

## Oral Health Status among 12-Year-Old Children in a Rural Kenyan Community

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Received Date: December 22, 2013 Accepted Date: February 24, 2014 Published Date: February 26, 2014

Citation: Hideki Fukuda, *et al.* (2014) Oral Health Status among 12-Year-Old Children in a Rural Kenyan Community. J Dent Oral Health 1: 1-5

### Abstract

**Objectives:** To determine the oral health status among schoolchildren in a rural Kenyan community and examine the relationship between oral symptoms and perceived general health.

**Participants:** 150 pupils, aged 12 years, in two primary schools in the Mbita District.

**Methods:** Dental caries was assessed using the decayed, missing, and filled teeth (DMFT) index. Gingivitis was evaluated using the criteria used for oral examinations in Japanese schools. Information about oral health behavior was collected through a dental health questionnaire.

**Results:** DMFT index values were 0.26 and 0.23 among boys and girls, respectively. Almost 90% of pupils had no dental caries. Frequency of tooth brushing was significantly associated with dental plaque accumulation. The percentage of subjects with dental plaque covering  $\geq 30\%$  of the labial surfaces of anterior teeth increased as the frequency of tooth brushing decreased.

**Conclusions:** The overall mean DMFT index of 0.24 was lower than those reported in previous studies in Kenyan children, which may be explained by differences in socioeconomic status and dietary habits within our study group. Dental plaque was significantly related to the prevalence of gingivitis. These findings indicate the urgent need for oral health education programs in Kenyan schools that address chronic dental symptoms besides dental caries, such as gingivitis.

**Keywords:** Dental caries; Gingivitis; Oral hygiene; Tooth-brushing methods/techniques

### Introduction

Dental caries remains a common disease among school-aged children and is thought to be increasing worldwide, especially in developing countries. The Oral Health Country/Area Profile Project reported that the Decayed, Missing and Filled Teeth (DMFT) index, a standard indicator of oral health, increased steadily from 1.15 in 2004 to 1.19 in 2011 in 12-year-old children living in African countries [1]. In contrast, a systematic review of information published from 1967 to 1997 concluded that the DMFT index among 11–13-year-old in Sub-Saharan Africa had not increased significantly during this earlier time

period [2,3]. However, assessing long-term trends in the incidence of dental caries is difficult due to the lack of nationwide survey data in most African countries. Several studies have examined oral health status among schoolchildren in Kenya, but they have mainly been conducted in urban areas and cross sectional in nature. Accordingly, neither the current oral health status nor changes over time is adequately documented in rural Kenyan schoolchildren.

To create awareness regarding oral disease and promote preventive behaviors in schoolchildren, a current perspective on their oral health situation must first be obtained. This study aimed to clarify the oral health situation among schoolchildren in a rural Kenyan community. The second objective of this study was to investigate the relationship between oral symptoms and perceived general health. Previously, Meei-Shia

*et al.* [4] reported that children with poor perceived general health tended to report more dental symptoms than did children with good perceived general health. Maintaining oral health may therefore be an important factor in promoting overall good health. However, to our knowledge, no study has investigated the relationship between oral symptoms and general health condition in rural Kenyan communities.

## Materials and Methods

### Study area

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 [5]. As of July 2011, this program had collected data from 11,182 households and 55,929 inhabitants over an area of 163.28 km<sup>2</sup>. 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 [6]. Importantly, no dental facility existed in the Mbita District at the time of the study; the nearest dental clinic was located in Homa Bay, approximately 50 km away.

### Participants

This study was conducted in two primary schools (coded “U” and “K”) selected by the superintendent of educational affairs of Mbita District. All participants were students aged 12 years who attended one of these two primary schools. The schoolmasters prepared lists of 12-year-old students, comprising 86 students from primary school U and 64 from primary school K. After obtaining consent, oral examinations were conducted and dental health surveys were administered to all eligible pupils from 19 to 20 February 2011.

### Oral examination

Two Kenyan dentists who were faculty members at the University of Nairobi School of Dental Sciences (UNSDS) conducted oral examinations. Dental caries was assessed and classified according to the World Health Organization standard [7]. Gingivitis was evaluated around the anterior teeth according to criteria used in oral examinations in Japanese schools. If gingivitis was observed in only a few areas, gingivitis was documented as requiring “observation only.” If gingivitis was observed in all areas around all anterior teeth, gingivitis was documented as requiring “detailed professional examination and treatment.” The extent of dental plaque was evaluated on the labial surfaces of anterior teeth and classified as covering <30% or ≥30%. To avoid inter-observer effects, oral examiners were calibrated before beginning data collection.

Oral examinations were carried out in a classroom with windows. The pupils' oral status was examined using a head lamp to visualize the oral cavity and a disposable mirror and dental probe to work within the mouth. When the dentists conducting the examinations discovered a case that required further dental treatment, the pupil was issued a referral letter to the nearest dental clinic and/or a prescription for analgesic

medication, depending on the symptoms.

### Questionnaire

The original questionnaire was developed in English through extensive consultation with staff members at NUITM and UN-SDS. The questionnaire was then modified with advice from local community health workers (LCHWs) in the Mbita District. LCHWs were hired to support the questionnaire portion of the study and to conduct group oral-health education activities after the oral examinations.

Perceived general and oral health conditions were scored using a five-point scale as follows: excellent, very good, good, fair, or poor. When analyzing the data, these items were grouped into three categories: very good, good, and poor. Oral health status was further assessed by questioning each student about several specific symptoms.

### Statistical methods

Mean DMFT index values were compared between boys and girls using Student's *t*-test. The chi-squared test was used to determine the equality of proportions. All statistical tests were conducted using IBM SPSS software (ver.20.0; IBM, Chicago, IL, USA).

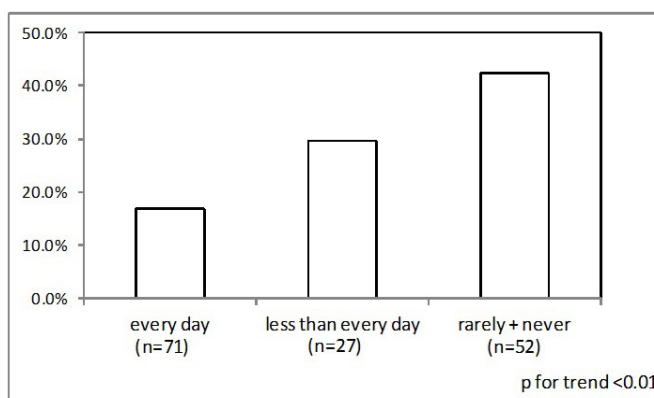
### Ethical considerations

Before the day of the study, we informed the study objectives and procedures to all participants and their guardians by letter. On the day of the study, the study objectives and procedures were discussed again and written informed consent was obtained from them. We did not conduct any invasive examination procedures in this study. This study was approved by the Kenyatta National Hospital Ethics & Research Committee (P328/9/2010) on 8 December 2010.

## Results

### Oral health status

DMFT index values were 0.26 and 0.23 among boys and girls, respectively, and this difference was not statistically significant (Table 1). Almost 90% of pupils had no dental caries. Furthermore, filled or treated teeth (referred to as F-teeth) were not



**Figure 1:** Percentage of those who have ≥30% dental plaque on anterior teeth by toothbrushing frequency.

Table 1 Oral status by gender

	(n)	DMFT index	p value*	DMF			p value**	gingivitis			p value**
				DMF=0	DMF=1	DMF≥2		non	observation only <sup>a)</sup>	detailed professional examination and treatment <sup>b)</sup>	
Gender											
boy	( 58 )	0.26	0.25	84.5%	8.6%	6.9%	0.57	36.2%	51.7%	12.1%	<0.01
girl	( 92 )	0.23		88.0%	6.5%	5.4%		59.8%	38.0%	2.2%	
Total	( 150 )	0.24		86.7%	7.3%	6.0%		50.7%	43.3%	6.0%	

\* Student's *t*-test\*\* *p* for trend<sup>a)</sup> Gingivitis was observed in only few areas around all anterior teeth.<sup>b)</sup> Gingivitis was observed in all areas around all anterior teeth.

Table 2 Relationship dental plaque and oral health status

	(n)	DMF			p value*	gingivitis			p value*
		DMF=0	DMF=1	DMF≥2		non	observation only <sup>a)</sup>	detailed professional examination and treatment <sup>b)</sup>	
Dental plaque									
non	( 6 )	83.3%	16.7%	0.0%	0.54	100.0%	0.0%	0.0%	<0.01
< 30%	( 102 )	88.2%	5.9%	5.9%		61.8%	37.3%	1.0%	
≥ 30%	( 42 )	83.3%	9.5%	7.1%		16.7%	64.3%	19.0%	
Total	( 150 )	86.7%	7.3%	6.0%		50.7%	43.3%	6.0%	

\* *p* for trend<sup>a)</sup> Gingivitis was observed in only few areas around all anterior teeth.<sup>b)</sup> Gingivitis was observed in all areas around all anterior teeth.

observed in any students (data not shown).

In contrast to the situation with dental caries, the prevalence of gingivitis was significantly higher among boys than among girls. More specifically, 12% of boys and 2% of girls were judged as requiring “detailed examination.”

### Relationship between dental plaque and oral health status

Frequency of tooth brushing was significantly associated with the extent of dental plaque on the labial surfaces of the anterior teeth. The percentage of subjects with dental plaque covering ≥30% of the labial surfaces of anterior teeth increased as the frequency of tooth brushing decreased (Figure 1).

Dental plaque showed a direct, statistically significant relationship with the prevalence of gingivitis, but not with dental caries (Table 2).

### Relationship between general health status and oral health status

Self-reported acute and intelligible oral symptoms, such as toothache, tooth fracture, and bad breath, were significantly associated with general health status (Table 3). In contrast, chronic and unintelligible oral symptoms, such as gum bleed-

ing, food impaction, bad dentition, and jaw joint noise, were not associated with general health status. However, comprehensive and subjective feelings regarding oral health status were strongly associated with general health status.

## Discussion

Several published studies have examined dental caries among schoolchildren and young adolescents in Kenya. Mean DMFT index values among 13–15-year-old attending primary schools in Nairobi ranged from 1.8 [8] to 1.54 [9]. Another study reported that the mean DMFT index value among primary schoolchildren (aged 12 years) in Nairobi was 0.76 [10]. The University of Nairobi Dental Hospital reported that the average number of decayed teeth among patients was 3.7 [11]. In contrast, mean DMFT indexes in a rural Kenyan community were reported to be 0.36 among children aged 12 years [10], 1.9 among children aged 12–18 years [12], and 1.9 among young adults (18–24 years) [13]. The overall mean DMFT index in the present study (0.24) was much lower than these previously reported values. This difference may be due to differences in socioeconomic status and dietary habits.

The relationship between sugar consumption and caries is not strong in Western countries [14], especially in the modern age of widespread fluoride exposure [15]. However, in developing countries, dental caries tends to increase with sugar



Table 3 Relationship between general health condition and oral symptoms

	(n)	general health condition <sup>a)</sup>			p value*
		very good	good	poor	
tooth ache					
Yes	( 81 )	27.2%	53.1%	19.8%	<0.01
No	( 69 )	53.6%	44.9%	1.4%	
tooth mobility					
Yes	( 27 )	22.2%	63.0%	14.8%	0.07
No	( 123 )	43.1%	46.3%	10.6%	
tooth fracture					
Yes	( 26 )	26.9%	42.3%	30.8%	<0.01
No	( 124 )	41.9%	50.8%	7.3%	
gum bleeding					
Yes	( 98 )	37.8%	48.0%	14.3%	0.25
No	( 52 )	42.3%	51.9%	5.8%	
food impaction					
Yes	( 107 )	40.2%	45.8%	14.0%	0.59
No	( 43 )	37.2%	58.1%	4.7%	
bad breath					
Yes	( 56 )	28.6%	55.4%	16.1%	0.03
No	( 94 )	45.7%	45.7%	8.5%	
bad dentition					
Yes	( 18 )	27.8%	61.1%	11.1%	0.44
No	( 132 )	40.9%	47.7%	11.4%	
sensitive tooth					
Yes	( 78 )	41.0%	46.2%	12.8%	0.97
No	( 72 )	37.5%	52.8%	9.7%	
jaw joint noise					
Yes	( 26 )	38.5%	46.2%	15.4%	0.67
No	( 124 )	39.5%	50.0%	10.5%	
tooth holes					
Yes	( 43 )	41.9%	41.9%	16.3%	0.77
No	( 107 )	38.3%	52.3%	9.3%	
oral health condition <sup>b)</sup>					
poor	( 30 )	16.7%	43.3%	40.0%	<0.01
good	( 82 )	37.8%	58.5%	3.7%	
very good	( 37 )	62.2%	32.4%	5.4%	
<b>total</b>	<b>( 150 )</b>	<b>39.3%</b>	<b>49.3%</b>	<b>11.3%</b>	

\* p for trend

<sup>a)</sup> Perceived general health condition for subject.<sup>b)</sup> Perceived oral health condition for subject.

consumption, suggesting that sugar consumption remains an important risk factor for the development of dental caries. Ismail *et al.* [16] indicated that the consumption of desserts and snacks with high sugar content might be increasing in urban areas in some developing countries. Similarly, the difference in high-sugar dessert and soda consumption may be increasing between Kenyan cities and rural communities.

Approximately 12% of the young subjects in this study reported eating sweets more than 4-5 days per week, whereas only 1% reported drinking soda at a similar frequency. In addition, most (92%) of the "sweets" consumed were raw sugarcane. In contrast, Gathecha *et al.* [17] reported that 43% and 34% of subjects in an urban cohort consumed cake/biscuits and soda, respectively, at a similarly high frequency; 34% and 10% of rural subjects in the same study reported consuming cake/biscuits and soda. The children participating in the present study may have had fewer opportunities to buy products with high sugar content. This dietary habits, likely contributed to the relatively low prevalence of dental caries.

Although the prevalence of dental caries was low among children examined in this study, the frequent tooth brushing was not so common. Overall, only 47% of schoolchildren

brushed their teeth once a day, compared to values ranging from 77% to 97% in other studies [10,18-20]. This relatively low rate of tooth brushing, which effectively removes dental plaque, may explain our findings regarding dental plaque and gingivitis. Only 4% of children examined in this study lacked dental plaque on the labial surfaces of the anterior teeth. We suspect that this value is low compared with previous findings [18], although direct comparison is difficult due to methodological differences in assessment. Nevertheless, we found that the percentage of children in whom dental plaque covered  $\geq 30\%$  of the labial surfaces of the anterior teeth decreased significantly with increased tooth brushing frequency (Figure 1). Likewise, our data showed that dental plaque coverage had a significant relationship with the prevalence of gingivitis, although not with dental caries. Although the subjects in this study had poor oral health behavior and oral hygiene, their relatively low sugar consumption may explain the absence of an observed relationship with dental caries. Gibson *et al.* [21] reported that a significant relationship between dental caries and sugar consumption was present only among children with poor tooth-brushing behavior. Thus, if the subjects in this study experience a future dietary shift toward the inclusion of more products with high sugar content, their generally poor oral hygiene may leave them vulnerable to increased incidences of gingivitis and dental caries.

The results of this study revealed that perceived general health was closely associated with perceived oral health. This result is supported by those of previous studies [4,22]. Acute oral symptoms with pain were significantly associated with perceived general health, but chronic oral health status was not. For example, gum bleeding due to gingivitis was not related to perceived general health, suggesting that participants do not consider this chronic oral disease to constitute a health problem.

These results, as well as our findings related to oral hygiene habits, indicate an urgent need for increased oral health education. Because oral hygiene habits, such as tooth brushing, do not appear to be firmly established among children in this community, oral health education programs delivered through the school system may be useful. In addition to oral hygiene, oral health education is required to teach children about chronic dental conditions other than dental caries, particularly gingivitis, and the consequences of this disease for long-term oral health.

## Conclusion

The overall mean DMFT index observed in the present study (0.24) is markedly lower than those reported in other studies conducted in Kenya. However, the percentage of children with dental plaque on  $\geq 30\%$  of the labial surfaces of anterior teeth increased with the decreasing frequency of tooth brushing. The present findings indicate that although dental caries may not be currently an issue in this population, oral health education is urgently needed to promote dental hygiene, to combat the current problems with dental plaque and gingivitis and to protect these children against future dietary shifts that may bring them into contact with high-sugar food and increased risk of caries.

## Acknowledgements

This study was sponsored by Nagasaki University, Nagasaki, Japan. The authors appreciate the strong supports to this field work by Nagasaki University Africa Station (Director: Prof. Ichinose Y, Prof. Shimada M, Assist. Prof. Goto K) and NU-ITM Kenya Station (Mr. Kazama H, Mr. Takato M, Mr. Diellah P, Mr. Okumu S). The authors would like to thank all of the children, school staff, and local authorities in Mbita District for their cooperation in the study.

## Competing interests statement

The authors declare that they have no competing financial interests.

## Authors' contributions

HF wrote the proposal, participated in data collection, analyzed the data, and drafted the paper. CN, EK, EG, and YH approved the proposal and participated in data collection and analysis. All authors read and approved the final manuscript.

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