

Original Article

Effect of oral health education programme on oral health awareness and plaque maturity status among hearing-impaired children

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Abstract Many studies have indicated that hearing-impaired (HI) children have poor oral hygiene mainly contributed by difficulties in communication. The objectives of the study were to assess the difficulties experienced by HI children during dental visit and the effectiveness of “Oral Health Care for the Hearing-Impaired” (OCHI) programme in improving the oral health knowledge and practice, and reducing the dental plaque maturity scores among HI children. A community intervention study was conducted and training of trainers (TOT) was done to train the teachers in delivering oral health education (OHE) and practices by using developed booklet and video. The difficulties faced by the HI children during dental visit, and the oral health knowledge and practice (OHKP) were assessed by face-to-face interview with HI children whilst the dental plaque maturity was assessed using GC Tri Plaque ID Gel™ (TPID) during pre-intervention, post-intervention-1 and post-intervention-2. Data were analysed using SPSS version 22. Among the teachers, there was an increase in the mean (SD) total knowledge and attitude score during post-TOT compared to pre-TOT, 46.1 (2.44) and 43.7 (4.01); ($p < 0.001$) and 16.7 (2.11) and 14.3 (2.38); ($p < 0.001$) respectively. For the oral health practice, there were positive changes in practice among teachers during post-TOT compared to pre-TOT. There were also significant changes in mean knowledge scores of HI children with time ($p = 0.003$) and the plaque maturity scores were significantly reduced during post-intervention-1 and post-intervention-2. Thus, the OCHI programme was effective in improving oral hygiene among HI children. However, the inconsistent pattern was observed for their oral health practices that need further research.

Keywords: Dental; dental plaque; health education; hearing loss; oral health.

Introduction

Two hundred and seventy five million people globally had moderate to profound hearing impairment, whereby 80% of them were from low and middle income countries (WHO, 2013). In a 2005 survey, the prevalence of hearing impairment in Malaysian general population was 17.14% (National ORL Registry, 2011).

Difficulties in communication hinder hearing-impaired (HI) individuals from gaining good knowledge regarding proper health care. Thus, there is a need for medical or dental personnel to learn some basic manual signs or finger spelling to ensure that oral health messages could be delivered effectively (Thornton and Wright, 1989). Maintaining good oral hygiene is

important to prevent dental problems such as caries and periodontal disease. This habit should be nurtured during childhood and become part of self-grooming. However, several studies indicate that HI children had been shown to have poor oral hygiene, high prevalence of caries and unmet needs of treatment (Jain *et al.*, 2008; Kumar *et al.*, 2008). The prevalence of dental caries among 5-22 years old subjects in an institution for HI in India was 83.92% (Jain *et al.*, 2008). Kumar *et al.* (2008) reported that prevalence of periodontal disease among HI was 58% with majority (76%) had fair to poor oral hygiene. Jain *et al.* (2008) also found that among their HI children, 79.5% had one surface filling and 22.1% need two surface filling. A study in China showed upon comparing 229 HI individuals studying in

special school and healthy 196 individuals aged 17-19, the HI group were lacking in oral health knowledge, lacking in effective oral health practice with the caries prevalence of 55.9% compared to normal individual, 13.3% (Wei *et al.*, 2012). Thus, dental health education is important to improve the oral health awareness and to promote better oral hygiene (Ballal and Ahmed, 2010; Jain *et al.*, 2008; Oredugba and Akindayomi, 2008).

Teachers can be trained to be an oral health educators (Ehizele *et al.*, 2011). However, the teachers had difficulties in delivering oral health information to the children due to lack of materials such as video or oral health written information or appropriate activities to teach oral health at school (Kubo *et al.*, 2014). The aims of this study were to identify the difficulties experienced by HI children during dental visit and to assess the effectiveness of 'Oral Health Care for the Hearing Impaired' (OCHI) programme in improving the oral health knowledge, practices in oral health care and the severity of mature dental plaque among HI children.

Materials and methods

Ethical approval was obtained from the Human Research Ethics Committee, Universiti Sains Malaysia, USM/JePEM/280.5(1.4) and Department of Special Education, Ministry of Education Malaysia and Kelantan Education Department Malaysia (Reference no: KP(BPPDP)603/5/Jld.100) to conduct the study at schools.

A community intervention study was conducted using the training of trainers (TOT) concept. In this study, the teachers of HI children were chosen to become the trainers. The study was conducted at one of the special schools for the deaf in the state of Kelantan, Malaysia from June to November 2014. Power and Sample Size Calculations (PS) software (Dupont and Plummer, 1998) was used to calculate the sample size for the teacher based on comparing the mean knowledge of oral health among teachers before and after intervention which was 45.8, standard deviation (SD) of 2.38 and detectable

difference (DD) of 1 unit (Seman *et al.*, 2008). For the HI children, the sample size was calculated based on comparing the mean plaque scores of HI children before and after intervention which was 0.62, SD of 0.33 with a DD of one unit plaque score (Hebbal *et al.*, 2011). Therefore, a total of 46 teachers and 29 HI children were needed in this study at the power of 90% and alpha of 0.05.

All the teachers at the selected school were included except those who did administrative work and were not involved in teaching activities. The inclusion criteria were HI children aged 7-14 years old and without impaired manual dexterity. For the HI, those who were unable to read or understand sign language were excluded. The hearing impairment is graded as mild, moderate, severe and profound base on the hearing threshold during the hearing test. Hearing threshold between 26-40 dB is graded as mild, 41-60 dB is graded as moderate, 61-80 dB as severe and when the threshold reached 81 dB and above, the hearing impairment is graded as profound (WHO, 2013). The sociodemographic profiles of the normal children and HI children consists of their ages, genders, level of parents' education and level of hearing impairment were previously reported (Haliza *et al.*, 2016). The interventional study was divided into two phases.

Phase 1

At the initial stage, the oral health knowledge, attitude and practice (KAP) of the teachers were assessed to obtain pre-TOT data. A self-administered questionnaire was conducted using a questionnaire adopted from Ramroop *et al.* (2011) which consisted of three domains; knowledge, attitude and practices regarding oral health. The domain of knowledge consisted of 25 items with 'yes', 'no' and 'do not know' response. The score for the answers ranged from 0 to 2. The correct answer scored 2, while the wrong answer scored 0 and 'do not know' scored 1. The minimum score was 0 while the maximum score was 50 (D'Cruz and Aradhya, 2013). For the attitude domain, it consisted of 5 items with 5 Likert

scales ranging from 'strongly agree', 'agree', 'not sure', 'not agree' and 'strongly disagree'. Reverse coding was done in negatively worded statement. The minimum score was 5 while the maximum score was 25. Practice domain consisted of 6 items in which the teachers had to tick the correct answer. The score for the answers was calculated based on the frequency of each item.

For HI children, a face-to-face interview by trained interviewers was based on a questionnaire adopted from Siddibhavi *et al.* (2011) for oral health knowledge and practice part while experience during dental visit was by Champion and Holt (2000). After the interview session, a clinical oral examination was carried out by a single trained examiner to assess the dental plaque maturity level among HI children by using GC Tri Plaque ID Gel™ (TPID), GC Corporation, Japan (Haliza *et al.*, 2016). TPID was applied to all tooth surfaces using a microbrush. The children were then instructed to lightly rinse their mouth with tap water. Immediately after rinsing, the colour changes were observed and were coded into different score in order to assess the stage of maturity of dental plaque on each surface except for occlusal. The colour changes were coded into different coding in order to assess the severity of the dental plaque maturity on each surface. TPID colour changes indicated that no colour; no plaque, pink or red; immature plaque, blue or purple; mature plaque and light blue; mature and acid producing plaque which scored '0', '1', '2' and '3' respectively. Partially erupted teeth or badly carious tooth were also excluded from the assessment. Based on the colour changes on the total surfaces, the sum of dental plaque maturity scores (DPMS) was obtained by using a formula:

$$\text{DPMS} = \frac{\text{No plaque (0) + immature plaque (1) + mature plaque (2) + acid producing plaque (3)}}{\text{Number of surface evaluated}}$$

The range of the numerical severity of the dental plaque maturity score was between 0 to 3 for each child. The children were allowed to look into the mirror to see the

stained plaque area and advised on good oral hygiene practice, especially among children with mature dental plaque. The children were advised to get further treatment if there was any caries or dental treatment needed. After the dental plaque maturity was assessed, the children were advised to brush their teeth before they went back to the class.

Phase 2

In this phase, oral health education (OHE) materials were developed to assist the teachers in delivering OHE to HI children. The developed OHE materials were a booklet entitled 'Oral Health Care Module for Hearing-Impaired Children' and a video entitled 'Oral Health Care for Children'. The whole intervention programme in this phase was named as 'Oral Health Care for the Hearing-Impaired' (OCHI) programme.

The contents were prepared by two dental public health specialists, one otologist and two laymen who were not in the field of dentistry. The layman's terms were used in order to facilitate the teachers to convey the oral health messages to HI children. Pictures and cartoon graphics were included in the booklet and video to capture interest among the readers and audiences. The contents of the booklet and video were about healthy diet related to good oral health, the importance of dental plaque control to prevent dental caries and periodontal disease, the role of fluoride and the importance of regular dental visit. Both the booklet and video were distributed to the teachers of HI children and the sign language were included in the video to assist the communication with HI children in delivering oral health message.

A half-day course of OCHI programme for HI teachers was conducted at the special school for the deaf which included oral health talks, question and answer session and demonstration on the effective tooth brushing and flossing technique. The modified Bass technique was introduced during the tooth brushing demonstration (TBD) session. The same questionnaire was given to the teachers immediately after the programme to assess the post-TOT.

The video that was provided to the teachers was played every Sunday before the school assembly for four weeks. The teachers were asked to deliver oral health messages and monitor the TBD done by HI children after their recess every day that took about five minutes. The children were provided with a soft bristled toothbrush and fluoridated toothpaste for the TBD session. The booklets were also given to HI children for their daily reference and guidance in achieving effective oral health care. The post-intervention evaluation for HI children was carried out within three to five days (post-intervention-1) and followed by four weeks (post-intervention-2) after the intervention.

Statistical methods

All data were processed in IBM SPSS version 22.0 statistical software. Descriptive statistic was done. Paired t-test was applied to compare pre-post TOT of the mean knowledge, practice and attitude scores among teachers. Repeated measure ANOVA was utilised to analyse the difference and changes in means of knowledge scores and DPMS within HI children. The p -value was set as significant at $p < 0.05$.

Results

A total of 31 teachers were recruited in this study (Table 1). The mean (SD) age of the teachers was 36.1 (6.60) years and the majority were females (80.6%). All were Malays and more than half of the teachers received the tertiary level of education from both of Institute of Teacher Training and university with their mean (SD) working experience was 9.8 (6.77) years. Information regarding oral health care was gathered mostly from the dentist and television.

As for HI children, a total of 64 of them participated in this study as shown in Table 2. The mean (SD) age of the HI children was 12.0 (2.12) years and most of them were having severe (28.8%) to profound (61.0%) hearing impairment. More than half (57.8%) of HI children used a hearing aid with 4.7% of them had a cochlear implant. These profiles were published by Haliza *et al.* (2016) and presented here for comparison of the intervention findings and further discussion.

Table 1 Sociodemographic characteristics of teachers (n=31)

Characteristics	Mean (SD)	n (%)
Age (years)	36.1 (6.60)	
Sex		
Male		6 (19.4)
Female		25 (80.6)
Race		
Malay		31 (100)
Place of tertiary education		
Institute of Teacher Training		12 (38.7)
University		19 (61.3)
Working experience (years)	9.8 (6.77)	
Source of health information		
Medical doctor		2 (6.5)
Dentist		21 (67.7)
Nurse		3 (9.7)
Dental nurse		20 (64.5)
Family		7 (22.6)
Friends		9 (29.0)
Television		21 (67.7)
Radio		2 (6.5)
Magazine		19 (61.3)
Newspaper		14 (45.2)
Pamphlets		15 (48.8)
Internet		17 (54.8)
Others		1 (3.2)

The HI children were allowed to select more than one answer when asked about the difficulties experienced by them during their dental visit and also the reasons which made up the total number of more than 62. As shown in Table 3, the most common difficulty was inability to hear when being called from the waiting area (69.4%), followed by difficulties to communicate with dental nurse or dentist, both 66.1%. The other (59.7%) were not able to understand the information given by the dentist during the dental visit. The respondents agreed that the most common reason for their difficulties experienced during dental visit was that the dentist or dental nurse did not know sign language (85.5%). It was also agreed with 43.5% that the dentist or dental nurse who wore a face mask was also a contributing reason for their communication difficulties. Not only that, 30.6% of the respondents claimed that noisy background at the dental clinic was one of the barriers for effective communication.

Table 2 Sociodemographic characteristics of HI children (n=64)

Variables	n (%)
Age (years)	12.0 (2.12) ^a
Sex	
Male	30 (46.9)
Female	34 (53.1)
Ethnic	
Malay	64 (100.0)
Parents' education (n=63)^c	
Primary	3 (4.8)
Secondary	48 (76.2)
Tertiary	12 (19.0)
Monthly family household income (RM)	705 (738.00) ^b
Level of hearing impairment (n=59)^c	
Mild	2 (3.4)
Moderate	4 (6.8)
Severe	17 (28.8)
Profound	36 (61.0)
Use of hearing aid	
No	27 (42.2)
Hearing aid	34 (57.)
Cochlear Implant	3 (4.7)

^a mean (SD), ^b Median (IQR), ^c incomplete data in the school record

Comparison of mean oral health knowledge and attitude among teachers during pre-TOT and post-TOT

There was an increase in the mean (SD) of the total knowledge score during post-TOT when compared to pre-TOT, 46.1 (2.44) and 43.7 (4.01) respectively ($p < 0.001$). The mean attitude scores also increased during post-TOT compared to pre-TOT, 16.7 (2.11) and 14.3 (2.38) respectively ($p < 0.001$) (Table 4). As shown in Table 5, there were positive changes in oral health practice

among teachers during post-TOT compared to pre-TOT such as dental visit every 6-12 months; 36.7% at post-TOT compared to 19.4% during pre-TOT and reason for last dental visit due to dental pain; 60.0% at post-TOT compared to 80.6% % during pre-TOT. The practice of brushing the teeth twice per day has increased from 41.9% at pre-TOT to 73.3% during post-TOT. There were not much changes on time of tooth brushing the teeth in the morning and before bedtime, during pre and post-TOT. There was an increase in the percentage of duration of tooth brushing for two minutes or more during post-TOT (73.3%) compared to pre-TOT (71.0%) (Table 5).

Table 3 Difficulties experienced by HI children during dental visit and their reasons

Items	n (%)
Difficulties experienced	
Unable to hear when being called at the waiting area	43 (69.4)
Difficult to communicate with the dental nurse	42 (66.1)
Difficult to communicate with the dentist	42 (66.1)
Unable to understand the information given by dentist	37 (59.7)
Reasons	
The dentist / dental nurse is wearing a face mask	27 (43.5)
Noisy background	19 (30.6)
Dentists / dental nurses do not know sign language	53 (85.5)

Table 4 Comparison of total oral health knowledge and attitude score among teachers during pre-TOT and post-TOT (n=30)

Variables	Pre-TOT Mean (SD)	Post-TOT Mean (SD)	Mean difference (95% CI)	t-stat (df)	p-value
Knowledge	43.7 (4.01)	46.1 (2.44)	2.4 (1.04, 3.82)	3.57 (29)	<0.001
Attitude	14.3 (2.38)	16.7 (2.11)	2.4 (1.60, 3.26)	5.99 (29)	<0.001

Table 5 Oral health practice among teachers during pre-TOT (n=31) and post-TOT (n=30)

	pre-TOT n (%)	post-TOT n (%)
Dental visit		
6-12 months	6 (19.4)	11 (36.7)
Occasionally	9 (29.0)	13 (43.3)
When pain occurs	15 (48.4)	6 (20.0)
Never	1 (3.2)	0 (0)
Reason of last dental visit		
Dental pain	25 (80.6)	18 (60.0)
Advice from family and friends	2 (6.5)	3 (10.0)
Advice from dentist	7 (22.6)	9 (30.0)
Others	6 (19.4)	5 (16.7)
Regular visits to the dentist are necessary	30 (100)	30 (100)
Frequency of tooth brushing in a day		
Never	0 (0)	0 (0)
Once	0 (0)	0 (0)
Twice	13 (41.9)	22 (73.3)
>Twice	18 (58.1)	8 (26.7)
Time of tooth brushing		
Morning	30 (96.8)	30 (100)
After lunch	16 (51.6)	9 (30.0)
Before bedtime	29 (93.5)	28 (93.3)
Duration of tooth brushing (minutes)		
<2	9 (29.0)	8 (26.7)
≥2	22 (71.0)	22 (73.3)

Comparison of oral health knowledge and practice among HI children during pre-intervention and post-intervention

There were some attrition of the number of subjects during the intervention phase due to absenteeism.

Oral health knowledge

Among HI children, there were some fluctuations on knowledge of specific items which increased during post-intervention 1 compared to pre-intervention, and decreased during the post-intervention 2 such as the signs of dental caries, the causes of dental caries particularly due to bacteria and infrequent tooth brushing regularly, dental caries may affect the facial appearance and caries prevention (Table 6). Generally, in most of the items, the percentages of knowledge during post-intervention 2 were still higher when compared to the pre-intervention. Items that showed an increase in knowledge during both interventions included the

causes of dental caries due to the amount of sugary food taken, bleeding on brushing as the sign of gingivitis and cigarette smoking as a factor for gum disease. Half of the HI children knew that gum disease can be prevented through eating a good diet, regular tooth brushing and by visiting the dentist, during pre-intervention, post-intervention 1 and post-intervention 2. There were less than one-third of HI children knew that the role of fluoride was not for cleaning the teeth; 16.1%, 15.3% and 19.6% during pre-intervention, post-intervention 1 and post-intervention 2 respectively. The knowledge that fluoride does not strengthen the teeth increased during post-intervention 2 (28.3%). However, during post-intervention 2, less than half (47.8%) of the respondents knew that fluoride can prevent dental caries. There was a significant difference of mean (SD) knowledge score within the group with time; pre-intervention, post-intervention 1 and post-intervention-2 ($p=0.003$) (Table 7).

Table 6 Oral health knowledge among HI children during pre-intervention, post-intervention 1 and post-intervention 2

OH knowledge Items	Pre-intervention (n=62)			Post-intervention 1 (n=59)			Post-intervention 2 (n=46)		
	Yes n (%)	No n (%)	Do not know n (%)	Yes n (%)	No n (%)	Do not know n (%)	Yes n (%)	No n (%)	Do not know n (%)
Signs of dental caries									
Cavitation	33 (53.2)	13 (21.0)	16 (25.8)	31 (52.5)	18 (30.5)	10 (16.9)	23 (50.0)	15 (32.6)	8 (17.4)
Toothache	29 (46.8)	21 (33.9)	12 (19.4)	31 (52.5)	23 (39.0)	5 (8.5)	18 (39.1)	22 (47.9)	6 (13.0)
Cause of dental caries									
Amount of sugary diet	32 (51.6)	19 (30.6)	11 (17.7)	35 (59.3)	17 (28.8)	7 (11.9)	28 (60.9)	13 (28.3)	5 (10.9)
Bacteria	22 (35.5)	15 (24.2)	25 (40.3)	32 (54.2)	13 (22.0)	14 (23.7)	12 (26.1)	1 (45.7)	13 (28.3)
Infrequent tooth brushing regularly	24 (38.7)	21 (33.9)	17 (27.4)	37 (62.7)	15 (25.4)	7 (11.9)	11 (23.9)	28 (60.9)	7 (15.2)
Dental caries may affect the appearance	28 (45.2)	7 (11.3)	27 (43.5)	36 (61.0)	7 (11.9)	16 (27.1)	25 (54.3)	14 (30.4)	7 (15.2)
Knowledge on caries prevention									
Regular tooth brushing	44 (71.3)	11 (17.7)	7 (11.3)	52 (88.1)	3 (5.1)	4 (6.8)	30 (65.2)	9 (19.6)	7 (15.2)
Less sugary diet intake	36 (46.4)	10 (7.6)	18 (25.8)	39 (66.1)	16 (27.1)	4 (6.8)	19 (41.3)	16 (34.8)	2 (23.9)
Causes of bleeding on brushing									
Gingivitis	28 (45.2)	21 (33.9)	13 (21.0)	29 (49.2)	26 (44.1)	4 (6.8)	25 (54.3)	17 (37.0)	4 (8.7)
Dental caries	21 (34.4)	18 (29.5)	22 (36.1)	29 (49.2)	22 (37.3)	8 (13.6)	20 (43.5)	16 (34.8)	2 (21.7)
Knowledge of gum disease									
Bacteria	27 (43.5)	18 (29.0)	17 (27.4)	18 (30.5)	28 (47.5)	13 (22.0)	20 (43.5)	15 (32.6)	11 (23.9)
Sugary diet	34 (54.8)	13 (21.0)	15 (42.2)	25 (42.2)	20 (33.9)	14 (23.7)	30 (65.2)	7 (15.2)	9 (19.6)
Lack of vitamins	23 (37.1)	20 (32.3)	19 (30.6)	31 (52.5)	16 (27.1)	12 (20.3)	23 (50.0)	8 (17.4)	15 (32.6)
Cigarette smoking	16 (25.8)	33 (53.2)	13 (21.0)	20 (33.9)	24 (40.7)	15 (25.4)	19 (41.3)	19 (41.3)	8 (17.4)
Gum disease prevention									
Good diet	35 (58.1)	8 (12.9)	18 (29.0)	44 (74.6)	9 (15.3)	6 (10.2)	23 (53.0)	12 (26.1)	11 (23.9)
Regular tooth brushing	35 (56.5)	12 (19.4)	15 (24.2)	46 (78.0)	7 (11.9)	6 (10.2)	29 (63.0)	14 (30.4)	3 (6.5)
Dental visits	35 (56.5)	11 (17.7)	16 (25.8)	47 (79.7)	9 (15.3)	3 (5.1)	27 (58.7)	9 (19.6)	10 (21.7)
Role of fluoride									
Tooth cleaning	43 (69.4)	10 (16.1)	9 (14.5)	46 (78.0)	9 (15.3)	4 (6.8)	37 (80.4)	9 (19.6)	0
Strengthening teeth	39 (62.9)	10 (16.1)	13 (21.0)	48 (81.4)	7 (11.9)	4 (6.8)	21 (45.7)	13 (28.3)	12 (26.1)
Caries prevention	23 (37.1)	22 (35.5)	17 (27.4)	42 (71.2)	15 (25.4)	2 (3.4)	22 (47.8)	15 (32.6)	9 (19.6)

Table 7 The effect of time on oral health knowledge among HI children

Intervention	n	Knowledge score Mean (95% CI)	F statistic (df)	p-value ^a
Pre-intervention	62	23.9 (22.18, 25.56)	6.32 (2,88)	0.003
Post-intervention 1	59	26.24 (24.31, 28.18)		
Post-intervention 2	46	22.51 (20.52, 24.50)		

^a Repeated measure ANOVA. Pairwise comparisons with Bonferroni correction show significant differences for all pairs. The Mauchly's test indicated the assumption of sphericity was met $\chi^2(2)=0.984$, $p=0.713$.

Table 8 Oral health practice of HI children during pre-intervention, post-intervention 1 and post-intervention 2

OH practice items	Pre-intervention	Post-intervention 1	Post-intervention 2
	(n=62)	(n=59)	(n=46)
	n (%)	n (%)	n (%)
Dental visits			
6–12 months	15 (24.2)	9 (15.3)	5 (10.9)
Occasionally	0 (0.0)	3 (5.1)	6 (13.0)
When pain occurs	12 (19.4)	10 (16.9)	12 (26.1)
School dental service	35 (56.5)	37 (62.7)	23 (50.0)
Reason for last dental visit			
Dental pain	25 (40.3)	26 (44.1)	7 (15.9)
Advice from family and friends	21 (33.9)	21 (35.6)	17 (37.0)
Advice from dentist	18 (29.0)	22 (37.3)	26 (56.5)
First dental visit			
Fear and anxiety	22 (35.5)	13 (22.0)	18 (39.1)
Fear	12 (19.4)	22 (37.3)	16 (34.8)
Less fear	10 (16.1)	5 (8.5)	8 (17.4)
No fear	18 (29.0)	19 (32.2)	4 (8.7)
Regular dental visits			
Yes	39 (62.9)	49 (83.1)	36 (78.3)
No	23 (15.1)	10 (16.9)	10 (21.7)
Frequency of tooth brushing a day			
Never	6 (9.7)	2 (3.4)	4 (8.7)
Once	15 (24.2)	8 (13.6)	13 (28.3)
Twice	19 (30.6)	32 (54.2)	22 (47.8)
> Twice	22 (35.5)	17 (28.8)	7 (15.2)
Time of tooth brushing			
Morning	48 (77.4)	46 (78.0)	32 (69.6)
After lunch	25 (40.3)	30 (50.8)	17 (37.0)
Before bedtime	41 (46.4)	43 (72.9)	27 (58.7)
Duration of tooth brushing (minutes)			
< 2	38 (61.3)	35 (59.3)	28 (60.9)
≥ 2	24 (38.7)	24 (37.5)	18 (39.1)
Observation while brushing			
Parent/guardian	26 (41.9)	21 (35.6)	21 (45.7)
Never but advice	8 (12.9)	21 (35.6)	12 (26.1)
Never	6 (9.7)	9 (15.3)	6 (13.0)
Only mother/guardian	22 (35.5)	8 (13.6)	7 (15.2)

Oral health practice

Table 8 shows the oral health practice at pre-intervention, post-intervention 1 and post-intervention 2 among HI children. The HI children often visited the dentist or dental nurse mostly during the school dental visit. The main reason for the last dental visit was due to dental pain; 40.3% and 44.1% at pre-intervention and post-intervention 1 respectively. At post-intervention 2, the main reason for the last dental visit was due to advice given by a dentist or dental nurse (56.5%). In terms of

dental fear, more than one-third of the children were scared and hesitant when first visited the dentist as assessed at pre-intervention (35.3%) and post-intervention 2 (39.1%); whereas at post-intervention 1, mostly felt a bit scared (37.3%). More than two-third of the HI children agreed that regular visits to the dentist were necessary; 62.9%, 83.1% and 78.3% at pre-intervention, post-intervention 1 and post-intervention 2 respectively. The results for brushing twice per day have increased during post-intervention 1 (54.2%) and post-intervention 2 (47.8%)

compared to during pre-intervention (30.6%). Majority of the children brushed their teeth in the morning as assessed at pre-intervention (77.4%), post-intervention 1 (78.0%) and post-intervention 2 (69.6%). The frequency of HI children brushing the teeth before sleep at night has increased at post-intervention 1 (72.9%) compared to pre-intervention (46.4%). When compared between post-intervention 2 and post-intervention 1, the percentage has decreased at post-intervention 2 (58.7%), but still higher when compared with pre-intervention.

There were more than half of the HI children who still brushing the teeth less than two minutes; 59.3% during post-intervention 1 and 60.9% during post-intervention 2 when compared to 61.3% during pre-intervention. Most of the parents or guardian observed the HI children brushing their teeth as assessed during post-intervention 2 (45.7%) compared to during pre-intervention (41.9%).

Comparison of dental plaque maturity among HI children during pre-intervention, post-intervention 1 and post-intervention 2

Table 9 shows the results of the difference of dental plaque maturity scores between pre-intervention and post-intervention 1, pre-intervention and post-intervention 2 and between post-intervention 1 and post-intervention 2 using repeated measure ANOVA. There were significant reductions in plaque maturity scores at the end of both post-interventions compared to pre-intervention.

At baseline, only 34.4% of HI children had immature plaque whilst 65.6% had mature and acid-producing plaque. However, after post-intervention 1, those who had mature plaque had reduced to 7.5% and in post-intervention 2, there was none of them had mature plaque (Table 10).

Table 9 The effect of time on dental plaque score among HI children

	n	Plaque scores Mean (95% CI)	F statistic (df)	p-value ^a
Pre-intervention	61	1.8 (1.60, 1.93)	65.02 (2,76)	<0.001
Post-intervention 1	53	1.2 (1.19, 1.29)		
Post-intervention 2	41	1.1 (1.04, 1.10)		

^a Repeated measure ANOVA. Pairwise comparisons with Bonferroni correction show significant differences for all pairs. The Mauchly's test indicated the assumption of sphericity was violated $\chi^2(2)=0.248$, $p<0.001$). Therefore, degrees of freedom were corrected using Greenhouse-Geisser estimate of sphericity ($\epsilon=0.571$)

Table 10 Plaque maturity level among HI children during pre-intervention (n=61), post-intervention 1 (n=53) and post-intervention 2 (n=41)

Plaque maturity level	Pre-intervention n (%)	Post-intervention 1 n (%)	Post-intervention 2 n (%)
Immature plaque	21 (34.4)	49 (92.5)	41 (100)
Mature plaque	31 (50.8)	4 (7.5)	0 (0)
Acid-producing plaque	9 (14.8)	0 (0)	0 (0)

Discussion

The response rate among HI children and teachers during the initial phase of the study was good with almost all participated in the study. However, there were attrition among HI children at the end of post-intervention 2, 16 (25.8%) during face-to-face interview and 20 (32.8%) HI children during dental plaque maturity assessment. There was no important bias even if the losses were up to 60% (Kristman *et al.*, 2004). However, the attrition rate might affect the generalisability of the result of the study to the general population.

Sociodemographic characteristics of teachers

More female than male teachers in both primary (69.8%), and secondary (69.3%) schools in Malaysia was being reflected in this study as most of the teachers involved were female (Hujoel *et al.*, 2006). This would also indicate that females are preferably employed in educational institutes at higher proportion compared to males (Seman *et al.*, 2008). In Malaysia, the Ministry of Health provides a school dental service (SDS) for school children which includes oral examination, dental treatment and oral health education given by dentists or dental nurses. The teachers with longer service years might have exposure on the effective oral hygiene practice through indirect oral health education given to the children during the SDS.

Difficulties experienced by HI children during dental visit

The difficulties experienced by HI children while at the dental clinic seem quite similar as more than half of them reported facing the same difficulty in all the items evaluated. The finding that most of the children had more than one difficulty concurred with the previous study (Harnacke *et al.*, 2012). The difficulty with the highest percentage in this study was being called from the waiting area, and this differed from a report by the previous study which stated that communicating with the dentist was the most common difficulty in the dental clinic (Harnacke *et al.*, 2012).

Therefore, they suggested that dentists should routinely enquire about a child's preferred means of communication, for

example sign language and cued speech. The main reason for difficulty in this study was due to the dentists or dental nurses did not know sign language, while other study reported the most common reason was due to dentist wearing mask (Champion and Holt, 2000). In the current study, other difficulties experienced by HI children included the dentists or dental nurses wearing mask during dental treatment, followed by background noise from the dental instruments such as dental headpieces. The HI children with moderate hearing loss would be affected by this noise.

Oral health KAP among teachers during pre-TOT and post-TOT

There was a statistically significant improvement in oral health knowledge during post-TOT among teachers which concurred with previous studies among preschool teachers in one of the district in Kelantan (Seman *et al.*, 2008). The highest changes were seen on the items for causes of dental caries related to the amount of sugar consumed. With the current knowledge, the teachers would be able to advise the children to make a better choice by choosing less cariogenic food or limiting it only during main meal and not for snacking. The post-TOT evaluation was done to ensure that the teachers already had sufficient knowledge regarding oral health care before they delivered OHE to HI children. The TOT programme was conducted as planned in OCHI program for teachers by dental public health specialists. Based on the data during pre-TOT, the items with low scores during pre-TOT were highlighted in the oral health talk during OCHI programme, especially on sugar as the causes of dental caries, bleeding while brushing as the sign of gingivitis and the role of fluoride on dental health. Since the teachers were given the booklet, it can be used as a reference even after the OCHI programme was completed.

The intervention programme in this study allowed knowledge transfer from the academician or university to the community which enabled empowerment of the community by developing personal skill and increasing their confident level towards oral health care (Daly *et al.*, 2013). This was

prevalent in order to ensure the oral health messages could be delivered to special and targeted groups. One of the key roles of health professionals is to enable and nurture health promotion within the community. Thus, involving the local community actively in the identification of oral health diseases would influence the community in initiating changes of oral health practice among the HI children. The OCHI programme would enable the teachers and HI children to exert more control over the personal and environmental factors which would affect their health. The intervention programme equipped the teachers and HI children with the necessary knowledge and attitude towards maintaining and improving oral health. Choosing teachers as trainers was a good choice since they already have the teaching skills. Having oral health educators or trainers may allow the dentist to focus more on patient care (Ab-Murat and Watt, 2006). The oral health education has bridged the oral health knowledge gap between normal and HI children by facilitating HI children to gauge the knowledge in a suitable method and with minimal communication barriers. In the long term, the trained teachers may influence the children and community, for a better oral hygiene practice (Sofola *et al.*, 2002). In our study, the teachers were divided into three small groups during the tooth brushing and flossing demonstration session to enable the facilitators to closely monitor and ensure all the teachers received the skill of effective tooth brushing and flossing technique. This was further enhanced through demonstration done by the facilitators followed by return demonstration by the teachers. Each teacher was allowed to do return demonstration on the technique to the facilitators. Educating non-dental, for example school teachers, nurses or educator, supplying with appropriate materials and knowledge was necessary for basic information and oral hygiene promotion (Sgan-Cohen, 2005). The materials also need to be clear with precise information and easy language to be understood by children (Kubo *et al.*, 2014). There was not much local intervention study done among teachers regarding the KAP on

oral health. Thus, not much comparison could be done based on previous studies. An intervention study among 31 pre-school teachers in Kelantan, Malaysia, found that there was a significant improvement on items regarding dental caries and periodontal disease (Seman *et al.*, 2008). There was a need for nutrition education and counselling which aimed in teaching the parents regarding the importance of reducing exposure to hidden sugar among the children such as limiting cariogenic food during mealtime and restricting sugary snack which are slowly eaten, for examples candy and lollipop, and to foster eating pattern based on the food pyramid (Tinanoff and Palmer, 2000). There was also an improvement in the teachers' knowledge about using fluoridated toothpaste could prevent dental caries. A systematic review had confirmed that using fluoridated toothpaste was effective in preventing caries both among children and adolescent compared to placebo (Walsh *et al.*, 2010).

Oral health knowledge and practice among HI children during pre-intervention and post-intervention

TOT approach was found to be more feasible compared to employing experts to provide an educational programme on population (Patil *et al.*, 2014; Poyato-Ferrera *et al.*, 2003). The result after 3-5 days of the programme by the teachers showed an improvement in the knowledge score among HI children. However, the result was not significant. This might due to the very short duration of the evaluation whereby the child had not fully understood the oral health care messages given. In terms of practice, there was an improvement in the perception of regular dental visit, frequency of tooth brushing twice a day, and brushing the teeth before bedtime. The knowledge among HI children significantly improved after one month. The knowledge gained can be utilised as a guide to make choice for health improvement.

Dental plaque maturity among HI children during pre-intervention and post intervention

In previous studies the use of TPID solution was mainly suggested for educational

purpose to engage the patient in proper oral hygiene practice and to assess the patient compliance to oral health care (Brostek and Walsh, 2014). In our study, the TPID was selected due to its rapid changes on colours and it is easy to use for children without the need to use the dental probe. This technique was considered as non-invasive and would prevent dental fear and anxiety among children. The colour changes were coded into different coding in order to assess the severity of plaque maturity on each tooth surface. By using the DPMS score the severity of plaque maturity would indicate the area on the tooth surface which is not effectively cleaned during tooth brushing. The significant reduction of dental plaque maturity during post intervention among the study subjects was similar with other studies (Biesbrock *et al.*, 2003; Frenkel *et al.*, 2001; Shetty *et al.*, 2014). Previous study also showed improvement in oral health knowledge among school children after oral health education by different modes which either by using audio-visual aid, blackboard, chalks, pictures or charts (Hebbal *et al.*, 2011). Providing oral health education specifically tooth brushing technique by using video was shown effective in improving oral hygiene among the subjects (Harnacke *et al.*, 2012). There are many tooth brushing techniques available and diverse recommendations on which technique to be used by adults or children. A study among 180 normal children aged 6-8 years in India found that the modified Bass technique was the most effective, followed by horizontal scrub and the Fones technique as the least effective one (Patil *et al.*, 2014). In a study among 6-16 years old HI children in India, the horizontal scrub was selected due to its being easy to practice and has technically sound method (Sandeep *et al.*, 2014). In our study, there was a significant improvement in oral hygiene among HI children. Modified Bass technique was selected as it was commonly recommended and was found to be effective (Poyato-Ferrera *et al.*, 2003; Wainwright and Sheiham, 2014). The Bass method was superior in cleaning the tooth tissue adjacent to the gingival tissue of the lingual and facial aspects without any significant differences in the overall effectiveness

(Gibson and Wade, 1977). However, no method of tooth brushing has been shown to be clearly superior to others (Pyoto-Ferera *et al.*, 2003).

Active participation by the school children in oral health education would improve oral hygiene and reduce plaque level which would eventually improve the gingival health (D'Cruz and Aradhya, 2013). During the intervention, teachers and school children were introduced on the use of dental floss. The guidance on the effective way of using dental floss was given via OCHI video. However, the children in this study were not assessed on the use of dental floss, but on the effective tooth brushing technique. There are debates in the effectiveness of using floss as an interdental plaque cleaning. A study found that flossing was effective but not popular and always being neglected (Cancro and Fischman, 2000). However, professional flossing was shown to be effective in reducing interproximal caries in low fluoridated areas as it served as a mechanical plaque control in interproximal areas of teeth (Hujoel *et al.*, 2006) whilst fluoride serve as chemical means of caries prevention (Axelsson *et al.*, 2004).

Conclusion

Due to communication problem, most of HI children reported of having difficulty when being called from the dental clinic waiting area. The OCHI programme was effective in improving the oral health knowledge and reducing the mature plaque scores among HI children. However, an inconsistent pattern was observed for their oral health practice that need further research. Special oral health education method that able to be communicated and fulfilled the needs of HI children should be developed to ensure the effectiveness of oral health education to this disadvantage group of children towards achieving optimum oral health.

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