ORIGINAL ARTICLE

Association between Oral Health Knowledge, Attitude and Practice with Dental Plaque Maturity Status among Adolescents in Kota Bharu, Kelantan

Ahmad Azhar Misran[1], Munirah Mohd Adnan[2], Normastura Abd Rahman[2]

[1] Klinik Rawatan Keluarga (Pergigian), School of Dental Sciences, Universiti Sains Malaysia, Kelantan, Malaysia.
[2] Dental Public Health Unit, School of Dental Sciences, Universiti Sains Malaysia, Kelantan, Malaysia

ABSTRACT

Introduction: School students are young adolescents who are in a period of acquiring good oral hygiene habits that are practised as they grow up. This study aimed to determine the association between oral health knowledge, attitude and practices (KAP) of the adolescents and their dental plaque maturity status. **Methods:** A cross-sectional study was conducted among 174 school students aged 13 to 14 years in Kota Bharu, Kelantan. The oral health knowledge, attitude and practices were assessed by self-administered questionnaires, while the dental plaque maturity status was assessed using GC Tri Plaque ID gel TM (TPID). The data were analysed using IBM SPSS version 24.0. **Results:** The mean (SD) for knowledge and attitude score of the students were 4.69 (1.44) and 3.63 (0.63), respectively. The mean (SD) dental plaque maturity score (DPMS) of the students was 1.02 (0.55). Students who had answered correctly on sugar and practised tooth brushing twice daily had significantly lower mean DPMS as compared to those who had answered incorrectly and practised tooth brushing less than twice daily (p<0.05). **Conclusion:** Adolescents participated in this study had moderate oral health knowledge and good oral health attitude. Correct knowledge regarding sugar and toothbrushing routines of at least twice a day significantly associated with the dental plaque maturity status.

Keywords: Oral health, Oral hygiene, Adolescent, Dental plaque, Toothbrushing

Corresponding Author:
Munirah Mohd Adnan, DrDPH
Email: muniraha@usm.my
Tel: +609-7675888

INTRODUCTION

School student is one of the focused populations for oral health education across the globe (1,2). During this period of time, they are receptive in establishing healthy habits, which will benefit their childhood days and their future (2,3). Globally, dental caries and gingivitis are the main oral health problems among school students (4,5).

Dental plaque is found to be one of the factors of dental caries and periodontal problems (6,7). Dental plaque biofilm mode of maturation allows microbes to survive under nutrition-limited conditions for a long period of time by establishing food chains among the microbial community. Moreover, it contains acid-producing bacteria (8). Streptococcus mutans produces acid that makes the tooth structure susceptible to dental caries (9). Toxin and waste products from bacteria cause inflammatory response in gingival tissues that result in gingivitis that may lead to periodontitis (6). The Malaysian Ministry of Health (MOH) plans multiple oral health programmes to give oral health education to various target groups, which includes antenatal mothers, schoolchildren, adults and the elderly (10). One of the programmes is an oral health education programme focusing on primary and secondary school students, named School Dental Service (SDS). Oral health teams consist of dental practitioners and dental nurses who continuously visit schools to promote oral health, teach students how to perform tooth brushing effectively, offer oral health care preventive measures and dental treatment like fillings and extractions.

In Malaysia, a study found that only 43.1% of the school students in Kuching, Sarawak aged 13 to 16 years had oral health knowledge score more than the mean average score of 6.22, about 24.4% of the students had visited the dentist regularly, and most of the students (95.7%) reported to have brushed their teeth at least twice a day (11). However, little is known regarding the level of Kelantan school children's oral health knowledge, attitude and practice and their dental plaque maturity status. The purpose of this study was to determine the level of oral health knowledge, attitude and practice; and its relationship with the dental plaque maturity status of 13- to 14-year-old school students in Kota Bharu, Kelantan. This age group was chosen because they have acquired oral health education through SDS for at least six years during their primary school. The

findings of this study could serve as baseline data for further improvements in increasing the oral health knowledge, attitude and practice of secondary school students in Kota Bharu, Kelantan.

MATERIALS AND METHODS

This cross-sectional study was conducted in May 2017. A sample size of 174 school students aged 13 and 14 years in Kota Bharu, Kelantan was calculated to participate in this study from four different government 'Sekolah Menengah Kebangsaan (SMK)' secondary schools. The schools were selected by means of simple random sampling. A number of eight students did not complete the questionnaires and subsequently removed from the study. It was resulting in a number of 166 students eligible for data analysis.

Only schools that were involved in the SDS from the Ministry of Health Malaysia were included in the study. The inclusion criteria for school students were those who were involved in the SDS during their primary school years, considering the students have been taught about effective tooth brushing technique and understand the Malay language. School students who were wearing any fixed or removable orthodontic or prosthodontic appliances and scored three or more for the Index of Orthodontic Treatment Need were excluded from the study. Students with physical disabilities which may affect their tooth brushing practice were also excluded.

The principals of the selected schools were approached to request permission to conduct the study at their respective schools prior to data collection. Consents from parents also were obtained for the students who were involved in this study. The consent forms were handed over to the teachers in charge of every school two weeks before the data collection day. Within two weeks, parents of the students were asked to hand over the consent forms back to the respective teachers. Students of both age groups were gathered in a classroom with the presence of the teacher in charge. A self-administered questionnaire was distributed to be answered. This session was conducted for about 10-15 minutes in a classroom involving 10-15 students at a time to ease the handling of every session. The researcher was present in the group and was available should the school students were in doubt of any part of the questionnaires.

An adapted self-administered Oral Health Knowledge, Attitude and Practice (KAP) questionnaire was translated into Bahasa Malaysia (12). The Bahasa Malaysia translated questionnaire was pretested on ten school students from the same age group prior to the actual data collection for face validity. Unclear terms were changed by reconciliation with two Dental Public Health specialists. This questionnaire consisted of four parts; socio-demographic profile, knowledge, attitudes and practices on oral health. The socio-demographic profile consisted of five variables; sex, age, racial background of the students, parents' or guardians' educational level and household income per month. The oral health knowledge was assessed using seven questions (dental plaque is formed by colonisation of bacteria trying to attach themselves to the tooth's smooth surface; dental caries mainly caused by bacteria; having sugar can lead to dental caries; fluoride toothpaste is good for preventing dental caries; bacteria is one of the reasons causing gingival inflammation; gingival bleeding is normal during toothbrushing; tooth brushing is an important way to prevent gingival bleeding), with "yes", "no" and "do not know" responses. Correct answers were given '1' mark, whilst wrong or "do not know" answers were given '0' mark. The total oral health knowledge score ranged from 0 to 7. The oral health attitude was assessed based on four questions (regular dental check-ups prevent dental problems; the condition of my teeth is greatly important to me; the condition of my teeth has been decided since birth and has no relation to self-care; self-care is important for preventing dental problems), with 'agree' and 'disagree' responses. Positive attitude was given "1" mark, while negative attitude was given "0" mark. The total attitude score ranged from 0 to 4.

The oral health practice domain was assessed using eight questions. Each question had multi-choice answers. The question on frequency of tooth brushing had four responses either "more than once a day", "once a day", "seldom" or "do not brush". The choices for the question on type of fluoride toothpaste were "fluoridated toothpaste", "not fluoridated toothpaste" and "do not know". The question on the frequency of consuming sweets had a list of three responses which included "more than once a day", "once a day" and "not every day". The question on the experience of toothache during the last 12 months had two responses of either "yes" or "no". The question on the action taken when experiencing toothache had responses consisting of "go to the dentist or dental nurse for treatment", "take medication either self-administered or from parents" and "nothing". The question on whether the student had ever met dentists or dental therapists included responses of either "yes I have" or "no, I have never seen". The question on the last time visiting a dentist or dental nurse specified responses which included "less than a year ago", "1 to 2 years ago" and "more than two years ago". The question on the reason for their last dental visit had responses which included "regular dental checkup", "toothache", "oral injury", "preventive care", "periodontal problem" and "others". Percentage was calculated for each of the responses.

After answering the questionnaires, the dental plaque maturity test was conducted using the GC Tri Plaque ID™ (GC TPID) dental plaque disclosing gel by GC Corporation, Tokyo, before the students' first recess session. A single examiner performed the clinical

examination with an assistant for dental charting which was conducted in a dental treatment room at the school, while the student was sitting on a chair with a backrest with the examiner standing in front of the chair under good room lighting. Benchmarking was made against a Dental Public Health Specialist trainee with seven years of working experience in clinical dentistry and had a master qualification in Dental Public Health before data collection took place. This examination position followed the guidelines issued by WHO in conducting oral health surveys (13). The GC TPID was applied onto tooth surfaces, excluding the occlusal surface, using a micro brush and left undisturbed for 2 minutes. The student was instructed to rinse their mouth lightly with tap water for 30 seconds. Different colours of dye were observed, and findings were recorded using a scoring scheme adopted from a study involving hearing-impaired children (14) as shown in (Table I). Students' dental plaque maturity scores (DPMS) were calculated as the total number of surfaces with the staining (x points) divided by the number of surfaces evaluated (14).

Table I: Scoring of Colour Indications for GC TPID Gel

Colour	Indication	Scoring
No colour	No plaque	0
Pink or Red	Fresh plaque	1
Blue or Purple	Mature plaque	2
Light Blue	Mature and strong acid produc-ing plaque	3

GC TPID Gel: GC Tri Plaque ID Gel

IBM SPSS version 24.0 software was used for data entry and data analysis. Data was checked, explored and cleaned. Data was explored using descriptive statistics and graphs for each variable. Categorical variables were summarised in frequency and percentage (%). Meanwhile, numerical variables were summarised in mean and standard deviation (SD) or median and interquartile range (IQR). The Kappa Statistics was used for benchmarking of the examiner. The statistical analyses used were independent t-test, Fisher exact test, one way ANOVA and Mann Whitney U test to determine the association of oral health KAP and dental plaque maturity status. The level of significance was set at 0.05 (two-tailed).

Ethical approval for this study was obtained from the Human Research and Ethics Committee, Universiti Sains Malaysia (Reference. no: USM/JEPeM/17020094). This study was also approved by the Malaysian Ministry of Education (Reference. no: KPM.600-3/2/3 Jld 36(4)) and the Kelantan Education Department (Reference number: JPKn/SPS/UPP.600-5/4 Jld. 8 (69).

RESULTS

The Kappa score calculated for benchmarking of dental plaque maturity score assessment was 0.86. The socio-demographic profile of the school students is presented in Table II. Most of the students are female (64.5%) and Malay (99.4%). More than 85% of the students received information on oral health from dentists and dental nurses. Table III shows the mean oral health knowledge score, oral health attitude score and the DPMS of the school students. The mean (SD) for knowledge and attitude score of the students were 4.69 (1.44) and 3.63 (0.63), respectively. The mean DPMS of the school students was 1.02 (0.55). The independent t-test results showed that students who had knowledge that sugar can cause dental caries were significantly lower mean DPMS than their peers who had answered incorrectly about it (p=0.022) (Table IV).

Table II: Socio-demographic profile of 13- to 14-year-old school students (n=166)

Variables	n (%)
Gender	
Male	59 (35.5)
Female	107 (64.5)
Age	
13 years old	82 (49.4)
14 years old	84 (50.6)
Race	
Malay	165 (99.4)
Indian	1 (0.6)
Parent's education	
Mother (n=164)	
Tertiary	44 (26.9)
Secondary	107 (65.2)
Primary	13 (7.9)
Father (n=164)	
Tertiary	37 (22.6)
Secondary	104 (63.4)
Primary	23 (14.0)
Guardian (n=6)	
Tertiary	2 (33.3)
Secondary	3 (50.0)
Primary	1 (16.7)
Parents' household income (monthly)	RM 1500 (3100)[a]
Source of oral health information	
No information	6 (3.6)
Dentist / Dental Nurse / Health Workers	142 (85.5)
Television / Radio	40 (24.1)
Newspaper / Reading Materials	28 (16.9)
Internet	32 (19.3)
Family / Friends	50 (30.1)
Others	1 (0.6)

[a] Median (IQR)

Table V shows no significant association between school students who had fresh and matured plaque with oral health attitude. Table VI shows the association between oral health practice and DPMS, which shows significantly lower mean DPMS in students who practised tooth brushing at least twice a day compared to those who practised tooth brushing less than twice a day (p=0.015).

DISCUSSION

The Kappa score of 0.86 for benchmarking of dental plaque maturity score showed very good reliability (15).

Table III: Mean Score of Oral Health Knowledge, Oral Health Attitude and DPMS (n=166)

	Oral Health Knowledge Score [a] Mean (SD)	Oral Health Attitude Score [b] Mean (SD)	DPMS [c] Mean (SD)
13- to 14-year-olds	4.69 (1.442)	3.63 (0.626)	1.02 (0.545)

[a] Oral health knowledge score ranged from 0 to 7
[b] Oral health attitude score ranged from 0 to 4
[c] DPMS score ranged from 0 to 3
DPMS: Dental Plaque Maturity Score

A total of 166 secondary school students aged 13 and 14 years from four different secondary schools in Kota Bharu, Kelantan, participated in this study. The response rate for this study was 95.4%. A total of 80% response rate or more is classified as good (16).

This study demonstrated the involvement of 35.5% male students and 64.5% female students. Respondents involved in this study were students in the first class for form 1 and 2 in all participating schools. The percentage of participation according to sex demonstrated that relatively more female students were placed in the first class as compared to male students. This is in agreement

with a study that found female students perform better in school than male students (17).

The mean (SD) oral health knowledge score of students in this study was 4.69 (1.44). It was relatively higher than the mean for oral knowledge score of school students in the study by Gao et al., (2014). Our findings reflected better oral health knowledge among students in our study as compared to rural school children in Shaanxi, China. The urban demographic background of the school students in the current study in juxtaposition to the rural school children in Shaanxi, China, could be a possible explanation as to why the oral health knowledge acclaimed better scores. Urban communities showed better oral health knowledge than rural communities (18,19). The mean (SD) oral health attitude score of the students was 3.63 (0.63). It was comparable with the findings of rural children in China (12).

The mean (SD) DPMS of these students was 1.02 (0.55). It was relatively lower than the DPMS among school

Table IV: Association between Oral Health Knowledge Variables and the DPMS (n=166)

Oral Health Knowledge Variable	DPMS Mean (SD)	Mean difference (95% CI)	t-stat (df)	*p*-value
Dental plaque is formed by the colonisation of bacteria trying to attach themselves to the tooth's smooth surface				
Correct	1.04 (0.511)	-0.049	-0.545 (164)	0.586
Wrong/ Do not know	0.99 (0.611)	(-0.228,0.129)		
Dental caries is mainly caused by bacteria				
Correct	1.02 (0.547) 1.03	-0.012	-0.105 (164)	0.917
Wrong/ Do not know	(0.543)	(-0.235,0.212)		
Consuming sugar can lead to the dental caries				
Correct	0.99 (0.543) 1.366	-0.372	-2.308 (164)	0.022
Wrong/ Do not know	(0.455)	(-0.690, -0.054)		
The fluoride toothpaste is good for preventing dental caries				
Correct	1.04 (0.556) 0.96	0.081	0.841 (164)	0.402
Wrong/ Do not know	(0.511)	(-0.109,0.272)		
Bacteria was one of the reasons causing gingivitis				
Correct	1.08 (0.574) 0.96	0.119	1.403 (164)	0.162
Wrong/ Do not know	(0.505)	(-0.048,0.285)		
Gingival bleeding is normal during tooth brushing				
Correct	1.01 (0.495) 1.03	-0.015	-0.179 (129.695)	0.859
Wrong/ Do not know	(0.609)	(-0.185,0.154)		
Tooth brushing is not an important way to prevent gingival bleeding				
Correct	1.07 (0.557) 0.99	0.079	0.923 (164)	0.357
Wrong/ Do not know	(0.536)	(-0.090,0.248)		

Table V: Association between Oral Health Attitude and Plaque Groups (n=166)

Oral Health Attitude Variable		Fresh Plaque n (%)	Matured Plaque n (%)	*p*-value
Regular dental check-ups prevent dental problems				
	Agree	19 (11.45)	139 (83.73)	0.599
	Disagree	0 (0.0)	8 (4.82)	
The condition of my teeth is greatly important to me				
	Agree	19 (11.45)	144 (86.74)	1.000
	Disagree	0 (0.00)	3 (1.81)	
The condition of my teeth has been decided since birth and has no relation to self-care				
	Agree	2 (1.20)	21 (12.66)	1.000
	Disagree	17 (10.24)	126 (75.90)	
Self-care is important for preventing dental problems				
	Agree	14 (8.43)	124 (74.70)	0.324
	Disagree	5 (3.01)	23 (13.86)	

Table VI: Association between Oral Health Practices and Dental Plaque Maturity Score (n=166)

Oral Health Practices	DPMS Mean (SD)	Mean differences 95% CI	t-stat (df)	p-value
Frequency of tooth brushing				
At least twice a day	0.99 (0.533)	-0.347	-2.459 (164)	0.015[a]
Less than twice a day	1.33 (0.565)	(-0.626, -0.068)		
Usage of different types of toothpastes				
Fluoridated toothpaste	1.01 (0.530)	-0.030	-0.301 (164)	0.764[a]
Non-fluoridated toothpaste/ do not know	1.04 (0.595)	(-0.227,0.167)		
Frequency of eating sweets				
More than once per day	1.08 (0.495)	0.069	0.673 (164)	0.502[a]
At most once per day	1.01 (0.558)	(-0.135,0.275)		
Experienced toothache in the previous 12 months				
Yes	.96 (0.544)	-0.077	-0.737 (164)	0.462[a]
No	1.04 (0.546)	(-0.284,0.130)		
Action taken when experience toothache				
Meet the dentist or dental nurse	1.02 (0.533)		0.015 (2,163)	0.985[b]
Took medication either self-administered or from parents	1.03 (0.588)	-		
No action taken	1.01 (0.524)			
Met the dentist before				
Yes	1.02 (0.545)	-	-	-
No	-			
Last time visited the dentist or dental nurse				
Less than a year ago	1.04 (0.72)	-	-	0.174[c]
1 or 2 years ago	0.92 (0.81)			

[a] Independent t-test [b] One way ANOVA [c] Mann-Whitney U test
DPMS: Dental Plaque Maturity Score

students in Bachok, Kelantan (14). The differences in socioeconomic status between families of school students residing in Kota Bharu compared to Bachok may explain that Kota Bharu school students had lower DPMS than Bachok school students (20). This finding was in line with studies conducted in India and Brazil (21,22).

The mean (SD) DPMS in students who answered the question correctly on the implications of sugar was significantly better than those who answered wrong (p=0.022). This demonstrates that knowledge on the implication of sugar is imperative to ensure better plaque status. The acidic environment created by sugar enhances the attachment of primary colonisers of dental plaque onto readily formed acquired pellicle. Primary colonisers consist of aerobic and facultative anaerobic bacteria (23). By this condition, sugar has an initial role in developing dental plaque and in maintaining the acidic environment while constituting low pH for acidogenic bacteria to produce more acid. However, knowledge alone is insufficient to determine one's actual practise (24). Correct knowledge on the formation of dental plaque, the role of fluoride and bacteria, and the significance of brushing were not significantly associated with the mean DPMS among school students in this study. This happens when knowledge is necessary but not sufficient to be translated into action (24). As for the oral health practices, school students who reported practising tooth brushing at least twice a day demonstrated significantly better mean DPMS than their counterparts who reported performing brushing less than two times a day (p=0.015). Frequent tooth brushing

with fluoridated toothpaste exposes the teeth to fluoride. This enhances the effect of fluoride to control plaque maturity progression. Tooth brushing at least twice daily was recommended by the Centers for Disease Control and Prevention (25). Interdental mechanical plaque controls such as flossing and mouthwash act as supplementary oral hygiene measures (26).

CONCLUSION

In conclusion, the oral health knowledge of 13- to 14-year-old school students in Kota Bharu, Kelantan, was moderate. On the other hand, they showed a good oral health attitude. Most school students were categorised as having fresh plaque. Adolescents with correct knowledge on the role of sugar and practised tooth brushing at least twice daily demonstrated better dental plaque maturity status (DPMS). However, there was no association between oral health attitude and DPMS.

ACKNOWLEDGEMENTS

REFERENCES

1.   Kwan SYL, Petersen PE, Pine CM, Borutta A. Health-promoting schools: An opportunity for oral health promotion. Bulletin of the World Health

Organization. 2005.

2. Jürgensen N, Petersen PE. Promoting oral health of children through schools--results from a WHO global survey 2012. Community Dent Health [Internet]. 2013 Dec;30(4):204–18. Available from: http://www.ncbi.nlm.nih.gov/pubmed/24575523

3. Alnakhli A, Omar O. Effectiveness of Two Instruction Methods in Improving Tooth Brushing Skills in Children: A Clinical Trial. Br J Med Med Res [Internet]. 2016 Jan 10;17(6):1–5. Available from: http://www.sciencedomain.org/abstract/15837

4. Petersen PE. The World Oral Health Report 2003: continuous improvement of oral health in the 21st century - the approach of the WHO Global Oral Health Programme. Community Dent Oral Epidemiol [Internet]. 2003 Dec;31:3–24. Available from: http://doi.wiley.com/10.1046/j..2003.com122.x

5. Petersen PE, Bourgeois D, Ogawa H, Estupinan-Day S, Ndiaye C. The global burden of oral diseases and risks to oral health. Bull World Health Organ [Internet]. 2005 Sep;83(9):661–9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/16211157

6. Felton S, Chapman A. Basic guide to oral health education and promotion. John Wiley & Sons; 2013.

7. Patil S, Patil P, Kashetty M. Effectiveness of different tooth brushing techniques on the removal of dental plaque in 6-8 year old children of Gulbarga. J Int Soc Prev Community Dent [Internet]. 2014;4(2):113. Available from: http://www.jispcd.org/text.asp?2014/4/2/113/138305

8. Seneviratne CJ, Zhang CF, Samaranayake LP. Dental plaque biofilm in oral health and disease. Chin J Dent Res [Internet]. 2011;14(2):87–94. Available from: http://www.ncbi.nlm.nih.gov/pubmed/22319749

9. Marsh PD, Martin M V, Lewis MAO, Williams D. Oral Microbiology. Elsevier Health Sciences; 2009.

10. Umer A, Umer A. Oral Health Care in Malaysia – a Review. Pakistan Oral Dent J. 2011;31(1).

11. Whye Lian C, Siow Phing T, Shiun Chat C, Cheong Shin B, Hakim Baharuddin L, Bainun Jalil Che Z. Oral health knowledge, attitude and practice among secondary school students in Kuching, Sarawak. Arch Orofac Sci. 2010;5(1):9–16.

12. Gao J, Ruan J, Zhao L, Zhou H, Huang R, Tian J. Oral health status and oral health knowledge, attitudes and behavior among rural children in Shaanxi, western China: a cross-sectional survey. BMC Oral Health [Internet]. 2014 Dec 29;14(1):144. Available from: http://bmcoralhealth.biomedcentral.com/articles/10.1186/1472-6831-14-144

13. World Health Organization. Oral Health Surveys - Basic Methods 5th edition. WHO. 2013.

14. Tugeman H, Rahman NA, Yusoff A, Daud MKM. Oral health knowledge, practice and dental plaque maturity status of hearing-impaired children. Sains Malaysiana. 2016;45(5):761–8.

15. Altman DG. Practical Statistics for Medical Research [Internet]. Practical Statistics for Medical Research. Chapman and Hall/CRC; 1990. Available from: https://www.taylorfrancis.com/books/9781000228816

16. Locker D. Response and Nonresponse Bias in Oral Health Surveys. J Public Health Dent [Internet]. 2000 Jun;60(2):72–81. Available from: http://doi.wiley.com/10.1111/j.1752-7325.2000.tb03298.x

17. Kessels U, Heyder A, Latsch M, Hannover B. How gender differences in academic engagement relate to students' gender identity. Educ Res [Internet]. 2014 Apr 3;56(2):220–9. Available from: http://www.tandfonline.com/doi/abs/10.1080/00131881.2014.898916

18. Varenne B, Petersen PE, Ouattara S. Oral health behaviour of children and adults in urban and rural areas of Burkina Faso, Africa. Int Dent J [Internet]. 2006 Apr;56(2):61–70. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0020653920343057

19. Ogunbodede EO, Kida IA, Madjapa HS, Amedari M, Ehizele A, Mutave R, et al. Oral Health Inequalities between Rural and Urban Populations of the African and Middle East Region. Adv Dent Res [Internet]. 2015 Jul 22;27(1):18–25. Available from: http://journals.sagepub.com/doi/10.1177/0022034515575538

20. H., Sakinah, Seong, T.C., Rosniza, R & Jayah KP. Socio-Demographic , Dietary and Physical Activity Determinants of Adolescents Overweight and Obesity in Kelantan. Heal Environ J. 2012;3(1):44–53.

21. Tomazoni F, Vettore MV, Zanatta FB, Tuchtenhagen S, Moreira CHC, Ardenghi TM. The associations of socioeconomic status and social capital with gingival bleeding among schoolchildren. J Public Health Dent [Internet]. 2017 Dec;77(1):21–9. Available from: http://doi.wiley.com/10.1111/jphd.12166

22. Baiju RP, Peter E, Nayar B, Varughese J, Varghese N. Prevalence and predictors of early periodontal disease among adolescents. J Indian Soc Periodontol [Internet]. 2019;23(4):356. Available from: http://www.jisponline.com/text.asp?2019/23/4/356/253439

23. Welin-Neilands J, Svensäter G. Acid Tolerance of Biofilm Cells of Streptococcus mutans. Appl Environ Microbiol [Internet]. 2007 Sep 1;73(17):5633–8. Available from: https://aem.asm.org/content/73/17/5633

24. World Health Organization. Health education: theoretical concepts, effective strategies and core competencies: A foundation document to guide capacity development of health educators. Health Promotion Practice. 2012.

25. Centers for Disease Control and Prevention. Hygiene-related Diseases [Internet]. [cited 2020

Nov 11]. Available from: https://www.cdc.gov/healthywater/hygiene/disease/dental_caries.html

26. Choo A, Delac DM, Messer LB. Oral Hygiene Measures and Promotion: Review and Considerations. Aust Dent J [Internet]. 2001 Sep;46(3):166–73. Available from: http://doi.wiley.com/10.1111/j.1834-7819.2001.tb00277.x