

## Oral Hygiene Status among the Elderly in an Area with Limited Access to Dental Services in a Rural Kenyan Community

Yoshihiko Hayashi<sup>1,\*</sup>, Hideki Fukuda<sup>2</sup>, Takashi Matsuura<sup>1</sup>, Kazuo Toda<sup>3</sup>, and Evelyn G. Wagaiyu<sup>4</sup>

<sup>1</sup>Department of Cariology, Nagasaki University Graduate School of Biomedical Sciences, Sakamoto, Nagasaki, Japan

<sup>2</sup>Department of Oral Health, Nagasaki University Graduate School of Biomedical Sciences, Sakamoto, Nagasaki, Japan

<sup>3</sup>Department of Integrative Sensory Physiology, Nagasaki University Graduate School of Biomedical Sciences, Sakamoto, Nagasaki, Japan

<sup>4</sup>University of Nairobi School of Dental Sciences, Nairobi, Kenya

\*Corresponding author: Yoshihiko Hayashi, Department of Cariology, Nagasaki University Graduate School of Biomedical Sciences, Sakamoto 1-7-1, Nagasaki 852-8102, Japan; FAX: +81-(0)95-819-7680; TEL: +81-(0)-95-819-7677; Email: hayashi@nagasaki-u.ac.jp

Received Date: January 25 2017; Accepted Date: February 14 2017; Published Date: February 16 2017

Citation: Yoshihiko Hayashi, et al. (2017) Oral Hygiene Status among the Elderly in an Area with Limited Access to Dental Services in a Rural Kenyan Community. J Dent Oral Health 4: 1-6.

**Objectives:** The aim of this study was to investigate the oral status of elderly individuals in the Mbita District, which has limited access to dental services.

**Participants:** 131 subjects, aged over 65 years, in the central part of Mbita District.

**Method:** We selected 150 elderly individuals living in the central part of Mbita using a Health and Demographic Surveillance System. A total of 131 participants were surveyed using interviews and oral examinations in the Luo language.

**Results:** There were no significant differences in the ages between genders in the four areas surveyed in Mbita ( $75.58 \pm 6.12$  years among females,  $75.74 \pm 7.82$  years among males). The total number of subjects by gender was 85 (64.9%) females, and 46 (35.1%) males, a significant difference ( $P < 0.01$ ). Regarding the number of remaining teeth, subjects ( $n=5$ ) with good consciousness of their general health had  $28.8 \pm 3.63$  teeth, subjects ( $n=62$ ) with an average consciousness had  $22.21 \pm 7.62$ , and subjects ( $n=64$ ) with a poor consciousness had  $21.20 \pm 7.08$ . The average number of caries was 2-4 teeth. The lower front teeth of 86.3% of subjects had been extracted due to a traditional custom. Regarding the number of carious teeth, there was no significant difference between subjects using a plastic tooth brush and those using a chewing stick.

**Conclusion:** Elderly individuals with a good consciousness of general health had significantly more remaining teeth than those who were less conscious, resulting in a high activity of daily life. Instruction in proper brushing techniques is therefore the most important factor for subjects to ensure good oral health.

**Keywords:** Oral status; Life habits; Elderly individuals; Rural Kenyan community

### Introduction

Nagasaki University has an overseas research site in Mbita District in western Kenya. In 2006, the Nagasaki University Institute of Tropical Medicine (NUITM) launched a Health and Demographic Surveillance System (HDSS) devoted to collecting health-related data in the Mbita District of Nyanza Province, about 300 km west of Nairobi, Kenya [1]. As of July 2011, this program had collected data from 11,182 households and 55,929 inhabitants over an area of 163.28 km [2]. The Mbita HDSS revealed that most people

earned their living through fishing on Lake Victoria; 89% of households also used the lake for drinking water and only 1.9% of households had electric lighting [2]. The number of registered dentists in Kenya was 700 [3], giving a dentist/population ratio of 1:56,000. Regarding urbanization, 20% live in rural areas and 80% in urban areas. Notably, no dental facilities existed in the Mbita District at the time of the study, with the nearest dental clinic located in Homa Bay, approximately 50 km away. Such areas with limited access to dental services necessarily have no epidemiological data regarding the oral health of the inhabitants [3-5].

©2017 The Authors. Published by the JScholar under the terms of the Creative Commons Attribution License <http://creativecommons.org/licenses/by/3.0/>, which permits unrestricted use, provided the original author and source are credited.

In 2009, 3.45% of the 38.61 million people in Kenya were over 65 years of age [6]. Little information is available on the rural population. Maintaining oral health may be an important factor in promoting good overall health. Basic information on the elderly can be collected using the HDSS. The aim of the present study was to investigate the oral health of elderly individuals in the Mbita District, assess the relationships between general health and dental caries, and determine their tooth-brushing and dietary habits using both interviews and oral examinations.

## Materials and Methods

The study was conducted in full accordance with the World Medical Association Declaration of Helsinki. The study was approved by the Kenyatta National Hospital/University of Nairobi-Ethics and Research Committee (P328/09/2010) on August 7, 2013. An informed consent form was signed by each participant and a witness before the interview and before the oral examination.

### Participants

Ten percent of approximately 50,000 inhabitants (HDSS data in Mbita District) resulted in a total of 5,000 people. Population information for Kenya revealed that approximately 3% (3.45% exactly in 2009) of the total populations was over 65 years of age. We therefore set a target population of 150 elderly individuals living in the central part of Mbita using the HDSS. Ultimately, after exclusion, 131 subjects (34 from the Mbita central area, 41 from the southern area, 26 from the eastern area, and 30 from the middle-southern area) were surveyed.

### Questionnaire

The original questionnaire was developed in English through extensive consultation with staff at the NUITM Mbita Research Site. Using the questionnaire, HDSS staff surveyed the subjects' gender, age, general health, oral health, oral hygiene habits, and eating habits, using the Luo language in a one-on-one interview with each subject. General health status was recorded based on each subject's self-assessment or self-impression, and grouped into three categories: good, average, and poor.

### Oral examination

Japanese dentist conducted oral examinations in the presence of a Kenyan dentist. Oral examinations were carried in the subjects' homes. The subjects' oral status was examined using a pen light to visualize the oral cavity and a disposable mirror to work within the mouth. The remaining number of teeth, the number of carious teeth, and the presence or absence of the traditional extraction were checked and recorded. We recorded the position extracted traditionally directly through the interview. Then, it was possible to differentiate general extracted teeth due to caries and/or periodontitis with traditionally extracted teeth. Present and past experience of toothache and management for pain were inquired about using the Luo language supported by HDSS staff.

### Statistical analyses

Subject age was classified into three categories: 65-70, 71-80, and 81-90 years old. As the oldest elderly individual in the present study was a 92-year-old male in the eastern area,

he was grouped into the 81-90 years old category. The data were expressed as the means  $\pm$  SD. The differences between two groups were assessed using a one-tailed Student's t-test and Fisher's exact test. Analyses of multiple groups were performed using a two-way analysis of variance followed by Bonferroni/Dunnnett post hoc test. All statistical analyses were performed using the StatView software program (version 5.0; SAS Institute Inc., Cary, NC, USA). Significance was set at  $P < 0.05$ .

## Results

The average age of the subjects living in the central, southern, eastern, and middle-southern areas were  $74.25 \pm 6.85$  ( $n=30$ ),  $75.48 \pm 5.23$  ( $n=25$ ),  $76.94 \pm 6.67$  ( $n=18$ ), and  $75.77 \pm 6.06$  years old ( $n=22$ ) for females, respectively, and  $71.21 \pm 6.41$  ( $n=14$ ),  $77.75 \pm 7.10$  ( $n=16$ ),  $76.13 \pm 8.97$  ( $n=8$ ), and  $75.5 \pm 6.44$  years old ( $n=8$ ) for males, respectively. Although there were no significant differences in the overall mean ages between genders ( $75.58 \pm 6.12$  for females,  $75.74 \pm 7.82$  for males), there were significant differences in ages between the central and other three areas ( $P < 0.05$ ). We examined a total of 85 (64.9%) females, and 46 (35.1%) males, a significant difference between genders ( $P < 0.01$ ). The percent ratio of females to males in 2009 was 54.8:45.2 among those over 65 years of age in Kenya, and 57.5:42.5 among those over 65 years of age in Nyanza Province, which includes Mbita District. There were no significant differences among these percent ratios.

### Relationship between general health and oral health

The pain in the knee and/or leg mostly affected subjects' general health. Table 1 shows the relationship between general health status and living area. Although there was no statistical difference in status among living areas, there were significant differences between rates of good and average status ( $P < 0.01$ ), and between good and poor status ( $P < 0.01$ ).

Regarding the number of remaining teeth, subjects ( $n=5$ ) with a good consciousness of their general health had  $28.8 \pm 3.63$ , subjects ( $n=62$ ) with an average consciousness had  $22.21 \pm 7.62$ , and subjects ( $n=64$ ) with a poor consciousness had  $21.20 \pm 7.08$ . There were significant differences in the number of remaining teeth between subjects with poor consciousness and those with good status ( $P < 0.01$ ), and between subjects with average consciousness and those with good status ( $P < 0.01$ ).

Regarding the number of carious teeth, subjects ( $n=5$ ) with a good consciousness had  $1.2 \pm 1.30$ , subjects ( $n=62$ ) with an average consciousness had  $2.24 \pm 2.68$ , and subjects ( $n=64$ ) with a poor consciousness had  $1.5 \pm 1.96$ . There were significant differences in the number of carious teeth between subjects with an average consciousness and those with a poor status ( $P < 0.05$ ).

### Relationship between age and oral health status

As the number of males in each age group was small in each area, the number of both remaining teeth and carious teeth in the four areas were combined to analyze the data by age group. Regarding the number of remaining teeth, 65- to 70-year-old subjects had  $24.5 \pm 3.13$  among females ( $n=22$ ) and  $27.88 \pm 3.76$  among males ( $n=17$ ); 71- to 80-year-old subjects had  $20.51 \pm 6.80$  among females ( $n=47$ )

and  $22.71 \pm 4.91$  among males (n=17); and 81- to 90-year-old subjects had  $18.31 \pm 11.81$  among females (n=16) and  $18.25 \pm 9.29$  among males (n=12).

**Table 1:** The relationship between general health and living area

	Center	South	East	Middle-south	Total
Poor	17	27	8	12	64
Average	15	12	17	18	62
Good	2	2	1	0	5
Total	34	41	26	30	131

There was a significant difference in the number remaining between genders among 65- to 70-year-old subjects ( $P < 0.01$ ). In both genders, there were significant differences in the number remaining between 65- to 70-year-old and 71- to 80-year-old subjects ( $P < 0.01$ ). There were also significant differences in the number remaining between 65- to 70-year-old and 81- to 90-year-old subjects among females ( $P < 0.05$ ) and males ( $P < 0.01$ ). Regarding the number of carious teeth, 65- to 70-year-old subjects had  $1.55 \pm 1.95$  among females (n=22) and  $1.71 \pm 1.69$  among males (n=17); 71- to 80-year-old subjects had  $1.81 \pm 2.52$  among females (n=47) and  $2.29 \pm 2.78$  among males (n=17); and 81- to 90-year-old subjects had  $1.56 \pm 2.37$  among females (n=16) and  $2.42 \pm 2.50$  among males (n=12). There were no significant differences among any categories.

#### Relationship between toothache and types of management

During the oral examination, subjects were asked about their present and past experience of toothache and its management. Five categories were created and recorded: no experience, and experience with patience, sedatives, herbs, or extraction. No dental treatments except extraction were observed in the oral cavity. This extraction during adulthood was performed by a dentist and differed completely from the traditional extraction performed during childhood. Regarding pain management, there were no significant differences in regimens among the four areas. However, significant differences were noted for the present pain condition between the rates of no experience versus using sedatives, using herbs, and extraction (all  $P < 0.05$ ). Significant differences were also noted between the rates of patience and using sedatives, using herbs, and extraction (all  $P < 0.01$ ). Regarding the past pain condition, significant differences were noted between using sedatives and extraction, and between using herbs and extraction (both  $P < 0.05$ ).

**Table 2:** The relationship between toothache and type of management in each area

	Present					Past				
	Center	South	East	M-S	Total	Center	South	East	M-S	Total
None	14	10	16	8	48	6	18	6	9	39
Patience	13	27	10	19	69	2	8	4	12	26
Sedative	6	1	0	2	9	5	1	1	3	10
Herb	1	2	0	0	3	1	1	1	0	3
Extraction	0	1	0	1	2	20	13	14	6	53
Total	34	41	26	30	131	34	41	26	30	131

M-S: Middle-south

#### Traditional extraction

Traditional extraction was observed generally for the lower incisors and canines (total 6 teeth). Table 3 indicates the distribution of extraction cases among the four areas. Although there were no significant differences in the rates of extraction among the four areas in Mbita, a significant difference was noted between the presence and absence of traditional extraction in the four areas ( $P < 0.01$ ). Among 113 cases of extraction, we observed 3 cases of 8-tooth extraction (including the lower first bilateral premolars) and 3 cases of 5-tooth extraction (where the lower right canine could not be extracted). The 18 (13.7%) subjects without the traditional extraction comprised 8 cases which rejected the extraction, 9 who did not live in Mbita during childhood, and 1 case at his childhood when the tradition was prohibited.

**Table 3:** The relationship between traditional extraction (T. E.) and living area

T. E.	Center	South	East	Middle-south	Total
Yes	24	38	24	27	113
No	10	3	2	3	18
Total	34	41	26	30	131

#### Relationship between brushing and oral health status

Table 4 indicates the relationship between the four surveyed areas and brushing tools, and the number of brushing times. Although there were no significant differences regarding the frequency and the instruments among the four areas, significant differences were noted in the number of subjects between the users of a plastic brush (n=43) or a chewing stick (n=78) (overlapped number) ( $P < 0.05$ ), and between brushing once daily and brushing more or less frequency (all  $P < 0.01$ ). Regarding the number of carious teeth, subjects using a plastic brush had  $1.74 \pm 2.05$  (n=43), and those using a chewing stick  $1.90 \pm 2.48$  (n=78). There was no significant difference in the number of carious teeth between the two instruments. Subjects who brushed once per day (n=71) had  $1.82 \pm 2.26$  carious teeth, those who brushed twice per day (n=12) had  $2.08 \pm 2.15$  teeth, those who brushed three times per day (n=4) had  $4 \pm 4.32$  teeth, those who brushed less frequently than every day (n=7) had  $1.14 \pm 1.68$  teeth, those who brushed rarely (n=19) had  $1.89 \pm 2.75$ , and those who never brushed (n=13) had  $2.08 \pm 1.98$  teeth. There were no significant associations between the brushing frequency and the number of carious teeth.

**Table 4:** The relationship between brushing habits and living area

Frequency	CenterSouth	East	Middle-south	Total	
<b>Everyday</b>					
Once	14	22	17	19	72
Twice	5	4	1	2	12
Three times	0	1	3	0	4
Not everyday	5	0	1	1	7
Rarely	4	8	2	5	19
Never	3	6	1	3	13
<b>Total</b>	<b>34</b>	<b>41</b>	<b>26</b>	<b>30</b>	<b>127</b>
<b>Instrument</b>					
Plastic	14	12	6	11	43
Stick	17	22	20	19	78
<b>Total</b>	<b>29</b>	<b>34</b>	<b>26</b>	<b>30</b>	<b>121</b>

Edentulous subjects were excluded. The numbers for instruments overlapped, as some subjects used both.

### Dietary habits

Regarding the number of meals consumed per day, subjects in the central area (n=34) had  $2.68 \pm 0.53$  per day, those in the southern area (n=41) had  $2.90 \pm 0.30$  per day, those in the eastern area (n=26) had  $2.69 \pm 0.47$  per day, and those in the middle-southern area (n=30) had  $2.97 \pm 0.18$  per day. Although there were no significant differences in the number of meals per day between the central and eastern areas or between the southern and middle-southern areas, there were significant differences between the central and southern areas ( $P < 0.05$ ), central and middle-southern areas ( $P < 0.01$ ), southern and eastern areas ( $P < 0.05$ ), and middle-southern and eastern areas ( $P < 0.01$ ). The dietary habits were almost the same among the four surveyed areas. Regarding the number of meals consumed per day, subjects in the central area (n=34) had  $2.68 \pm 0.53$  per day, those in the southern area (n=41) had  $2.90 \pm 0.30$  per day, those in the eastern area (n=26) had  $2.69 \pm 0.47$  per day, and those in the middle-southern area (n=30) had  $2.97 \pm 0.18$  per day. Although there were no significant differences in the number of meals per day between the central and eastern areas or between the southern and middle-southern areas, there were significant differences between the central and southern areas ( $P < 0.05$ ), central and middle-southern areas ( $P < 0.01$ ), southern and eastern areas ( $P < 0.05$ ), and middle-southern and eastern areas ( $P < 0.01$ ). The dietary habits were almost the same among the four surveyed areas. Table 5 shows the number of subjects with a sweets habit in each of the four areas. There were no significant differences between the rates of such a habit among the areas. The average number of carious teeth among subjects with no sweets habit was  $1.76 \pm 2.19$  (n=58), that among those who rarely ate sugarcane was  $1.05 \pm 1.33$  (n=22), and that those who rarely ate sweets was  $2.43 \pm 2.77$  (n=47) for all areas. Although there was no significant difference in the number of carious teeth between those who never ate any sweets and those rarely did, there were significant differences between those who never ate

any sweets and those who rarely ate sugarcane ( $P < 0.05$ ), and those who rarely ate sweets and those rarely ate sugarcane ( $P < 0.01$ ). Sugar tea drinking is popular in the Mbita District. The relationship between the number of spoonfuls of sugar and the number of carious teeth were surveyed in each area. The respective numbers of spoonfuls per day and carious teeth for subjects (except edentulous ones) were  $1.88 \pm 1.30$  and  $1.78 \pm 2.28$  in the central area (n=32),  $2.44 \pm 1.52$  and  $1.68 \pm 1.99$  in the southern area (n=40),  $1.4 \pm 1.03$  and  $2.64 \pm 3.26$  in the eastern area (n=25), and  $2.12 \pm 1.41$  and  $1.7 \pm 1.88$  in the middle-southern area (n=30). Although there were no significant differences in the number of carious teeth among the four areas, there were significant differences of the numbers of spoonfuls between the south and the east ( $P < 0.01$ ) and between the east and middle-south ( $P < 0.05$ ). There were totally no significant differences between the numbers of spoonfuls of sugar and the numbers of carious teeth in each area.

**Table 5:** The relationship between the frequency of sweet habits and living areas

	Center	South	East	Middle-south	Total
None	15	19	16	7	57
Rarely					
Sugarcane	12	4	1	5	22
Sweets	5	17	8	18	48
<b>Total</b>	<b>32</b>	<b>40</b>	<b>25</b>	<b>30</b>	<b>127</b>

Edentulous subjects were excluded.

### Discussion

Regarding age, the subjects in the central area tended to be slightly younger than those in the other three areas. The life expectancy in Kenya was 60.3 years in 2009 [7]. As the subjects' average age was  $75.58 \pm 6.52$  years old overall, the presently examined subjects were extremely elderly. As the numbers examined were low and this affects generalization of data in this study, the bias due to subject selection should be generally considered. However, we feel that they made an ideal group for examining the oral status of elderly individuals in a rural Kenyan community.

Although extremely few subjects professed a good consciousness of their general health (n=5), they had significantly more remaining teeth than those who were less conscious, which results in a high activity of daily life [8]. However, since the number of carious teeth was not always small among subjects with a good health status, a carious condition is not directly affected by the general health status among our subjects, which is supported by the finding that only one subject with good health consciousness believed she had good oral status in the questionnaire. Furthermore, in this district, it is custom for a grandchild (secondary school age) to support their grandparent in their daily life by living together, which is probably useful for maintaining elderly individuals' mental health.

The present examination clearly revealed that older subjects had fewer remaining teeth than younger ones. This phenomenon is likely due to the fact that only one method of treatment, tooth extraction is available in the Mbita District,

which means that general conservative and prosthodontic treatments have never been carried out. Management for tooth pain is carried out in three steps: the first involves bearing the pain through patience; the second involves using sedatives (a popular choice; bought at the pharmacy or received at the health center or district hospital) or herbs (very rare); and the final step is extraction, depending on the severity of pain (personal communication). As such, the only and final treatment for managing a severe pain is to have the tooth extracted at the district hospital or at the dentist's private home (information from interview). A high frequency of extraction for treating past pain conditions was reported in the present statistical analyses. Regarding the traditional extraction of the Luo tribe, this custom was continued until the 1950s (personal communication). A superintendent of education in the Mbita District explained that this custom arose as a form of emergency management for tetanus cramp, to ensure that patients could still eat. In the present interview, no one complained about this custom. The extractions were carried out by traditional specialists. Historically, the extraction of the 8 lower frontal teeth was popular in the past, eventually replaced by 6-tooth extraction, and finally, 4-tooth extraction (personal communication); however, this pattern was not recognized in the present oral examination. To our knowledge, this is the first to report on the prevalence of traditional extraction and its rejection in this tribe.

Regarding the brushing instrument and frequency, neither of these factors was found to be related to the number of carious teeth. We failed to obtain any meaningful results about brushing frequency in our statistical analyses, although this is the first study of the brushing habits of elderly individuals to include different kinds of brushing instruments. The findings regarding the effects of a plastic brush versus a chewing stick are controversial [9-16]. The present results reveal that instruction regarding the proper brushing method is more important for elderly individuals to ensure oral health, as the kind of brushing instrument does not particularly matter.

Meals were usually taken three times per day in the surveyed areas. Corn porridge as an alternative to the staple dumplings and omena (small fish soup) as a side dish do not require masticate, which is useful for elderly individuals, especially those with few or no teeth. Cooking methods are therefore quite important for meals consumed by elderly individuals [17]. Regarding the number of carious teeth, as there was no significant difference in number between those who never ate any sweets and those who rarely did, a rare habit of sweets did not appear to affect the frequency of caries directly. However, there was a significant difference in the number of carious teeth between those who rarely ate sweets and those who rarely ate sugarcane. Natural sugarcane seems less likely to induce carious teeth than artificial sweets. Although sugar consumption through tea drinking was suspected as a source of caries, we observed no relationship in our data analyses, indicating that tea drinking supplemented with sugar does not present an adequate risk factor for caries formation because the retention time of sugar in the oral cavity is probably short [18].

The average number of caries was 2-4 teeth. This relatively low frequency may be due to socioeconomic status and dietary habits. Furthermore, since we observed a high prevalence of fluorosis among elementary school pupils in the same district (unpublished data), as have similar previous reports [19-21], the concentration of fluoride in the drinking water may be related to the present low prevalence of caries among elderly individuals.

## Conclusion

As the subjects' average age was  $75.58 \pm 6.52$  years old overall, the present examined subjects were extremely elderly compared with the average life span of a Kenyan in 2009 (60.3 years). We therefore feel that they made an ideal group for examining the oral status of elderly individuals in a rural Kenyan community. Elderly subjects with a good consciousness of their general health had significantly more remaining teeth than those with a lower consciousness, which results in a high activity of daily life. The present results reveal that instruction regarding the appropriate brushing method is the most important factor for elderly subjects to ensure good oral health. This study is the first to report that individuals were allowed to reject the traditional extraction when they were at teenager. Most subjects ate three times per day in the surveyed areas. Corn porridge for an alternative to the staple dumplings and omena (small fish soup) as a side dish do not require mastication, which necessary to masticate, which is useful for elderly individuals, especially those with few or no teeth. Cooking methods are therefore quite important for meals consumed by elder individuals. The relatively low frequency of caries observed in this population may be due to mainly the subjects' habits for brushing, low frequency of sweets taking, and without eating between meals.

## Acknowledgments

This study was funded by the Japan Society for the Promotion of Science KAKENHI Oversea Research Project (Grant Number: 25305040). The authors thank NUITM Nairobi station (Director: Prof. Ichinose Y, Prof. Shimada M, Assist. Prof. Goto K), NUITM Mbita Research Site (Mr. Kazama H, Mr. Takato M) and the HDSS staffs (Chief: Mr. Diela P, Mr. Okumu S) at the Mbita Research Site for supporting this project.

## Competing interests statement

The authors declare that they have no competing financial interests.

## Authors' contributions

YH wrote the proposal, participated in the data collection, analyzed the data, and drafted the paper. HF, TM, KT, and EGW approved the proposal and participated in data collection and analysis. All authors read and approved the final manuscript.

## References

- 1) Kaneko S, Mushinzimana E, Karama M (2007) Demographic Surveillance System (DSS) in Suba District, Kenya. *Tropical Medicine and Health* 35: 37-40.
- 2) Kaneko S, Kopyio J, Kiche I, Wanyua S, Goto K, et al. (2012) Health and Demographic Surveillance System in the Western and coastal areas of Kenya: an infrastructure for epidemiologic studies in Africa. *J Epidemiol* 22: 276-285.
- 3) Kaimenyi JT (2004) Oral health in Kenya. *Int Dent J* 54: 378-82.
- 4) Ng'ang'a PM, Valderhaug J (1992) Dental caries in primary school children in Nairobi, Kenya. *Acta Odontol Scand* 50: 269-272.
- 5) Frencken J, Manji F, Mosba H (1986) Dental caries prevalence amongst 12-year-old urban children in East Africa community. *Dent Oral Epidemiol* 14: 94-98.
- 6) Kenya National Bureau of Statistics (2011) The 2009 Kenya Population and Housing Census.
- 7) <http://www.worldlifeexpectancy.com/country-health-profile/kenya>
- 8) Takeuchi K, Aida J, Kondo K, Osaka K (2013) Social participation and dental healthstatus among older Japanese adults: A population-based cross-sectional study. *PLoS One* 8: e61741.
- 9) Olsson B. Efficiency of traditional chewing sticks in oral hygiene programs among Ethiopian schoolchildren (1978) *Community Dent Oral Epidemiol* 6: 105-109.
- 10) Norton MR, Addy M (1989) Chewing sticks versus toothbrushes in West Africa. A pilot study. *Clin Prev Dent* 11: 11-13.
- 11) Gazi M, Saini T, Ashri N, Lamboume A (1990) A Meswak chewing stick versus conventional toothbrush as an oral hygiene aid. *Clin Prev Dent* 12: 19-23.
- 12) Darout IA, Albandar JM, Skaug N (2000) Periodontal status of adult Sudanese habitual users of miswak chewing sticks or toothbrushes. *Acta Odontol Scand* 58: 25-30.
- 13) Wu CD, Darout IA, Skaug N (2001) Chewing sticks timeless natural toothbrushes for oral cleansing. *J Periodont Res* 36: 275-284.
- 14) Al-Otaibi M, Al-Harthy M, Soder B, Gustafsson A, Angmar-Mansson B (2003) Comparative effect of chewing sticks and toothbrushing on plaque removal and gingival health. *Oral Health Prev Dent* 1: 301-307..
- 15) Al-Otaibi M (2004) The miswak (chewing stick) and oral health. Studies on oral hygiene practices of urban Saudi Arabians. *Swed Dent J* 167: 2-75.
- 16) Fukuda H, Saito T, Kihara E, Wagaiyu EG, Hayashi Y (2016) Oral hygiene status of chewing stick users in a rural Kenyan Community. *Oral Health Dent Manag* 15: 27-30.
- 17) Keller HH, Hedley M, Hadley T, Wong S, Vanderkooy P (2005) Food workshops, nutrition education, and older adults: a process evaluation. *J Nutr Elder* 24: 5-23.
- 18) Like GA, Gough H, Beeley JA, Geddes DA (1999) Human salivary sugar clearance after sugar rinses and intake of foodstuffs. *Caries Res* 33: 123-129.
- 19) Opinya GN, Valderhaug J, Birkeland JM, Lokken P (1991) Fluorosis of deciduous teeth and first permanent molars in a rural Kenyan community. *Acta Odontol Scand* 49: 197-202.
- 20) Ng'ang'a PM, Valderhaug J (1993) Prevalence and severity of dental fluorosis in primary schoolchildren in Nairobi, Kenya. *Community Dent Oral Epidemiol* 21: 15-18.
- 21) Makhanu M, Opinya G, Mutave RJ (2009) Dental fluorosis, caries experience and snack intake of 13-15 year olds in Kenya. *East Afr Med J* 86: 120-124.

**Submit your manuscript to a JScholar journal and benefit from:**

- ¶ Convenient online submission
- ¶ Rigorous peer review
- ¶ Immediate publication on acceptance
- ¶ Open access: articles freely available online
- ¶ High visibility within the field
- ¶ Better discount for your subsequent articles

Submit your manuscript at  
<http://www.jscholaronline.org/submit-manuscript.php>