ORAL HEALTH KNOWLEDGE, ATTITUDES AND PRACTICES OF 11-12 YEAR OLD *ORANG ASLI* CHILDREN IN CAMERON HIGHLAND, MALAYSIA

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Abstract: The indigenous *Orang Asli* (OA) children in Malaysia have poor oral health. This study aimed to evaluate their oral health knowledge, attitudes and practices (KAP) in order to develop a suitable oral health promotion program. A cross-sectional study was conducted among 249, 11-12 year old OA children in Cameron Highland District, Malaysia. A 31-item questionnaire was used to assess their oral health KAP. Total scores for knowledge and attitude sections were described in percentages. The levels of percentage scores were categorized into "good" (80-100%), "moderate" (60-79%) and "poor" (<60%). The practice items were described individually in frequencies and percentages. Data were analyzed using the SPSS version 22 software. Overall, 227 children responded with 91.2% response rate. The mean total score for knowledge section was 61.8% (SD = 8.2); 51.1% had "poor", 42.7% had "moderate" and 6.2% had "good" knowledge levels. The mean total score for attitude section was 70.3% (SD = 9.8); 19.4% had "poor", 61.7% had "moderate" and 18.9% had "good" attitude levels. For oral health practices, 190 (83.7%) of the subjects brushed their teeth $\geq$2x/day, 182 (80.2%) used fluoride toothpaste $\geq$2x/day, 128 (56.3%) consumed sugary foods $\geq$2x/day, 122 (53.8%) consumed sugary drinks $\geq$2x/day, and 84 (67.4%) chewed betel nut $\geq$once/day. This study showed the majority of subjects had poor and moderate oral health knowledge and attitude levels, respectively. The majority chewed betel nut. A school-based oral health promotion program is recommended to promote positive KAP and improve the oral health and well-being of the study population.

Keywords: knowledge, attitudes, practices, oral health, Orang Asli, indigenous

INTRODUCTION

Oral disease is a public health problem due to its high prevalence and impact on daily life (Petersen, 2004). Dental caries

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and periodontal disease are the two most prevalent diseases of the oral cavity (Petersen *et al*, 2005). An estimated 60-90% of school children in industrialized countries and the majority of adults worldwide have experienced dental caries (WHO, 2004) . In Asia and Latin America, dental caries have been reported to be the most prevalent of oral diseases with a negative impact on daily activities (Petersen, 2003; Petersen *et al*, 2005).

In Malaysia, the 2007 National Oral Health Survey of School Children reported the caries prevalence in primary teeth among children aged 6 years was 74.5%, among children aged 12 years was 41.5% and aged 16 years was 59.6% (Oral Health Division, 2010). The prevalence of dental caries among indigenous *Orang Asli* (OA) children aged 6-15 years in Selangor State, Malaysia has been reported to be 75.0% (Kadir and Yassin, 1990).

The determinants of oral health at the community level include social, economic, cultural and environmental factors (Watt, 2012). At the individual level, the knowledge, attitudes and practices regarding oral health are associated with the level of oral health (Gao *et al*, 2014). A study from Malaysia reported an oral health promotion program targeting individuals and small groups of children resulted in positive behavior changes (Ab-Murat and Watt, 2006). These findings were supported by findings from another similar study where effective oral health education in a supportive environment resulted in improved oral health attitudes and practices (Smyth *et al*, 2007). Other studies reported sustained behavior changes can result in improved oral health status and well-being (Shenoy and Sequeira, 2010; Rosema *et al*, 2012; D'Cruz and Aradhya, 2013).

In Malaysia, most OA children grow up in poor communities with diverse oral health beliefs, values and habits (Saub and Jaafar, 2001). Apart from the need to improve the social, economic, and environmental determinants of oral health, efforts to promote the children's oral health require implementing a tailored oral health program taking into account differences in culture, language, needs and capacity of the OA children. Using a conventional oral health education program for this population may not be suitable. There is a need to develop a culturally sensitive oral health promotion program that is socially acceptable to OA children and their parents (Al-Omiri *et al*, 2006). Such a program must take into account existing oral health knowledge, attitudes, and practices (KAP) among OA children and their parents when developing such a program. There have been no previous studies of the KAP regarding oral health among OA children in Peninsular Malaysia. Therefore, we aimed to conduct a study to assess the oral health KAP of OA children in Peninsular Malaysia.

MATERIALS AND METHODS

We conducted a cross-sectional study using a validated self-filled questionnaire among OA primary school children in Pahang State, Peninsular Malaysia. Pahang State was chosen because it has the largest OA population in Peninsular Malaysia: 37.9% of the entire OA population (JHEOA, 2010). Cameron Highland (CH) District was selectively chosen within Pahang State as the study site for several reasons. First, CH has more OA primary schools than the other districts in Pahang State. Second, all the OA schools in CH are accessible by a four-wheel-drive vehicle. Third, all the schools in CH agreed to participate in the study. The schools also provided overnight accommodations for the study subjects during the weekdays. This resulted in a large number of OA children participating in the study.

The study inclusion criteria were (a) OA children aged 11-12 years who attended an OA school, (b) both parents were of OA origin, (c) the subjects had to be able to read and write in *Bahasa Malaysia*, and (d) parents gave consent to participate in the study.

There are 4 OA primary schools in CH district: Primary school (PS) Menson, PS Telanok, PS Terisu, and PS Lemoi. These schools have a total of 249 OA students aged 11-12 years. The sample size calculation was based on a 60% caries prevalence based on the results of a local study among OA children (Kadir and Yassin, 1990), 5% error, 80% precision, and calculated using the formula for the known population size to give an initial sample size of 157 (Krejcie and Morgan, 1970). This number was increased by 30% to 204 to account for non-respondents. Since the study sample size of 204 is not far from the total number of OA students aged 11-12 years of 249, we decided to include all students who met the inclusion and exclusion criteria in this study.

The self-administered questionnaire used for this study was adapted from a local questionnaire used to assess children's levels of oral health knowledge, attitudes and practices (Yusof and Jaafar, 2013). A focus group discussion involving a group of OA children not involved in the final study was conducted to assess the applicability and relevance of the questionnaire for use by OA children. Following the focus group discussion, minor changes were made to the questionnaire. Two additional items, betel nut chewing and use of teeth cleaning aids other than a toothbrush were added to the questionnaire. The questionnaire was content validated by dental public health specialists at the University of Malaya, followed by face validation by a group of OA children not involved in the final study.

The final questionnaire used was comprised of 44 items arranged in 5 sections: Sections A and B were comprised of 13 demographic items, Section C was comprised of 9 oral health knowledge (OHK) items, Section D was comprised of 13 oral health attitude (OHA) items and Section E was comprised of 9 oral health practice (OHP) items. A pre-test to assess the questionnaire's internal consistency resulted in Cronbach's alpha values of 0.52 and 0.68 for OHK and OHA sections, respectively. As a result, both the OHK and OHA sections were regarded as a scale each. However, the Cronbach's alpha for the OHP section was 0.38 which meant the OHP items had an unacceptable internal consistency (Cohen, 1988). Therefore, it was decided the OHP items would be described individually for each of the 9 items.

The OHK items consisted of questions about sugar intake, signs of caries and gum disease, dental plaque, fluoride use, oral disease prevention and oral habits. The OHA items consisted of 3 question themes: attitudes about tooth brushing (5 items), sugary foods/drinks intake (4 items), and betel nut chewing (4 items). The OHP items consisted of questions about tooth brushing frequency, fluoride toothpaste use, sugary food and drink intake, smoking, betel nut chewing and mouth rinsing.

For OHK and OHA items, answers were selected on a 5-point Likert scale: 1 point = strongly disagree, 2 points = disagree, 3 points = unsure, 4 points = agree and 5 points = strongly agree. For OHP items, answers were selected from a range of 8 answer options: never to >2 times/day.

Data collection took place at one school at a time until the four schools were covered. Prior to data collection, consent forms were distributed to the OA parents and collected by the classroom teacher two weeks later. On data collection day, the children were assembled in their respective classroom. Instructions to answer the questionnaire were given

by the researcher who then instructed the children in how to complete the questionnaire. After filling out the questionnaire, students were educated about oral health by the researcher. Free toothbrushes and fluoride toothpaste were distributed to each subject.

Data analysis

The OHK section consisted of 1 negative and 8 positive items and the OHA section consisted of 6 negative and 7 positive items. The scores for the negative items were reversed so a person who chose "strongly disagree" would score 5 points for those items and vice-versa. All negative items were reversed to positive items in all tables.

Total scores for the OHK and OHA sections were calculated by adding up the individual item points and converted into percentages. For OHK levels, a student was deemed to have a "good" level of OHK if he scored an average of ≥4 points in the 9 statements with a range of scores = 36-45 points (80-100%), a "moderate" level if he scored an average of ≥3 points but <4 points in the 9 statements with a range of scores = 27-35 points (60-79%) and a "poor" level if he scored an average of <3 points in the 9 statements with a range of scores <27 points (<60%). Likewise, for OHA levels, a "good" level has a range of scores = 52-65 points (80-100%), a "moderate" level has a range of scores = 39-51 points (60-79%) and a "poor" level has a range of score <39 points (<60%). For each item of the OHK and OHA sections, responses were categorized as "good" (5 points), "moderate" (4 points) and "poor" (1-3 points).

For OHP items, in addition to frequencies and percentages, items regarding tooth brushing habits, fluoride toothpaste use and mouth rinsing were categorized as "good" (≥2 times/day), "moderate" (once/day) and "poor" (<2-3x/week) (Davies *et al*, 2003; The American Dental Association, 2012). For smoking and chewing betel nut, each item was categorized as "good" (never) and "poor" (at least once in the past year) (Trivedy *et al*, 2002).

Data were analyzed using the Statistical Package for Social Sciences version 20 software (IBM, Armonk NY). Descriptive statistics such as frequency distribution and mean score were done to describe the data. Multiple linear regression analysis was used to identify factor(s) associated with OHK and OHA results.

Ethical approval for the study was obtained from the Medical Ethics Committee, Faculty of Dentistry, University of Malaya (No: DF DP 1206/0078L). The study was conducted in accordance with the World Medical Association Declaration of Helsinki (World Medical Association, 2013). Permission to conduct the study was obtained from the Department of Orang Asli Affairs, the Ministry of Education, the Pahang State Education Department, the CH District Education Department, the school headmasters and the parents of the study subjects.

RESULTS

The response rate was 91.2% (*n*=227/249). Table 1 shows the demographic characteristics of the study subjects. Overall, 51.5% were females and 66.5% were in the fifth year of schooling. In terms of parents' occupation, 27.3% of fathers worked as farmers while 59.5% of mothers were housewives. In terms of parents' education, 42.7% of fathers and 36.6% of mothers had education up to a secondary school level. In terms of family income, 26.4% of families had a monthly income of ≤RM500 (USD1.00=RM4.20).

Table 1
Demographic characteristics of the study subjects (*N*=227).

Variable	No. (%)
Gender	
Male	110 (48.5)
Female	117 (51.5)
Year in school	
Fifth (11-year-olds)	151 (66.5)
Sixth (12-year-olds)	76 (33.5)
Paternal occupation[a]	
Government worker	16 (7.0)
Private sector worker	60 (26.4)
Farmer	62 (27.3)
Laborer	23 (10.1)
Self-employed	41 (18.1)
Unemployed	18 (7.9)
Maternal occupation[a]	
Government worker	4 (1.8)
Private sector worker	6 (2.6)
Farmer	56 (24.7)
Laborer	1 (0.4)
Self-employed	23 (10.1)
Unemployed	135 (59.5)
Paternal education level[a]	
None	65 (28.6)
Primary school	40 (17.6)
Secondary school	97 (42.7)
Diploma	2 (0.9)
University	1 (0.4)
Maternal education level[a]	
None	65 (28.6)
Primary school	56 (24.7)
Secondary school	83 (36.6)
Diploma	2 (0.9)
University	1 (0.4)
Household income in RM[a]	
≤500	60 (26.4)
501-1,000	43 (18.9)
1,001-2,000	24 (10.6)
>2,000	7 (3.1)

[a]Total number does not equal to 227 due to missing data; USD1.00 = RM4.30; RM, Ringgit Malaysia.

Table 2 shows the OHK question scores among the study subjects. Seven of the 9 items had a mean score close to 3.0, indicating on average the children were unsure whether the 7 statements were true or false: 3 statements related to knowledge

Table 2

Oral health knowledge question scores among study subjects ($N = 227$).

No.	Oral health knowledge statements	Mean (SD)	Good score n (%)	Moderate score, n (%)	Poor score n (%)
1	Consuming a lot of sweet foods/drinks causes tooth decay.	3.0 (1.4)	55 (24.2)	23 (10.1)	149 (65.6)
2	A hole in a tooth is a sign of tooth decay.	2.8 (1.1)	22 (9.7)	37 (16.3)	168 (74.0)
3	Reducing sugary foods/drinks will reduce the risk of tooth decay.	3.3 (1.3)	51 (22.5)	54 (23.8)	122 (53.7)
4	Dental plaque can cause gum disease.	2.7 (1.2)	24 (10.6)	30 (13.2)	173 (76.2)
5	Bleeding gums is a sign of gum disease.	2.9 (1.2)	26 (11.5)	45 (19.8)	156 (68.7)
6	Brushing teeth with fluoride toothpaste can prevent tooth decay.	3.8 (1.2)	76 (33.5)	76 (33.5)	75 (33.0)
7	We are encouraged to brush our teeth twice a day.	3.6 (1.2)	60 (26.4)	92 (40.5)	75 (33.0)
8	The habit of chewing betel nut is bad for oral health.	3.2 (1.2)	32 (14.1)	70 (30.8)	125 (55.1)
9	Smoking is bad for gum health.	2.5 (1.2)	20 (8.8)	33 (14.5)	174 (76.7)
	Total score	27.8 (5.2)			
	Total percentage score	61.8 (8.2)			

Good score = 5 points; Moderate score = 4 points; Poor score = 1-3 points; SD, standard deviation.

Table 3

Oral health knowledge levels among the study subjects ($N = 227$).

	Good level (total score = 80-100%)	Moderate level (total score = 60-79%)	Poor level (total score <60%)
Oral health knowledge level, n (%)	14 (6.2)	97 (42.7)	116 (51.1)

about tooth decay, 2 statements related to knowledge about gum disease, 1 statement related to smoking and 1 statement related to betel nut chewing. Items 6 and 7 had a mean score close to 4.0, indicating on average the children agreed with both statements related to tooth brushing. Majority of the subjects had a "poor" score on 7 of the 9 items (percentage range= 53.7-76.7%), representing 77.8% of the OHK items.

Overall, the mean total score of the OHK section was 61.8% (SD = 8.2). When the total scores were categorized, 51.1% of the subjects had a "poor" level of OHK, 42.7% had a "moderate" level and only 6.2% had a "good" level of OHK. (Table 3).

Table 4 shows the OHA question scores among the study subjects. Five of the 13 items had a mean score close to 4.0, indicating on average the children agreed with the 5 statements: 3 statements related to attitudes regarding toothbrushing, 1 statement related to attitudes regarding sweet foods/drinks and 1 statement related to attitude regarding betel nut chewing. Another 5 of the 13 items had a mean score close to 3.0, indicating on average the children were unsure of the 5 statements: 3 statements related to attitudes regarding sweet foods/drinks and 2 statements related to attitudes regarding betel nut chewing. Majority of subjects had a "poor" score on 6 of the 13 OHA items (percentage range = 64.8-79.7%), representing 46.2% of the OHA items.

Overall, the mean total score of the OHA section was 76.3% (SD = 9.8). When the total scores were categorized, 18.9% had a "good" level of OHA, 61.7% had a "moderate" level and 19.4% had a "poor" level of OHA (Table 5).

Table 6 shows the frequency distribution of the OHP items. Overall, 83.7% of the subjects brushed teeth $\geq$2x/day, 80.2% used fluoride toothpaste $\geq$2x/day and 11.0% cleaned their teeth using cleaning aids other than a toothbrush $\geq$once/day. The majority of subjects reported they never smoked cigarettes (96.0%), 67.4% chewed betel nuts $\geq$once/day, 56.3% consumed sugary foods $\geq$2x/day, 53.8% consumed sugary drinks $\geq$2x/day, 54.6% rinsed their mouth after meal $\geq$2x/day and 97.8% went to see a dentist $\geq$once/year.

Table 7 shows the percentage distribution of selected OHP items. Overall, the majority of subjects had a "good" OHP related to tooth brushing (83.7%), fluoride toothpaste use (80.2%), smoking (96.0%), and mouth rinsing after meal (54.6%). However, 83.3% of the subjects had a "poor" practice regarding betel nut chewing.

Table 8 shows the results of a multiple linear regression analysis of factors associated with OHA scores. PS Lemoi is found to be the significant factor for OHA scores among the subjects ($p = 0.003$). The regression coefficient for the PS Lemoi is -4.80, meaning the children in PS Lemoi would have 4.80 points lower in mean OHA scores than the children in SK Terisu when other factors are similar. No significant factor was found for OHK scores among the subjects.

DISCUSSION

This was the first study conducted to assess the oral health KAP of OA children in Malaysia. The response rate was 91.2%. This high rate could be because data collection took place on the school premises during school hours.

The majority of subjects had poor level of knowledge about oral health. Higher scores were seen on only 2 of the

Table 4
Oral health attitude scores among the study subjects (N = 227).

No.	Statements	Mean (SD) score	Good score n (%)	Moderate score n (%)	Poor score n (%)
	Brushing teeth is important to me because:				
1	It makes my breath fresh.	4.1 (0.9)	83 (36.6)	103 (45.4)	41 (18.1)
2	It makes my confidence grow.	3.8 (1.1)	62 (27.3)	83 (36.6)	82 (36.1)
3	The mouth is a body area that needs cleaning.	4.1 (0.9)	75 (33.0)	111 (48.9)	41 (18.1)
4	It prevents my teeth from becoming yellow.	3.5 (1.2)	56 (24.7)	65 (28.6)	106 (46.7)
5	It prevents my teeth from decaying.	3.5 (1.2)	62 (27.3)	66 (29.1)	99 (43.6)
	Sweet foods/drinks:				
6	Are bad for my teeth.	3.2 (1.3)	28 (12.3)	50 (22.0)	149 (65.6)
7	Are not my favorite food items.	3.0 (1.1)	25 (11.0)	55 (24.2)	147 (64.8)
8	Consumption needs to be reduced.	3.6 (1.1)	53 (23.3)	84 (37.0)	90 (39.6)
9	Should not be sold at the school canteen.	3.2 (1.2)	24 (10.6)	44 (19.4)	159 (70.0)
	Chewing betel nut:				
10	Makes my teeth look unattractive.	3.5 (1.3)	24 (10.6)	31 (13.7)	172 (75.8)
11	Does not add freshness to my mouth.	3.4 (1.2)	18 (7.9)	28 (12.3)	181 (79.7)
12	Will harm my mouth.	3.3 (1.2)	23 (10.1)	36 (15.9)	168 (74.0)
13	Is a habit that should be avoided.	3.6 (1.2)	64 (28.2)	70 (30.8)	93 (41.0)
	Total score	45.7 (8.6)			
	Total percentage score	76.3 (9.8)			

Good score = 5 points; Moderate score = 4 points; Poor score = 1-3 points.
SD, standard deviation.

Table 5
Oral health attitude levels among study subjects (N = 227).

Oral health attitude level, n (%)	Good level (total score = 80-100%)	Moderate level (total score = 60-80%)	Poor level (total score <60%)
	43 (18.9)	140 (61.7)	44 (19.4)

Table 6
Oral health practice question frequencies among study subjects (N=227).

No.	Questions	>2x/day n (%)	2x/day n (%)	Once/day n (%)	2-3x/week n (%)	Once/week n (%)	Once/month n (%)	Once/2-12 months n (%)	Never n (%)
1	How often do you brush your teeth?	65 (28.6)	125 (55.1)	36 (15.9)	1 (0.4)	-	-	-	-
2	How often do you use toothpaste when brushing your teeth?	37 (16.3)	145 (63.9)	42 (18.5)	1 (0.4)	-	-	-	2 (0.9)
3	How often do you use anything other than a toothbrush to clean your teeth?	3 (1.3)	9 (4.0)	13 (5.7)	21 (9.3)	20 (8.8)	3 (1.3)	16 (7.0)	142 (62.6)
4	How often do you smoke cigarettes?	1 (0.4)	-	2 (0.9)	3 (1.3)	-	-	3 (1.3)	218 (96.0)
5	How often do you chew betel nut?	37 (16.3)	47 (20.7)	69 (30.4)	17 (7.5)	15 (6.6)	2 (0.9)	2 (0.9)	38 (16.7)
6	How often do you drink sugary drinks/carbonated drinks?	63 (27.8)	59 (26.0)	80 (35.2)	9 (4.0)	9 (4.0)	2 (0.9)	2 (0.9)	3 (1.3)
7	How often do you eat sugary foods, such as cakes/candy/chocolate/ice cream?	75 (33.0)	53 (23.3)	54 (23.8)	13 (5.7)	15 (6.6)	6 (2.6)	8 (3.5)	3 (1.3)
8	How often do you rinse your mouth with water after eating?	52 (22.9)	72 (31.7)	48 (21.1)	4 (1.8)	7 (3.1)	4 (1.8)	3 (1.3)	37 (16.3)
9	How often do you visit a dentist?	-	-	-	-	-	-	222 (97.8)	5 (2.2)

Table 7
Oral health practice question scores among study subjects (*N*=227).

No.	Questions	Good score *n* (%)	Moderate score *n* (%)	Poor score *n* (%)
1	How often do you brush your teeth?	190 (83.7)	36 (15.9)	1 (0.4)
2	How often do you use fluoride toothpaste when brushing your teeth?	182 (80.2)	42 (18.5)	3 (1.3)
3	How often do you smoke cigarettes?[a]	218 (96.0)	NA	9 (4.0)
4	How often do you chew betel nut? [a]	38 (16.7)	NA	189 (83.3)
5	How often do you rinse your mouth with water after eating?	124 (54.6)	48 (21.1)	55 (24.2)

Good score = ≥2x/day; Moderate score = once/day; Poor score = ≤2-3x/week
[a]Good score = never; Poor score = at least once in the past year.
NA, not applicable.

9 knowledge questions: knowledge about the need to brush teeth twice daily and about the preventive effect of fluoride against caries. This is not surprising since the children are examined yearly by a dental team and are educated about the need to brush teeth twice daily and the benefits of using fluoride toothpaste.

Despite having a good knowledge about brushing twice daily using fluoride toothpaste, the subjects had a poor knowledge about the role of sugar causing caries, the clinical signs of caries and the importance of reducing sugar to prevent caries. These findings indicate an inadequate knowledge about caries prevention and the effects of sugar on caries formation. Subjects also had a poor knowledge regarding gingivitis and gum disease. This suggests the education given at the yearly dental visits is not being remembered, understood or applied. Further studies of the education given during the yearly dental visits are needed to understand how to improve uptake and application of this knowledge. No oral health education has been included in the classroom. Our findings are similar to those of a study of school children from Jordan where knowledge regarding gum disease was poor (Al-Omiri *et al*, 2006).

The majority of subjects had a moderate to good knowledge about and attitude toward tooth brushing. This finding suggests a subject's knowledge was associated with attitude similar to other studies (Petersen *et al*, 1995; Östberg *et al*, 1999; Lin *et al*, 2001; Zhu *et al*, 2003; Poutanen *et al*, 2005; Al-Omiri *et al*, 2006). However, a temporal relationship between knowledge and attitude could not be determined due to the cross-sectional study design (Aday and Cornelius, 1996).

The subjects' attitudes about consuming sweet foods/drinks were poor. The

Table 8
Simple and multiple linear regression analyses of factors associated with OHA scores.

	Simple linear regression analysis		Multiple linear regression analysis	
	b^a (95%CI)	p-value	b^a (95%CI)	p-value
Gender				
Male	0		0	
Female	1.98 (0.22, 3.75)	0.028[b]	1.62 (-0.23,3.48)	0.087
Schools				
PS Terisu	0		0	
PS Menson	-0.46 (-3.08,2.16)	0.729	-2.65 (-5.71, 0.40)	0.088
PS Lemoi	-4.19 (-7.32, -1.05)	0.009[b]	-4.80 (-7.99, -1.61)	0.003[b]
PS Telanok	-1.18 (-3.61, 1.25)	0.339	-1.80 (-4.29, 0.68)	0.154
Paternal education level				
No formal education	0		0	
Primary school	2.65 (-0.01, 5.30)	0.051	2.78 (-0.39, 5.95)	0.085
Secondary school or higher	3.33 (1.22, 5.43)	0.002[b]	2.53 (-0.28, 5.34)	0.077
Maternal education level				
No formal education	0		0	
Primary school	1.26 (-1.15, 3.68)	0.303	-0.57 (-3.38, 2.25)	0.691
Secondary school or higher	3.09 (0.92, 5.227)	0.006[b]	1.93 (-1.00, 4.87)	0.195

b^a = b coefficient; [b]$p<0.05$; CI = confident interval.

majority felt consuming sweet foods/drinks was not harmful to their teeth. Most liked sweet foods/drinks and would not mind if they were sold in the school canteen.

Among our study subjects, the majority had a poor attitude and a poor knowledge about betel nut chewing. The majority of study subjects did not agree chewing betel nut makes their teeth look unattractive. They also did not believe chewing betel nut does not freshen their breath and did not believe the habit was harmful. However, the majority agreed/strongly agreed the habit should be avoided. Their opinion that the habit should be avoided could be the result of the oral health education given by the dental team. The dental team incorporates messages

against betel nut chewing to the children as the habit is quite prevalent among OA population in Malaysia (Ghani *et al*, 2011). The subjects' population should also be educated about the negative effects of chewing betel nut, including it being a risk factor for oral cancer (Warnakulasuriya *et al*, 2002).

In our study, the majority of study subjects had good practices in 5 of the 9 OHP items. The majority of study subjects reported brushing their teeth with fluoride toothpaste at least twice daily. This finding could be the result of the yearly dental team efforts to educate the subject population about good oral hygiene habits at each visit. It appears that tooth brushing alone is not sufficient to prevent the high prevalence of caries in the study

subjects. The diet of the study population must also be addressed effectively.

Overall, 80.1% of the subjects consumed sugary foods and 89.0% consumed sugary drinks at least once daily. These proportions were higher than the 26.3% of subjects who consumed sugary foods and 30.1% of subjects who consumed sugary drinks in a study from Sarawak State (Cheah *et al*, 2010) or the overall 20.1% among children aged 12-15 years from Shaanxi, China (Gao *et al*, 2014).

In our study, 83.3% of the subjects had experience chewing betel nut while 67.4% reported chewing betel nut at least once daily. Betel nut chewing has also been reported from other populations in Southeast Asia (Htin *et al*, 2014; Myint *et al*, 2016). Betel nut chewing is associated with oral cancer (Trivedy *et al*, 2002). Some of our subjects reported beginning to chew betel nut as early as 5 years old, copying their parents, grandparents and other community members, similar to findings from other studies when onset of betel nut chewing began in childhood (Ko *et al*, 1992; Lu *et al*, 1993; Yang *et al*, 1996). Any effort to tackle the problem of betel nut chewing in Malaysia must address the socio-cultural norms of the OA community. It is important to target village elders and tribal leaders in such a program. One way to address the betel nut chewing is by applying the health promotion principles to the community to overcome the socio-cultural barriers for change (WHO, 1986). School children should be targeted in school-based programs and educated about the risks of betel nut chewing.

The majority of study subjects reported they had never smoked before. Those who did smoke reported using a range of tobacco products including factory and home-made cigarettes. This finding is similar to other studies among aborigines from Malaysia, Australia and New Zealand (Saub and Jaafar, 2001; Minichiello *et al*, 2015). Oral health programs should include avoiding cigarette smoking and avoiding betel nut chewing in this study population; both of these habits are associated with increased risk for developing oral cancer (Phukan *et al*, 2001; Elton-Marshall *et al*, 2011; Lin *et al*, 2011).

The majority of our study subjects rinsed their mouths daily, similar to another study where mouth-rinsing was regarded as an appropriate method to clean the teeth if toothbrushing is not possible (Petersen *et al*, 2005).

It is not clear why the children in PS Lemoi had poorer oral health attitudes than the children from the other schools. It could be because Lemoi was the most remote study area where attitudes towards oral health may be poorer.

This study had some limitations. The sample size was relatively small, but was adequate based on the required sample size calculation. The study was only conducted among children aged 11-12 years because it was deemed children this age had adequate cognitive ability to read, understand and answer the questionnaire appropriately. This questionnaire was originally developed and validated for a similar age group in a mixed socio-economic setting in Malaysia (Yusof and Jaafar, 2013).

Future studies are needed to investigate the socio-cultural role of betel nut chewing in the OA community, its prevalence, and how this habit could be addressed effectively. A study to develop and test a school-based oral health promotion program is also recommended to improve the oral health practices in this population taking into account these findings.

In summary, our study subjects had poor and moderate oral health knowledge and attitudes levels, respectively. Although the majority of subjects brushed their teeth >2x/day with fluoride toothpaste, the majority also chewed betel nut >once/day. A school-based oral health promotion program is recommended to promote positive oral health knowledge, attitudes and practices to improve the oral health and well-being of the study population.

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