0.032	4 (36.4%)	4 (36.4%)	3 (27.3%)	0.664
Less than 1/3	9 (18%)	25 (50%)	16 (32%)		16 (32%)	24 (48%)	10 (20%)	
1/3 and more	2 (5.9%)	19 (55.9%)	13 (38.2%)		8 (23.5%)	19 (55.9%)	7 (20.6%)	

TBI and those who brushed their teeth rarely was significantly higher among chewing stick users than among tooth brush users. We also found that oral hygiene status in chewing stick users was poorer even after adjustment for subjects' characteristics and tooth-brushing behaviors.

Chewing stick users were found to brush less frequently per day and tended to have a less chance of receiving TBI. Receiving TBI is likely to lead the community to use a plastic tooth brush as opposed to the traditional chewing stick and would encourage them to brush their teeth more frequently. However, it is difficult to force the community to receive TBI or to use plastic tooth brushes instead of chewing sticks because chewing sticks have a number of advantages [2]. It has been reported previously that the percentage of those using chewing sticks differs according to gender, age group, educational class, and residential area [14,16]. However, our results suggested that the proportion that used chewing sticks did not differ significantly according to gender or age group. These results indicate that chewing sticks are likely a commonly used tooth-brushing tool in the population of the research area.

Our results showed that the oral hygiene status of chewing stick users was poor even after adjustment for subjects' characteristics and tooth-brushing behaviors. In addition, poor oral hygiene status led participants in this study 183 to periodontal disease. However, previous studies [2-8] showed that chewing sticks are as efficient in removing dental plaque as a plastic tooth brush. This discrepancy could be explained as follows. First, chewing stick users in the targeted community may be using inappropriate brushing techniques. Second, chewing stick users in the targeted community may not be paying sufficient attention to their oral health. The priority they ascribe to their oral health may be much lower than their other general health problems. Further investigations of the actual tooth-brushing techniques used are required. This will allow assessment of the adequacy of the techniques used. An assessment of the knowledge and practices of the community in terms of oral health issues will also reveal the level of interest in oral health matters.

Previous studies [2,5,18] have reported that chewing

stick users should receive specific TBI for the effective use of chewing sticks. The results of this study support that recommendation, because those who used chewing sticks were found to brush less frequently and avoided receiving TBI. An educational program for oral health, including appropriate tooth-brushing instructions for those using chewing sticks, is highly recommended for this community. Approximately 30% of chewing stick users and 70% of tooth brush users received TBI in this study. However, the contents of the TBI received by participants were unknown. Thus, whether the TBI was appropriate for the performance of good oral hygiene is also unknown. Multiple analyses have shown that receiving TBI and tooth-brushing frequency were not significantly related to the presence of heavy dental plaque. Thus, receiving TBI and brushing more frequently do not likely contribute to reducing heavy dental plaque deposits. This indicates that the participants in this study brushed their teeth using inappropriate methods. Appropriate and effective tooth-brushing instructions for users of both tooth brushes and chewing sticks must be introduced urgently. This would improve their oral hygiene status regardless of the tool used.

We recruited only 124 relatives of pupils at two primary schools as research subjects. Thus, selection bias should be considered, because those willing to attend medical consultations regarding their oral health problems were more likely to participate. Their oral hygiene status might be expected to be worse than that of the general population of this area. To generalize the results to the rest of the community, further studies with sufficient size of randomly-selected population are required. Participants were not asked when they brush their teeth for the last time before dental examination. Period between the last tooth-brushing and oral examination would influence the presence of dental plaque. Presence of dental plaque was investigated on the labial side of anterior teeth only. This measure referred to the index used widely in Japanese school dental examination. Although this measure is very simple, it could not evaluate dental plaque accurately. Further study should investigate the period after the last tooth-brushing and use the universal plaque indices such as the oral hygiene index (OHI).

Although our data indicate that chewing stick users had a poorer oral hygiene status, the chewing stick is recommended in rural communities because of its ready availability and inexpensiveness. To improve the oral hygiene status of chewing stick users, appropriate oral health education should be developed and disseminated to rural communities as quickly as possible.

### References

1. Hilal Ahmad NA. Therapeutic properties of meswak chewing sticks: A review. *African Journal of Biotechnology*. 2012; **11**: 14850-14857.
2. Wu CD, Darout IA, Skaug N. Chewing sticks timeless natural toothbrushes for oral cleansing. *Journal of Periodontal Research*. 2001; **36**: 275-284.
3. Gazi M, Saini T, Ashri N, Lambourne. A Meswak chewing stick versus conventional toothbrush as an oral hygiene aid. *Clinical Preventive Dentistry*. 1990; **12**: 19-23.
4. Mohammed Batwa JB, Sarah Batwa. The effectiveness of chewing stick miswak on plaque removal. *Saudi Dental Journal*. 2006; **18**: 125-133.
5. Al-Otaibi M, Al-Harthy M, Soder B, Gustafsson A, Angmar-Mansson B. Comparative effect of chewing sticks and toothbrushing on plaque removal and gingival health. *Oral Health & Preventive Dentistry*. 2003; **1**: 301-307.
6. Al-Otaibi M. The miswak (chewing stick) and oral health. Studies on oral hygiene practices of urban Saudi Arabians. *Swedish Dental Journal*. 2004; **167**: 2-75.
7. Olsson B. Efficiency of traditional chewing sticks in oral hygiene programs among Ethiopian schoolchildren. *Community Dentistry and Oral Epidemiology*. 1978; **6**: 105-109.
8. Darout IA, Albandar JM, Skaug N. Periodontal status of adult Sudanese habitual users of miswak chewing sticks or toothbrushes. *Acta Odontologica Scandinavica*. 2000; **58**: 25-30.
9. Al-Khateeb TL, O'Mullane DM, Whelton H, Sulaiman MI. Periodontal treatment needs among Saudi Arabian adults and their relationship to the use of the Miswak. *Community Dental Health*. 1991; **8**: 323-328.
10. Kemoli AM, van Amerongen, WE, de Soet, JJ. Antimicrobial and buffer capacity of crude extracts of chewing

### Acknowledgements

This study was selected as a support project for strategic collaborative research at Nagasaki University Kenya Research Station and sponsored by Nagasaki University, Nagasaki, Japan, in collaboration with the University of Nairobi, School of Dental Sciences. The authors thank all participants, school staff, and the local authorities at Mbita for their cooperation.

sticks (Miswaki) from Kenya. *ASDC Journal of Dentistry for Children*. 2001; **68**: 183-188, 152.

11. Almas K. The antimicrobial effects of seven different types of Asian chewing sticks. *Odontostomatol Trop*. 2001; **24**: 17-20.
12. Al lafi T, Ababneh H. The effect of the extract of the miswak (chewing sticks) used in Jordan and the Middle East on oral bacteria. *International Dental Journal*. 1995; **45**: 218-222.
13. Darout IA, Skaug, N, Albandar, JM. Subgingival microbiota levels and their associations with periodontal status at the sampled sites in an adult Sudanese population using miswak or toothbrush regularly. *Acta Odontologica Scandinavica*. 2003; **61**: 115-122.
14. Al-Otaibi M, Al-Harthy M, Gustafsson A, Johansson A, Claesson R, et al. Subgingival plaque microbiota in Saudi Arabians after use of miswak chewing and stick and toothbrush. *Journal of Clinical Periodontology*. 2004; **31**: 1048-1053.
15. Darout IA, Albandar, JM, Skaug, N, Ali, RW. Salivary microbiota levels in relation to periodontal status, experience of caries and miswak use in Sudanese adults. *Journal of Clinical Periodontology*. 2002; **29**: 411-420.
16. Varenne B, Petersen PE, Ouattara S. Oral health behaviour of children and adults in urban and rural areas of Burkina Faso, Africa. *International Dental Journal*. 2006; **56**: 61-70.
17. Oral Health Surveys: Basic methods. 4th edn. WHO Geneva, Switzerland. 1997.
18. van Palenstein Helderma WH, Munck L, Mushendwa S, Mrema FG. Cleaning effectiveness of chewing sticks among Tanzanian schoolchildren. *Journal of Clinical Periodontology*. 1992; **19**: 460-463.